

HIGHWAY WORK PROPOSAL

Wisconsin Department of Transportation
DT1502 01/2020 s.66.0901(7) Wis. Stats

Proposal Number: **009**

<u>COUNTY</u>	<u>STATE PROJECT</u>	<u>FEDERAL</u>	<u>PROJECT DESCRIPTION</u>	<u>HIGHWAY</u>
Outagamie	1130-44-74	WISC 2024402	Appleton- Green Bay; IH 41 Wrightstown Swef 34/Post-Bldg	IH 041

ADDENDUM REQUIRED ATTACHED AT BACK

This proposal, submitted by the undersigned bidder to the Wisconsin Department of Transportation, is in accordance with the advertised request for proposals. The bidder is to furnish and deliver all materials, and to perform all work for the improvement of the designated project in the time specified, in accordance with the appended Proposal Requirements and Conditions.

Proposal Guaranty Required: \$610,000.00 Payable to: Wisconsin Department of Transportation	Attach Proposal Guaranty on back of this PAGE.
Bid Submittal Date: August 13, 2024 Time (Local Time): 11:00 am	Firm Name, Address, City, State, Zip Code
Contract Completion Time December 15, 2025	SAMPLE NOT FOR BIDDING PURPOSES
Assigned Disadvantaged Business Enterprise Goal 6%	This contract is exempt from federal oversight.

This certifies that the undersigned bidder, duly sworn, is an authorized representative of the firm named above; that the bidder has examined and carefully prepared the bid from the plans, Highway Work Proposal, and all addenda, and has checked the same in detail before submitting this proposal or bid; and that the bidder or agents, officer, or employees have not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with this proposal bid.

Do not sign, notarize, or submit this Highway Work Proposal when submitting an electronic bid on the Internet.

Subscribed and sworn to before me this date _____

(Signature, Notary Public, State of Wisconsin)

(Bidder Signature)

(Print or Type Name, Notary Public, State Wisconsin)

(Print or Type Bidder Name)

(Date Commission Expires)

(Bidder Title)

Notary Seal

Type of Work:	For Department Use Only
Grading, Base, Asphalt Pavement, Culvert Pipe, Curb and Gutter, Sidewalk, Storm Sewer, Fence, Signs, Pavement Markings, Lighting, Building Construction, Communication Towers, Sanitary Sewer, Watermain.	
Notice of Award Dated	Date Guaranty Returned

**PLEASE ATTACH
PROPOSAL GUARANTY HERE**

PROPOSAL REQUIREMENTS AND CONDITIONS

The bidder, signing and submitting this proposal, agrees and declares as a condition thereof, to be bound by the following conditions and requirements.

If the bidder has a corporate relationship with the proposal design engineering company, the bidder declares that it did not obtain any facts, data, or other information related to this proposal from the design engineering company that was not available to all bidders.

The bidder declares that they have carefully examined the site of, and the proposal, plans, specifications and contract forms for the work contemplated, and it is assumed that the bidder has investigated and is satisfied as to the conditions to be encountered, as to the character, quality, and quantities of work to be performed and materials to be furnished, and as to the requirements of the specifications, special provisions and contract. It is mutually agreed that submission of a proposal shall be considered conclusive evidence that the bidder has made such examination.

The bidder submits herewith a proposal guaranty in proper form and amount payable to the party as designated in the advertisement inviting proposals, to be retained by and become the property of the owner of the work in the event the undersigned shall fail to execute the contract and contract bond and return the same to the office of the engineer within fourteen (14) days after having been notified in writing to do so; otherwise to be returned.

The bidder declares that they understand that the estimate of quantities in the attached schedule is approximate only and that the attached quantities may be greater or less in accordance with the specifications.

The bidder agrees to perform the said work, for and in consideration of the payment of the amount becoming due on account of work performed, according to the unit prices bid in the following schedule, and to accept such amounts in full payment of said work.

The bidder declares that all of the said work will be performed at their own proper cost and expense, that they will furnish all necessary materials, labor, tools, machinery, apparatus, and other means of construction in the manner provided in the applicable specifications and the approved plans for the work together with all standard and special designs that may be designed on such plans, and the special provisions in the contract of which this proposal will become a part, if and when accepted. The bidder further agrees that the applicable specifications and all plans and working drawings are made a part hereof, as fully and completely as if attached hereto.

The bidder, if awarded the contract, agrees to begin the work not later than ten (10) days after the date of written notification from the engineer to do so, unless otherwise stipulated in the special provisions.

The bidder declares that if they are awarded the contract, they will execute the contract agreement and begin and complete the work within the time named herein, and they will file a good and sufficient surety bond for the amount of the contract for performance and also for the full amount of the contract for payment.

The bidder, if awarded the contract, shall pay all claims as required by Section 779.14, Statutes of Wisconsin, and shall be subject to and discharge all liabilities for injuries pursuant to Chapter 102 of the Statutes of Wisconsin, and all acts amendatory thereto. They shall further be responsible for any damages to property or injury to persons occurring through their own negligence or that of their employees or agents, incident to the performance of work under this contract, pursuant to the Standard Specifications for Road and Bridge Construction applicable to this contract.

In connection with the performance of work under this contract, the contractor agrees to comply with all applicable state and federal statutes relating to non-discrimination in employment. No otherwise qualified person shall be excluded from employment or otherwise be subject to discrimination in employment in any manner on the basis of age, race, religion, color, gender, national origin or ancestry, disability, arrest or conviction record (in keeping with s.111.32), sexual orientation, marital status, membership in the military reserve, honesty testing, genetic testing, and outside use of lawful products. This provision shall include, but not be limited to the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation, and selection for training, including apprenticeship. The contractor further agrees to ensure equal opportunity in employment to all applicants and employees and to take affirmative action to attain a representative workforce.

The contractor agrees to post notices and posters setting forth the provisions of the nondiscrimination clause, in a conspicuous and easily accessible place, available for employees and applicants for employment.

If a state public official (section 19.42, Stats.) or an organization in which a state public official holds at least a 10% interest is a party to this agreement, this contract is voidable by the state unless appropriate disclosure is made to the State of Wisconsin Ethics Board.

BID PREPARATION

Preparing the Proposal Schedule of Items

A. General

- (1) Obtain bidding proposals as specified in section 102 of the standard specifications prior to 11:45 AM of the last business day preceding the letting. Submit bidding proposals using one of the following methods:
 1. Electronic bid on the internet.
 2. Electronic bid on a printout with accompanying diskette or CD ROM.
 3. Paper bid under a waiver of the electronic submittal requirements.
- (2) Bids submitted on a printout with accompanying diskette or CD ROM or paper bids submitted under a waiver of the electronic submittal requirements govern over bids submitted on the internet.
- (3) The department will provide bidding information through the department's web site at:

<https://wisconsin.gov/Pages/doing-business/contractors/hcci/bid-let.aspx>

The contractor is responsible for reviewing this web site for general notices as well as information regarding proposals in each letting. The department will also post special notices of all addenda to each proposal through this web site no later than 4:00 PM local time on the Thursday before the letting. Check the department's web site after 5:00 PM local time on the Thursday before the letting to ensure all addenda have been accounted for before preparing the bid. When bidding using methods 1 and 2 above, check the Bid Express™ on-line bidding exchange at <http://www.bidx.com/> after 5:00 PM local time on the Thursday before the letting to ensure that the latest schedule of items Expedite file (*.ebs or *.00x) is used to submit the final bid.

- (4) Interested parties can subscribe to the Bid Express™ on-line bidding exchange by following the instructions provided at the www.bidx.com web site or by contacting:

Info Tech Inc.
5700 SW 34th Street, Suite 1235
Gainesville, FL 32608-5371
email: <mailto:customer.support@bidx.com>

- (5) The department will address equipment and process failures, if the bidder can demonstrate that those failures were beyond their control.
- (6) Contractors are responsible for checking on the issuance of addenda and for obtaining the addenda. Notice of issuance of addenda is posted on the department's web site at:

<https://wisconsin.gov/Pages/doing-business/contractors/hcci/bid-let.aspx>

or by calling the department at (608) 266-1631. Addenda can ONLY be obtained from the department's web site listed above or by picking up the addenda at the Bureau of Highway Construction, 4th floor, 4822 Madison Yards Way, Madison, WI, during regular business hours.

- (7) Addenda posted after 5:00 PM on the Thursday before the letting will be emailed to the eligible bidders for that proposal. All eligible bidders shall acknowledge receipt of the addenda whether they are bidding on the proposal or not. Not acknowledging receipt may jeopardize the awarding of the project.

B. Submitting Electronic Bids**B.1 On the Internet**

- (1) Do the following before submitting the bid:
 4. Have a properly executed annual bid bond on file with the department.
 5. Have a digital ID on file with and enabled by Info Tech Inc. Using this digital ID will constitute the bidder's signature for proper execution of the bidding proposal.
- (2) In lieu of preparing, delivering, and submitting the proposal as specified in 102.6 and 102.9 of the standard specifications, submit the proposal on the internet as follows:
 1. Download the latest schedule of items reflecting all addenda from the Bid Express™ web site.
 2. Use Expedite™ software to enter a unit price for every item in the schedule of items.
 3. Submit the bid according to the requirements of Expedite™ software and the Bid Express™ web site. Do not submit a bid on a printout with accompanying diskette or CD ROM or a paper bid. If the bidder does submit a bid on a printout with accompanying diskette or a paper bid in addition to the internet submittal, the department will disregard the internet bid.
 4. Submit the bid before the hour and date the Notice to Contractors designates.
 5. Do not sign, notarize, and return the bidding proposal described in 102.2 of the standard specifications.
- (3) The department will not consider the bid accepted until the hour and date the Notice to Contractors designates.

B.2 On a Printout with Accompanying Diskette or CD ROM

- (1) Download the latest schedule of items from the Wisconsin pages of the Bid Express web site reflecting the latest addenda posted on the department's web site at:
<https://wisconsindot.gov/Pages/doing-bus/contractors/hcci/bid-let.aspx>
Use Expedite™ software to prepare and print the schedule of items. Provide a valid amount for all price fields. Follow instructions and review the help screens provided on the Bid Express™ web site to assure that the schedule of items is prepared properly.
- (2) Staple an 8 1/2 by 11 inch printout of the Expedite□□ generated schedule of items to the other proposal documents submitted to the department as a part of the bidder's sealed bid. As a separate submittal, not in the sealed bid envelop but due at the same time and place as the sealed bid, also provide the Expedite™ generated schedule of items on a 3 1/2 inch computer diskette or CD ROM. Label each diskette or CD ROM with the bidder's name, the 4 character department-assigned bidder identification code from the top of the bidding proposal, and a list of the proposal numbers included on that diskette or CD ROM as indicated in the following example:

Bidder Name

BN00

Proposals: 1, 12, 14, & 22

- (3) If bidding on more than one proposal in the letting, the bidder may include all proposals for that letting on one diskette or CD ROM. Include only submitted proposals with no incomplete or other files on the diskette or CD ROM.
- (4) The bidder-submitted printout of the Expedite□□ generated schedule of items is the governing contract document and must conform to the requirements of section 102 of the standard specifications. If a printout needs to be altered, cross out the printed information with ink or typewriter and enter the new information and initial it in ink. If there is a discrepancy between the printout and the diskette or CD ROM, the department will analyze the bid using the printout information.

- (5) In addition to the reasons specified in section 102 of the standard specifications, proposals are irregular and the department may reject them for one or more of the following:
1. The check code printed on the bottom of the printout of the ExpediteTM generated schedule of items is not the same on each page.
 2. The check code printed on the printout of the ExpediteTM generated schedule of items is not the same as the check code for that proposal provided on the diskette or CD ROM.
 3. The diskette or CD ROM is not submitted at the time and place the department designates.

B Waiver of Electronic Submittal

- (1) The bidder may request a waiver of the electronic submittal requirements. Submit a written request for a waiver in lieu of bids submitted on the internet or on a printout with accompanying diskette or CD ROM. Use the waiver that was included with the paper bid document sent to the bidder or type up a waiver on the bidder's letterhead. The department will waive the electronic submittal requirements for a bidding entity (individual, partnership, joint venture, corporation, or limited liability company) for up to 4 individual proposals in a calendar year. The department may allow additional waivers for equipment malfunctions.
- (2) Submit a schedule of items on paper conforming to section 102 of the standard specifications. The department charges the bidder a \$75 administrative fee per proposal, payable at the time and place the department designates for receiving bids, to cover the costs of data entry. The department will accept a check or money order payable to: "Wisconsin, Dept. of Transportation."
- (3) In addition to the reasons specified in section 102 of the standard specifications, proposals are irregular and the department may reject them for one or more of the following:
 1. The bidder fails to provide the written request for waiver of the electronic submittal requirements.
 2. The bidder fails to pay the \$75 administrative fee before the time the department designates for the opening of bids unless the bidder requests on the waiver that they be billed for the \$75.
 3. The bidder exceeds 4 waivers of electronic submittal requirements within a calendar year.
- (4) In addition to the reasons specified in section 102 of the standard specifications, the department may refuse to issue bidding proposals for future contracts to a bidding entity that owes the department administrative fees for a waiver of electronic submittal requirements.

PROPOSAL BID BOND

DT1303 1/2006

Wisconsin Department of Transportation

Proposal Number	Project Number	Letting Date
Name of Principal		
Name of Surety	State in Which Surety is Organized	

We, the above-named Principal and the above-named Surety, are held and firmly bound unto the State of Wisconsin in the sum equal to the Proposal Guaranty for the total bid submitted for the payment to be made; we jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns. The condition of this obligation is that the Principal has submitted a bid proposal to the State of Wisconsin acting through the Department of Transportation for the improvement designated by the Proposal Number and Letting Date indicated above.

If the Principal is awarded the contract and, within the time and manner required by law after the prescribed forms are presented for signature, enters into a written contract in accordance with the bid, and files the bond with the Department of Transportation to guarantee faithful performance and payment for labor and materials, as required by law, or if the Department of Transportation shall reject all bids for the work described, then this obligation shall be null and void; otherwise, it shall be and remain in full force and effect. In the event of failure of the Principal to enter into the contract or give the specified bond, the Principal shall pay to the Department of Transportation **within 10 business days of demand** a total equal to the Proposal Guaranty as liquidated damages; the liability of the Surety continues for the full amount of the obligation as stated until the obligation is paid in full.

The Surety, for value received, agrees that the obligations of it and its bond shall not be impaired or affected by any extension of time within which the Department of Transportation may accept the bid; and the Surety does waive notice of any such extension.

IN WITNESS, the Principal and Surety have agreed and have signed by their proper officers and have caused their corporate seals to be affixed this date: **(DATE MUST BE ENTERED)**

PRINCIPAL

(Company Name) **(Affix Corporate Seal)**

(Signature and Title)

(Company Name)

(Signature and Title)

(Company Name)

(Signature and Title)

(Company Name)

(Signature and Title)

NOTARY FOR PRINCIPAL

(Date)

State of Wisconsin)
) ss.
_____ County)

On the above date, this instrument was acknowledged before me by the named person(s).

(Signature, Notary Public, State of Wisconsin)

(Print or Type Name, Notary Public, State of Wisconsin)

(Date Commission Expires)

Notary Seal

(Name of Surety) **(Affix Seal)**

(Signature of Attorney-in-Fact)

NOTARY FOR SURETY

(Date)

State of Wisconsin)
) ss.
_____ County)

On the above date, this instrument was acknowledged before me by the named person(s).

(Signature, Notary Public, State of Wisconsin)

(Print or Type Name, Notary Public, State of Wisconsin)

(Date Commission Expires)

Notary Seal

IMPORTANT: A certified copy of Power of Attorney of the signatory agent must be attached to the bid bond.

CERTIFICATE OF ANNUAL BID BOND

DT1305 8/2003

Wisconsin Department of Transportation

Time Period Valid (From/To)	
Name of Surety	
Name of Contractor	
Certificate Holder	Wisconsin Department of Transportation

This is to certify that an annual bid bond issued by the above-named Surety is currently on file with the Wisconsin Department of Transportation.

This certificate is issued as a matter of information and conveys no rights upon the certificate holder and does not amend, extend or alter the coverage of the annual bid bond.

Cancellation: Should the above policy be cancelled before the expiration date, the issuing surety will give thirty (30) days written notice to the certificate holder indicated above.

(Signature of Authorized Contractor Representative)

(Date)

LIST OF SUBCONTRACTORS

Section 66.0901(7), Wisconsin Statutes, provides that as a part of the proposal, the bidder also shall submit a list of the subcontractors the bidder proposes to contract with and the class of work to be performed by each. In order to qualify for inclusion in the bidder's list a subcontractor shall first submit a bid in writing, to the general contractor at least 48 hours prior to the time of the bid closing. The list may not be added to or altered without the written consent of the municipality. A proposal of a bidder is not invalid if any subcontractor and the class of work to be performed by the subcontractor has been omitted from a proposal; the omission shall be considered inadvertent or the bidder will perform the work personally.

No subcontract, whether listed herein or later proposed, may be entered into without the written consent of the Engineer as provided in Subsection 108.1 of the Standard Specifications.

[illegible]

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS - PRIMARY COVERED TRANSACTIONS

Instructions for Certification

1. By signing and submitting this proposal, the prospective contractor is providing the certification set out below.
2. The inability of a person to provide the certification required below will not necessarily result in denial of participation in this covered transaction. The prospective contractor shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective contractor to furnish a certification or an explanation shall disqualify such person from participation in this transaction.
3. The certification in this clause is a material representation of fact upon which reliance was placed when the department determined to enter into this transaction. If it is later determined that the contractor knowingly rendered an erroneous certification in addition to other remedies available to the Federal Government the department may terminate this transaction for cause or default.
4. The prospective contractor shall provide immediate written notice to the department to whom this proposal is submitted if at any time the prospective contractor learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.
5. The terms "covered transaction," "debarred," "suspended," "ineligible," "lower tier covered transaction," "participant," "person," "primary covered transaction," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of the rules implementing Executive Order 12549. You may contact the department to which this proposal is being submitted for assistance in obtaining a copy of those regulations.
6. The prospective contractor agrees by submitting this proposal that, should this contract be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department entering into this transaction.
7. The prospective contractor further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," which is included as an addendum to PR- 1273 - "Required Contract Provisions Federal Aid Construction Contracts," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.
8. The contractor may rely upon a certification of a prospective subcontractor/materials supplier that it is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A contractor may decide the method and frequency by which it determines the eligibility of its principals. Each contractor may, but is not required to, check the Disapproval List (telephone # 608/266/1631).

9. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of a contractor is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.
10. Except for transactions authorized under paragraph 6 of these instructions, if a contractor in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department may terminate this transaction for cause or default.

Certification Regarding Debarment, Suspension, and Other Responsibility Matters - Primary Covered Transactions

1. The prospective contractor certifies to the best of its knowledge and belief, that it and its principals:
 - (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
 - (b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements or receiving stolen property;
 - (c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offense enumerated in paragraph (1)(b) of this certification; and
 - (d) Have not within a three-year period preceding this proposal had one or more public transactions (Federal, State or local) terminated for cause or default.
2. Where the prospective contractor is unable to certify to any of the statements in this certification, such prospective contractor shall attach an explanation to this proposal.

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SPECIAL PROVISIONS

1. General.

Perform the work under this construction contract for Project 1130-44-74, Appleton – Green Bay, IH 41 Wrightstown SWEF 34/POST - BLDG, IH 41, Outagamie County, Wisconsin as the plans show and execute the work as specified in the State of Wisconsin, Department of Transportation, Standard Specifications for Highway and Structure Construction, 2024 Edition, as published by the department, and these special provisions.

If all or a portion of the plans and special provisions are developed in the SI metric system and the schedule of prices is developed in the US standard measure system, the department will pay for the work as bid in the US standard system.

100-005 (20240105)

2. Scope of Work.

The work under this contract shall consist of building construction, communication towers, grading, base, HMA pavement, concrete driveway, concrete curb and gutter, storm sewer, culvert pipe, permanent signing, pavement marking, lighting, landscaping, and all incidental items necessary to complete the work as shown on the plans and included in the proposal and contract.

104-005 (20090901)

3. Prosecution and Progress.

Begin work within 10 calendar days after the engineer issues a written notice to do so.

Provide the start date to the engineer in writing within a month after executing the contract but at least 14 calendar days before the preconstruction conference. Upon approval, the engineer will issue the notice to proceed within ten calendar days before the approved start date.

To revise the start date, submit a written request to the engineer at least two weeks before the intended start date. The engineer will approve or deny that request based on the conditions cited in the request and its effect on the department's scheduled resources.

Construction Staging

Area inside of 1130-44-75 work zone must be vacated prior to July 1, 2025. Curb and gutter and concrete driveway shall be completed prior to August 15, 2025. Complete asphalt paving between August 15, 2024 and September 15, 2024, coordinate limits with contracts 1130-44-86 and 1130-44-75. Do not install concrete sidewalk or final landscaping items between 4+50'BX' to 5+65'BX' until after September 15, 2025 or after conduit is installed as part of the 1130-44-75 contract Weight in Motion System and Static Scale equipment.

If interim completion time expires before the completion of specified work in the contract, additional liquidated damages will be assessed as specified in standard spec 108.11.

Environmental Protection, Northern Long Eared Bat

Northern long-eared bats (NLEB) have the potential to inhabit the project limits because they roost in trees, bridges, and culverts. Roosts may not have been observed on this project, but conditions to support the species exist. The species and all active roosts are protected by the federal Endangered Species Act. If an individual bat or active roost is encountered during construction operations, stop work, and notify the engineer and the WisDOT Region Environmental Coordinator (REC).

Ensure all operators, employees, and subcontractors working in areas of known or presumed bat habitat are aware of environmental commitments and avoidance and minimization measures (AMMs) to protect both bats and their habitat.

Avoidance and Minimization Measures (AMMs) for Northern Long Eared Bat (NLEB) and Tri Colored Bat (TCB) include:

General AMM

1. Ensure all operators, employees, and contractors working in areas of known or presumed bat habitat are aware of all FHWA and the department environmental commitments, including all applicable AMMs.

Lighting AMM

1. Direct temporary lighting away from suitable habitat during the active season.

Tree Removal AMM

1. Apply time of year restrictions for tree removal, November 1 to March 31 of the calendar year.
2. Ensure tree removal is limited to that specified in the plans. Clearing limits shall be marked in the field by the engineer (e.g., install bright colored flagging/fencing prior to any tree clearing to ensure contractors stay within clearing limits).

Bridge AMM

1. If bridge assessment or P/A surveys suggest presence of a small number of bats (<5 – not a colony), and work is conducted during the active season, the following types of bridge work can generally be conducted with the presence of bats:
 - a. Above deck work where construction equipment or materials do not extend to the underside of deck where bats may be located (e.g., materials that may drip down to underside of deck) and does not include percussives (vibration) or noise levels above general traffic (e.g., road line painting, wing-wall work). Below deck work that is conducted away from roosting bats and does not involve percussives or noise level above general traffic (e.g., wing-wall work, some abutment, beam end, scour, or pier repair).
 - b. Any other bridge repair, retrofit, maintenance, and/or rehabilitation (which may include activities with percussives) conducted in the evening while the bats are feeding, starting one hour after sunset, and ending one hour before daylight excluding the hours between 10 p.m. and midnight and keep the lighting localized to the work operation.

Reasonable and Prudent Measures (RPMs). The following RPMs are necessary and appropriate to minimize impacts of incidental take of bats:

1. The department will ensure that all of the AMMs are implemented.
 - a. Notify contractors and construction staff of conservation measures and ensure compliance with these measures.
 - b. Bridge/culvert surveys for bats will be conducted by the department a minimum of 24 months before construction activities begin. Construction activities should not begin until after appropriate agencies have been notified of survey results (if not already on-site during the survey).
 - c. Only individuals with authorization to capture bats will capture and handle bats.
 - d. If any AMMs cannot be implemented or require modification, contact the engineer and REC for further discussion before proceeding with work.
2. The contractor will ensure that appropriate agencies are notified of construction initiation and completion dates, as well as any unforeseen circumstances.
 - a. Notify WisDOT REC Mae Sommerfeld via email (Mae.Sommerfeld@dot.wi.gov) or current REC when construction is expected to begin.
 - b. Provide contact information for WisDOT REC Mae Sommerfeld or current REC to appropriate on-site staff so the department can immediately notify agencies of any unforeseen or emergency circumstances or request clarification regarding conservation measures or terms and conditions.
 - c. Notify WisDOT Regional Environmental Coordinator Mae Sommerfeld via email (Mae.Sommerfeld@dot.wi.gov) or current REC when construction is complete.

3. Should a dead or injured bat be found during project activities; all contractors will ensure that construction activities cease immediately and that the engineer is notified.
 - a. Cease all construction activities if a dead or injured bat is found during project activities and immediately notify the engineer and WisDOT REC Mae Sommerfeld via email (Mae.Sommerfeld@dot.wi.gov) or current REC.
 - b. Contractors should be aware that if dead or injured bats are found additional conservation measures to prevent additional injury or mortality throughout the remaining project activities may be required on a project specific basis.

Migratory Birds

No evidence of swallow or other migratory bird nests have been observed on or under the following structures(s) during the preconstruction inspection. However, if nesting is later observed prior to or during construction, the contractor shall implement avoidance/deterrent measures or obtain a depredation permit. All active nests (when eggs or young are present) of migratory birds are protected under the federal Migratory Bird Treaty Act. The nesting season for swallows and other birds is from April 15 to August 31.

- SWEF building (15+10'RE')

Public Convenience and Safety.

Delete standard spec 107.8 (4) and replace with the following:

Notify the following organizations and departments at least 72 hours before road closures or detours are put into effect:

State of Wisconsin:

- Wisconsin State Patrol (920) 929-3700

Public on Town of Wrightstown

- Department of Public Works (920) 360-7560
- Served by Brown County Sheriff's Department (920) 448-4200
- Served by Greenleaf Fire Department (920) 864-2200
- Served by County Rescue Service (920) 469-9779
- Served by Wrightstown Community School District (920) 532-5551

Outagamie County

- Highway Department (920) 832-5673
- Public Safety Communications (920) 832-5000
- Sheriff's Department (920) 832-5605

Village of Wrightstown

- Department of Public Works (920) 532-0434
- Police Department (920) 532-6007
- Fire Department (920) 532-4556
- Wrightstown Community School District (920) 532-5551

The Outagamie County Public Safety Communications 911 dispatches all area police, fire and ambulance services, and will relay any notification given by the contractor in the event of an emergency.

4. Traffic.

The entire site will be closed to traffic for the duration of the project. The exit ramp from IH 41 will be closed for the duration of the project but may be used for construction access until 1130-44-75 begins. Coordinate the transition of the overlapping traffic control at the initiation of the 1130-44-75 contract. Ramp closure will be maintained by the 1130-44-75 contract upon initiation.

The existing access road off the East Frontage Road is to remain open thru the duration of the project. Access to the 1130-44-74 project work zone will be allowed only from the new Access Road from the East Frontage Road after initiation of 1130-44-75 contract.

A short road closure will be implemented on the East Frontage Road and Kerrigan Road to construct utility connections and replace the road surface. A maximum of 21 calendar days is allowed for this closure, coordinate closure with Town of Kaukauna clerk at (920) 419-2214 townofkaukaunaclerk@gmail.com and notify emergency services two weeks prior to closure.

Maintain emergency vehicle access at all times.

Prior to any traffic control being placed or road closure, provide the engineer, Wisconsin State Patrol and Outagamie County Highway Maintenance with the name and telephone number of a local person responsible for the emergency maintenance of traffic control. **See Public Convenience and Safety.** Contact the IH 41 Traffic Management Engineer, Susan Paulus, at (414) 460-3409 for the individuals at the Wisconsin State Patrol and Outagamie County Highway Maintenance.

Coordinate all traffic handling with the engineer. Place roadway signing as detailed on the plans and in conformance with the Manual on Uniform Traffic Control Devices (MUTCD), latest edition. Employ such flag persons, signs, barricades, and drums as may be necessary to safeguard or protect hazards in the work zone, such as exposed manholes or drop-offs for vehicles and direct traffic at locations where construction operations may interfere or restrict the smooth flow of traffic. Make arrangements and be responsible for the prompt replacement of damaged or dislocated traffic control or guidance signs, day or night.

Traffic requirements under this contract shall be coordinated with other adjacent and concurrent department or local municipality projects. The contractor shall be responsible for implementing and coordinating with other contractors all traffic control as shown on the plans. Modifications to the traffic control plan may be required by the engineer to be safe and consistent with adjacent others.

5. Holiday and Special Event Work Restrictions.

Do not perform work on, nor haul materials of any kind along or across any portion of the highway carrying IH 41 traffic, and entirely clear the traveled way and shoulders of such portions of the highway of equipment, barricades, signs, lights, and any other material that might impede the free flow of traffic during the following holiday and special event periods:

- From noon Friday, August 30, 2024 to 6:00 AM Tuesday, September 3, 2024 for Labor Day;
- From noon Wednesday, November 27, 2024 to 6:00 AM Monday, December 2, 2024 for Thanksgiving Day;
- From noon Tuesday, December 24, 2024 to 6:00 AM Sunday, December 29, 2024 for Christmas Day;
- From noon Tuesday, December 31, 2024 to 6:00 AM Thursday, January 2, 2025 for New Years Day;
- From noon Friday, April 18, 2025 to 6:00 AM Monday, April 28, 2025 for Easter/NFL Draft;
- From noon Friday, May 23, 2025 to 6:00 AM Tuesday, May 27, 2025 for Memorial Day;
- From noon Thursday, July 3, 2025 to 6:00 AM Tuesday, July 8, 2025 for Independence Day;
- From noon Friday, August 29, 2025 to 6:00 AM Tuesday, September 2, 2025 for Labor Day;
- From noon Wednesday, November 26, 2025 to 6:00 AM Monday, December 1, 2025 for Thanksgiving Day.
- Lambeau Field events with anticipated attendance of 30,000 or more:
 - IH 41 Northbound
 - Begin – 5 hours prior to the posted start time of the event.
 - End – At the posted start time of the event.
 - IH 41 Southbound
 - Begin – At the posted start time of the event.
 - End – 8 hours after the posted start time of the event.

6. Utilities.

This contract comes under the provision of Administrative Rule Trans 220.

stp-107-065 (20080501)

The utility work plan includes additional detailed information regarding the location of known discontinued, relocated, or removed utility facilities. These can be requested from the Wisconsin Department of Transportation during the bid preparation process or from the project engineer after the contract has been awarded and executed.

Some of the utility work described below is dependent on prior work being performed by the contractor at a specific site. In such situations, provide the engineer and the affected utility a good faith notice of when the utility is to start work at the site. Provide this notice 14 to 16 calendar days in advance of when the prior work will be completed, and the site will be available to the utility owner. Follow-up with a confirmation notice to the engineer and the utility owner not less than three working days before the site will be ready for the utility owner to begin its work.

Kaukauna Utilities – has electrical distribution facilities in the following locations:

- Along the east side of the East Frontage Road along the entire project site. No conflicts anticipated. Overhead crossing IH 41 near Station 1374+25 and continuing overhead over the IH 41 off-ramp for the SWEF.
- The following poles will be removed during the project:
 - Power Pole: 2+42'EL', 33.1' LT
 - Guy Wire: 2+43'EL', 25.4' LT
 - Power Pole: 50+81.5, 46' LT
 - Guy Wire: 50+86.5, 42.5' LT
- An underground electric distribution along the east side of the IH 41 off ramp to the existing building will be discontinued at the initiation of this project. Notify Kaukauna Utilities 30 days prior to building demolition to arrange for discontinuing this service.
- Contact Neil Jack Distribution Superintendent at (920) 462-0217, njack@ku-wi.org, of Kaukauna Utilities 30 days prior to needing them onsite to coordinate construction activities. Kaukauna Utilities will need 5 working days prior to contractor starting work at this site.

Level 3 Communications – has underground fiber optic along the east side of the East Frontage Road. No conflicts anticipated.

7. Other Contracts.

Clearing for this project was completed under contract 1009-37-01. Grubbing is to include the removal of any debris that remains within the slope intercepts of this project.

Contracts 1130-67-72, IH 41 Mainline, CTH JJ - Miners Way; 1130-67-76, S County Line Rd (CTH U) Intchg; and 1130-67-86, CTH U Frontage Roads will be let in July of 2025 with construction expected to begin in September. Work zones may impact construction traffic on East Frontage Road and IH 41.

Contract 1130-44-75, IH 41 Wrightstown Swef 34/Post-Site will be let in May of 2025 and will construct the remainder of the site. Work zone will connect to existing pavement or back of curb and gutter on Dumpster Pad, Employee Parking and sidewalk along 'BX'.

8. Work Done by Others.

The following work will be performed in conjunction with this project by others during the contract period.

Wisconsin Public Service Corporation (WPS) has underground natural gas that will be connected to the project site.

Kaukauna Utilities – will install electric service to the site during construction, coordination, work and materials required for this is included in the contract.

Village of Wrightstown sanitary and water main will be connected to the project site as part of the contract work.

Automated Logic will install an HVAC WebCTRL Building Automation System, as specified in section 23 09 24, under contract with DOT. Coordination with this work is included in the contract.

Project 1130-44-75 – will be let in May of 2025 and covers grading and paving the remainder of the site that is not completed under this contract.

Project 1130-67-76 – will be let in May of 2025 and covers grading and paving of IH 41 and adjacent ramps.

9. Hauling Restrictions.

Do not have a haul road longitudinally along the project inside the Interstate 41 right-of-way within 30 feet of the live traffic lanes.

10. Information to Bidders, WPDES Transportation Construction General Permit (TCGP) for Storm Water Discharges.

The department has obtained permit coverage through the Wisconsin Department of Natural Resources to discharge storm water associated with land disturbing construction activities under this contract. Conform to all permit requirements for the project.

This permit is the Wisconsin Pollutant Discharge Elimination System, Transportation Construction General Permit, (WPDES Permit No. WI-S066796-2). The permit can be found at:

[FINALsignedWisDOTCSGP.pdf \(widen.net\)](#)

A certificate of permit coverage is available from the regional office by contacting John Spielmacher at (920) 492-0134. Post the permit certificate in a conspicuous place at the construction site.

stp-107-056 (20230629)

11. Erosion Control.

Only areas indicated on plans will be topsoiled, fertilized, and seeded. Additional grading will be required with 1130-44-75 that will overlap the limits of this project. Final stabilization for the remainder of the site will occur with project 1130-44-75.

12. Notice to Contractor – Pre-Bid Meeting.

Supplement standard spec 102.3.1 with the following:

(3) Prospective bidders are strongly encouraged to attend a pre-bid meeting, which will be held virtually, on Tuesday, July 23, 2024 at 3:00 PM.

The meeting agenda will include the following:

- Introductions
- Project Overview
- Highway Construction Contract Information Contractors Checklist
- Prequalification materials (form DT1621)

- DBE requirements
- Buy America Requirements
- Contractor Questions/Bid Express
- Q&A

The meeting will be hosted via Microsoft Teams. Join on your computer, mobile app or room device or via telephone. Meeting information is below:

[Join the meeting now](#)

Meeting ID: 283 452 673 581

Passcode: VFFT2e

or Dial in by phone

[+1 872-240-1858](tel:+18722401858).,[842058670#](tel:+18722401858) United States, Chicago

[Find a local number](#)

Phone conference ID: 842 058 670#

13. Notice to Contractor – Project Storage and Staging Areas.

Supplement standard spec 106.4(2) and 107.9 with the following:

To accommodate construction of the department planned contracts for the remainder of the site, the department will implement a review and approval process for use of storage and staging areas within the right-of-way and adjacent to the project.

Equipment and materials can be stored within the slope intercepts shown on the plan and within the footprint of the roadway or structures within the project limits. Storage of equipment and materials will not be allowed in areas which are restricted by traffic and other requirements provided in the special provisions.

Make any requests for storage and staging areas located outside of the slope intercepts or outside of the proposed roadway and structure footprints to the engineer. The request should include the anticipated date for occupying the area, the anticipated date for vacating the area, and a proposed restoration plan for the area. The planned project storage and staging areas shall be submitted to the engineer for review and approval a minimum of 14 calendar days prior to the anticipated implementation. Review by the engineer does not constitute approval.

14. Notice to Contractor, New Utility Service Connection.

Coordinate all required utility work disconnections according to standard spec 107.22 and pay for the installation of new site utilities and tie-ins as may be necessary to complete the work as described below.

Network Service, Wrightstown SWEF: WisDOT Bureau of Traffic Operations has an existing network fiber facility crossing under IH 41 to a vault adjacent to the existing SWEF building. The plans include providing a new underground service by installing new conduit and vault from the existing vault. The run of fiber optic cable from the existing vault to the building will use the existing fiber optic cable slack in the vault. From the building to the Main Communications Tower, new fiber will be supplied and installed by the contractor.

Contact Mark Rasmussen at (608) 212-3584 of Wisconsin State Patrol 45 days in advance to coordinate the splicing operations and to verify proper placement of fiber between the existing vault and proposed connection to the Wrightstown SWEF\Post Building.

All necessary splicing, terminations, and equipment connections at the proposed Main Communications Tower are to be included as part of the telecommunications work for the tower. All necessary splicing, terminations, and equipment connections at the proposed Wrightstown SWEF\Post Building are to be included as part of the telecommunications work inside the building.

Installation of fiber optic from the existing vault to the building and from the building to the tower will be paid as part of the contract work.

Natural Gas Service, Wrightstown SWEF: WPS has existing service facilities south of the project area. WPS plans on providing an underground service from the south right-of-way to the proposed building location. Contact Wisconsin Public Service at newserviceinstallation@wisconsinpublicservice.com, (800) 242-9772 of WPS 90 days prior to needing them onsite to coordinate construction activities. Refer to **Work Request** 3389653-1.

Adam VandenHouten
Gas Operations Supervisor
Wisconsin Public Service
Office: (920) 617-5231
adam.vandenhouten@wisconsinpublicservice.com

WPS anticipates 5 working days to complete the new service. WPS will install the new services after grading has been completed to within 4 inches of final grades.

Electrical Service, Wrightstown SWEF\Post: The existing underground service will be relocated and upgraded to a three phase service during construction of this project.

Electrical Service, Main Communication Tower: A new underground single-phase service will be completed during construction of this project. Kaukauna Utilities anticipates 3 working days to complete the new services. Kaukauna Utilities will install the new services after grading has been completed to within 4 inches of final grades.

Contact Brian Wilms (920) 462-0222, bwilms@ku-wi.org of Kaukauna Utilities 30 days prior to needing them onsite to coordinate construction activities.

Sanitary Sewer, Wrightstown SWEF\Post. Plans for a new sanitary sewer to connect to Kerrigan Road sewer are included with this plan set.

Contractor is responsible for coordinating with the Village of Wrightstown work to install and connect the sanitary sewer within Village of Wrightstown right-of-way, including obtaining a Utility Service Permit [Microsoft Word - UtilityServicePermit.Word.NewLogo \(wrightstown.us\)](#) and a Right-of-Way Permit [Right-of-Way-Permit-PDF-11.12.20-1.pdf \(wrightstown.us\)](#). Contact Michael Ledig of Robert E. Lee & Associates, (920) 662-9641, or Andy Vickman, Superintendent of Public Works, avickman@wrightstown.us, (920) 532-0434, Ext. 42.

Water Main, Wrightstown SWEF\Post. Plans for a new water main that connect to Kerrigan Road water main are included with this plan set.

Contractor is responsible for coordinating with the Village of Wrightstown work to install and connect the water main within Village of Wrightstown right-of-way, including obtaining a Utility Service Permit [Microsoft Word - UtilityServicePermit.Word.NewLogo \(wrightstown.us\)](#) and a Right-of-Way Permit [Right-of-Way-Permit-PDF-11.12.20-1.pdf \(wrightstown.us\)](#). Contact Michael Ledig of Robert E. Lee & Associates, (920) 662-9641, or Andy Vickman, Superintendent of Public Works, (920) 532-0434, Ext. 42.

15. Notice to Contractor – Safety and Personnel Identification Program.

All workers shall wear OSHA and ANSI compliant safety head protection, safety glasses, safety-toe protective footwear, and safety vest at all times while within the project footprint. All workers shall wear OSHA and ANSI compliant safety pants within the right of way of a roadway with a posted speed limit of 50 mph or greater unless separated from traffic by positive protection (e.g., temporary concrete barrier). From dusk to dawn, all workers shall wear OSHA and ANSI compliant safety pants.

The prime contractor shall provide a copy of their current Company Safety Plans to the department 7 days prior to the preconstruction meeting. All workers shall comply with the Safety Plans of their employer.

All contractor personnel will be required to register in the program prior to performing work. Valid photo identification which includes unexpired driver's license, government issued identification cards, military identification, passport, or other identification approved by the department will be required to register. All personnel registered will be issued a hard hat sticker with an identification number by the department. Stickers shall be placed in a visible location on the hard hat. Register at the IH 41 corridor field office during normal business hours.

Noncompliance with this contract provision may result in removal of contractor personnel from the project or suspension of work according to standard spec 108.6 applicable under the contract.

ner41-108 (05072024)

16. Geotechnical Information.

A complete geotechnical report may be obtained by contacting John Spielmacher at:

E-mail: john.spielmacher@dot.wi.gov

Phone: (920) 492-0134

17. Field Facilities.

The department will provide primary field facilities for this project located at 3600 Commerce Court, Appleton, WI 54911.

The contractor is required to schedule and attend all meetings at the department provided field office facility. Formal meetings, unless otherwise specified, will not be scheduled at any offsite locations other than the field facility provided by the department.

ner41-105 (12052023)

18. Electrical Meetings.

Electrical Kick Off Meeting

No later than 5 working days prior to starting any electrical installation construction activities, arrange and conduct an Electrical Kick Off Meeting between the department, the engineer, and electrical subcontractors to discuss the construction of the electrical elements of the project including traffic signals, roadway lighting systems, Intelligent Transportation Systems (ITS), and all other electrical facilities.

During the electrical kick off meeting, the contractor may be requested to provide additional workplan information related to the electrical installation activities. Upon completion of the electrical kick off meeting and acceptance of any additional requested workplan information, the contractor will be given authorization to proceed with electrical construction activities. The contractor shall not start work on electrical installation activities until after authorization has been given by the engineer.

Additional Electrical Meetings

Arrange and conduct additional electrical progress meetings between the department, the engineer, and electrical subcontractors no later than 5 working days prior to:

1. Energizing new systems.
2. Opening roadway
3. Final inspection

Electrical Meeting Requirements

The contractor shall make meeting requests through the engineer not later than 10 working days prior starting any electrical installation construction activities. The engineer will arrange the meeting location and time. Electrical meetings shall be held during regular working hours between 9:00 AM and 5:00 PM Monday through Friday.

The department shall prepare and distribute an agenda 3 working days prior to the electrical meeting.

At the electrical meeting, prepare to discuss the following information as applicable to the electrical work included in the project:

1. Inspection Expectations
 - a. Project walk-throughs
 - b. Staking and verification of locations
 - c. Location and orientation of cabinet bases
2. Contractor Work Operations
 - a. Provide names and qualifications of personnel that will be working on the project.
 - b. Provide shop drawings, materials documentation, and lead times.
 - c. Coordination of electrical service application, installation, and reimbursement
 - d. Locations and elevations of electrical work
 - e. Schedule and operations for contract work – include critical path items and responsible parties
 - f. Electrical work completed by others
 - g. Temporary installations and connections
 - h. End of shift site requirements
 - i. Process for energizing new facilities
 - j. Timely measurement and agreement of quantities
3. Traffic Control Requirements
 - a. Traffic control requirements
 - b. Roadway lighting requirements for opening roadways
 - c. Staged ITS requirements.
4. Safety

The department will prepare meeting minutes.

The contractor and electrical subcontractor are required to attend all electrical meetings. Electrical meetings are considered incidental to the electrical work.

19. Outdoor Electrical / Lighting General.

Work described under this heading refers to exterior overhead lighting only. Interior building lighting is described elsewhere.

Notify the department's Electrical Field Unit at (920) 360-4749 at least three weeks prior to the beginning of the Electrical work. The department's Regional Electrical personnel will perform the inspections.

Electrical item inspections are required at the following times: after the staking of all electrical underground items, islands, curb and gutter, and medians; before the pouring of all lighting and cabinet bases; before cable and wire are pulled; during field terminations at the lighting bases; and prior to the installation of any poles or other above ground electrical items.

Request electrical inspections of the completed lighting work to the engineer and contact the department's Electrical Field Unit at (920) 360-4749 at least five working days prior to the time of the requested inspection.

20. Referenced Construction Specifications.

Building Construction shall conform to the "General Conditions of the Contract for Construction" AIA Document A201 - 2007, published by the American Institute of Architects.

If there is a discrepancy or conflict between the referenced specification and the standard specifications regarding contract administration, part 1 of the State of Wisconsin, Department of Transportation, Standard Specifications for Highway and Structure Construction, 2024 Edition governs.

21. Municipality Acceptance of Sanitary Sewer and Water Main Construction.

Both the department and Village of Wrightstown personnel will inspect construction of sanitary sewer and water main under this contract. Acceptance of the sanitary sewer and water main construction will be by the Village of Wrightstown.

stp-105-001 (20140630)

22. Underground Utility Record Drawings.

Keep a current set of plans at the project that are marked to show the location of underground utilities, as encountered during excavation and as installed new with the project. Accurately record the lengths, depths, invert elevations and location of valves, fittings, structures, pipes, service lines, and field changes for water main, sanitary sewer, storm sewer, and electrical work. Dimension utility locations from permanent reference points; record vertical distances. Submit record drawings to Village of Wrightstown, and their engineer upon completion of work.

23. SWEF\Post Building Construction.

The requirements included in this provision are applicable to the following bid items for the SWEF\Post Building construction and will be paid as each item acceptably completed under the following bid items:

SWEF\Post Building, Electrical Service	Item SPV.0060.10
SWEF\Post Building, Natural Gas Service	Item SPV.0060.11
SWEF\Post Building, General Construction	Item SPV.0060.100
SWEF\Post Building, Plumbing	Item SPV.0060.101
SWEF\Post Building, Heating and Ventilating	Item SPV.0060.102
SWEF\Post Building, Electrical	Item SPV.0060.103
SWEF\Post Building, Generator	Item SPV.0060.104
SWEF\Post Building, Lighting and Grounding Protection	Item SPV.0060.105
SWEF\Post Building, Fire Suppression	Item SPV.0060.106

Work, permits, materials and site protection related to the work requirements of these items not included in this contract will not be paid separately but shall be included in the applicable contract unit prices.

24. Clearing and Grubbing.

Add to standard spec 201.3:

The contractor is prohibited from open burning of weeds, brush, logs, limbs, stumps, roots, lumber, and debris from clearing and grubbing or from demolition.

Dispose of stumps, roots, brush, waste logs and limbs, timber tops and debris resulting from grubbing or occurring within grubbing limits by chipping and removing from the highway right-of-way.

ner-201-005 (20190717)

25. Abatement of Asbestos Containing Material 1130-44-74, Item 203.0216.S.001.

A Description

This special provision describes abating asbestos containing material in buildings or utility conduit.

B (Vacant)

C Construction

For Buildings:

Matt Geldmeyer, License Number:-16803, inspected Structure: inspected the Wrightstown SWEF Building and two storage shed structures for asbestos on August 20, 2022. No Regulated Asbestos Containing Material (RACM) was found on these structures. However, two (2) assumed ACM electric switch/fuse boxes (internal insulation panel) and assumed ACM mirror mastic were identified. For demolition, all ACM is required to be removed prior to the start of demolition activities. After the building is vacated and the power is de-energized, analyze samples of the assumed ACM and properly dispose of the materials. A copy of the inspection report is included with the bid package or available from John Spielmacher at (920) 492-0134 or john.spielmacher@dot.wi.gov.

The RACM must be abated by a licensed abatement contractor. According to NR447 and DHS159, ensure that DNR or DHS receives a completed Notification of Demolition and/or Renovation (DNR Form 4500-113 (R 8/11), or subsequent revision) via U.S. mail, hand-delivery, or using the online notification system at least 10 working days before beginning any demolition or relocation. Pay all associated fees. Provide a copy of the completed 4500-113 form and the abatement report to Bryan Learst, (920) 492-3509, Bryan.Learst@dot.wi.gov, and DOT BTS-ESS attn: Hazardous Materials Specialist, 5 South S.513.12, PO Box 7965, Madison, WI 53707-7965; or via email to dothazmatunit@dot.wi.gov. In addition, comply with all local or municipal asbestos requirements.

D Measurement

The department will measure Abatement of Asbestos Containing Material 1130-44-74 by each project, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
203.0216.S.001	Abatement of Asbestos Containing Material 1130-44-74	EACH

Payment is full compensation for submitting necessary forms; removing all asbestos; and for properly disposing of all waste materials.

stp-203-006 (20220628)

26. Removing Building (STA 15+10'RE'), Item 204.0231.001.

Conform to the requirements of standard spec 204 and as hereinafter specified.

The department has investigated the existing Wrightstown SWEF\Post Buildings for the presence of asbestos. The inspection report was completed on July 28, 2022.

No ACM was detected during this asbestos inspection. However, two assumed ACM electric switch/fuse boxes (internal insulation panel) and assumed ACM mirror mastic were identified. For demolition, all ACM is required to be removed prior to the start of demolition activities. As such, it is recommended that, after the building is vacated and the power is de-energized, samples of the assumed ACM be analyzed for asbestos prior to the start of demolition activities.

In addition, a wall-mounted mirror was observed in the bathroom. Typically, mirrors of this nature are mounted with a mastic/adhesive applied to the back, and mastic of this nature is considered suspect ACM. Due to the potential for breaking the entire mirror to perform observation and/or sampling for mastic, the mirror mastic was inaccessible. As such, mirror mastic (if present) is assumed ACM.

The following were identified the following total quantities of regulated waste materials observed in both buildings:

- Potential mercury-containing fluorescent and HID bulbs: 16 bulbs
- Potential PCB-containing ballasts: 6 ballasts
- Chemical fire extinguishers: 3

The identified regulated waste materials must be properly handled and disposed (or salvaged/recycled) according to all applicable local, state, and federal guidelines.

Contact the WisDOT Bureau of Highway Maintenance, John Spielmacher at (920) 492-0134 or john.spielmacher@dot.wi.gov to obtain a copy of the Pre-Demolition NESHAP Asbestos Inspection and Hazardous Material Survey.

Dispose of any and all materials associated with the buildings, including fuel tanks, underground pressure tanks, and lighting control cabinet as part of this item.

Coordinate electrical service termination to the building with the utility (Kaukauna Utilities) before beginning construction/demolition activities. Remove electrical service to the building and abandon all existing conduits a minimum of 2-feet below finished grade.

Abandon wells and remove septic tanks within the site as separate items included in the contract.

Contact Sgt. Clint Beck at (608) 294-8545 to coordinate the beginning of demolition activities to ensure State Patrol has removed all files and equipment prior to the beginning of demolition. State Patrol will require three weeks to vacate the site prior to demolition.

27. Site Clearance SWEF Site, Item 204.0241.001.

Add the following to standard spec 204.3.2.1(12):

Remove electrical circuiting, conduit, railing, concave mirror, trash receptacles, flag pole, landscaping, storage sheds, and various other appurtenances on the site as called out in the plans. Solar/LED speed sign mounted on existing light pole shown in plans shall be removed in a manner which allows for its re-use and arrange for transfer of equipment to:

Captain Karl L. Mittelstadt
Wisconsin State Patrol
Motor Carrier Enforcement Section
(608) 215-2804
Karl.Mittelstadt@dot.wi.gov

28. Removing Septic Tanks.

Add to standard spec 204.3.2.(11):

Plug unused sewers as specified for abandoning pipes and structures under standard spec 204.3.3.1.

29. Removing Street Light Assembly, Item 204.9060.S.001.

A Description

This special provision describes removing street lighting units conforming to standard spec 204. This work shall be according to the plans, standard detail drawings, and as hereinafter provided.

B Materials

Salvage all street lighting materials from the project except for internal pole wiring. Salvaged materials include transformer bases, poles, arms, LED luminaires and associated hardware.

C Construction

Disconnect and salvage the complete lighting unit from the locations shown in the plans and/or as designated by the engineer.

Carefully stockpile the complete lighting unit at a location approved by the engineer. Place all equipment on blocks so as not to be in direct contact with the ground. Salvaged items shall be stored and protected from damage until ready for pick up by WisDOT NE Region. Any damage to the salvaged materials resulting from the removal and salvaging operations shall be repaired or replaced in-kind at the contractor's expense. Contact the department's Electrical Field Unit at (920) 360-4749, a minimum of two business days prior to pick up.

D Measurement

The department will measure Removing Street Light Assembly as each individual lighting unit, acceptably removed and salvaged.

E Payment

Add the following to standard spec 204.5:

ITEM NUMBER	DESCRIPTION	UNIT
204.9060.S.001	Removing Street Light Assembly	EACH

30. Removing Static Scale, Item 204.9060.S.002.

A Description

Remove and dispose of existing truck weight scale and break down and remove the scale pit according to the pertinent requirements of standard spec 204 and as hereinafter provided.

B (Vacant)

C Construction

Remove static scale equipment and remove from site. All scale materials shall become the property of the contractor. Break concrete scale pit into pieces <2'. Removed pieces or place back in pit and backfill pit to match adjacent grade.

D Measurement

The department will measure Removing Static Scale as each individual unit, in place and acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
204.9060.S.002	Removing Static Scale	EACH

Payment is full compensation for removing and disposing of the existing truck weight scale equipment; breaking down, removing the scale pit and backfilling pit to existing grade.

31. Removing Electrical Conductors from Existing Conduit, Item 204.9090.S.001; Removing or Abandoning Conduit, Item 204.9090.S.002.

A Description

This special provision describes removing electrical conductors from existing conduit and removing or abandoning conduit conforming to standard spec 204.

B (Vacant)

C Construction

Conduit shall be removed or abandoned as necessary to establish a new lighting system as described in the lighting plans. Coordinate removal means and methods with the engineer in the field.

Wires shall be removed from the existing underground conduits as shown on the plans and as directed by the engineer. The engineer shall verify the extent of the wiring removal prior to disconnecting luminaires or communication equipment. Any necessary splices or disconnections shall be done as part of this pay item. Removed wires shall become property of the contractor and shall be disposed of off the project site.

D Measurement

The department will measure Removing Electrical Conductors from Existing Conduit by linear feet of conduit from where wires shall be removed and disposed of, regardless of conductor quantity within conduit, acceptably completed. The vertical length and wire slack shall be incidental to this pay item.

The department will measure Removing or Abandoning Conduit by linear feet of conduit, acceptably completed.

E Payment

Add the following to standard spec 204.5:

ITEM NUMBER	DESCRIPTION	UNIT
204.9090.S.001	Removing Electrical Conductors from Existing Conduit	LF
204.9090.S.002	Removing or Abandoning Conduit	LF

32. Backfill Structure Type B, Item 210.2100.

Modify standard spec 210.3 (1) to read:

Structure backfill shall be placed in lifts such that the entire lift achieves a minimum compaction level of 95% of its maximum modified Proctor dry density (ASTM D1557). Confirmation that this density is achieved shall be tested per lift during construction to ensure compliance as per CMM 860.

Add standard spec 210.4 (4):

Structure Backfill Type B under the footprint of the building is incidental to the SWEF/Post Building, General Construction bid item.

33. Seeding Rates.

Delete standard spec 630.3.5 and replace with the following:

(1) Use the following sowing rate for seeds in pounds per 1000 square feet:

- Temporary seeding at 3 pounds
- No. 10 at 3 pounds
- No. 20 at 5 pounds
- No. 30 at 5 pounds
- No. 35 at 5 pounds
- No. 40 at 5 pounds
- No. 45 at 5 pounds
- No. 60 at an equivalent seeding rate of 1.5 pounds^[1]
- No. 75 at an equivalent seeding rate of 0.3 pounds^[1]
- No. 80 at an equivalent seeding rate of 0.5 pounds^[1]
- No. 85A, 85B, 90A and 90B at 0.25 pounds
- No. 95A and 95B at 0.128 pounds
- Nurse crop seeding at 0.8 pounds

34. Furnishing and Planting Plant Material.

This project shall have a plant establishment period of 2 years.

Conform to standard spec 632, and as herein after provided.

Remove standard spec 632.3.18.3.

35. Landscape Planting Surveillance and Care Cycles.

If the care specialist fails to perform any of the required care cycles as specified in standard spec 632.3.19.1, the department will assess daily damages in the amount of \$200 to cover the cost of performing the work with other forces. The department will assess these damages for each day the requirements of the care cycle remain incomplete, except when the engineer extends the required time period.

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1130-44-74

36. Lamp, Ballast, LED, Switch Disposal by Contractor, Item 659.5000.S.

A Description

This special provision describes the detachment and packaging of lamps, ballasts, LEDs, and mercury containing switches (e.g., overhead roadway lighting, underdeck bridge, wall packs, pedestrian signals, traffic control stop lights and warning flashers, fluorescent bulbs, and thermostats), potential PCB-containing ballasts, and fire extinguishers removed under this contract for disposal as hazardous materials.

The preconstruction asbestos inspection identified the following total quantities of regulated waste materials observed in both buildings:

- Potential Mercury-containing fluorescent and HID bulbs (16)
- Potential PCB-containing ballasts: 6 ballasts

For Lamp, Ballast, LED, Switch Disposal by Contractor, coordinate removal from the work site by the department's hazardous waste disposal vendor. Disposal will be billed to the department by the hazardous waste disposal vendor.

B Materials

B.1 Disposal by Contractor

Items removed under this contract will be considered the property of the department for waste generator identification. The contractor is responsible for coordinating with the department's hazardous waste vendor for disposal:

<https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrcs/environment/hazwaste-contacts.pdf>

C Construction

C.1 Removal

Arrange for the de-energizing of luminaires after receiving approval from the engineer that the existing luminaires can be removed. Do not remove luminaires that cannot be replaced with proposed LED units and operational within the same workday. The new LED units need to be operational prior to sunset of the same workday.

Detach and remove luminaires and lamps from the existing traffic signal poles or respective structure. Avoid breaking fixtures whenever possible.

C.2 Packaging of Hazardous Materials

Provide a secure, level location removed from the travelled way for storage of the material for disposal.

Pack intact fixtures in the packaging of the new lamps used to replace them, or packaging affording the equivalent protection. Place in full, closed stackable cartons.

Pile cartons no more than four high if palletized and secure cartons with shrink wrap to prevent shifting or falling of the loads. Clearly mark each pallet with the words "Universal Waste Lamps" or "Universal Waste Ballasts", the date, and the number of fixtures on each pallet.

Pack broken fixtures into (min.) 6 mil thick plastic bags and place inside sturdy cardboard boxes or the equivalent. Mark the outer packaging with the term "Broken Fixtures/Lamps", the date and the number of broken fixtures clearly marked on the box.

The hazardous waste vendor will not accept fixtures improperly packaged. The vendor will reject any fixtures not removed as part of a contract pay item or otherwise required under this contract.

Pack ballasts and mercury containing switches in appropriate containers.

C.3 Disposal by Contractor

Complete the lamp and ballast inventory (<https://wisconsindot.gov/Documents/doing-bus/eng-consultants/cnslt-rsrcs/environment/dotlampballastinventory.dotx>) and contact the hazardous waste vendor to coordinate pickup and disposal at a location specified by the contractor. Consolidate all pallets and boxes from one project at a single location. Contact the hazardous waste vendor to set up an appointment for pickup. The hazardous waste vendor requires a minimum of one week advance notice to schedule pickup.

D Measurement

The department will measure Lamp, Ballast, LED, Switch Disposal by Contractor as each individual unit removed and received by the hazardous waste vendor, properly packaged, and acceptably completed, matching the total number of units provided on the inventory form. The department will not measure broken fixtures that exceed a total of 10 percent of all fixtures to be disposed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
659.5000.S	Lamp, Ballast, LED, Switch Disposal by Contractor	EACH

Payment for Lamp, Ballast, LED, Switch Disposal by Contractor is full compensation for detachment, handling, packaging, labeling and scheduling disposal with the hazardous waste vendor; and scrapping and disposal of all other materials.

37. Washed Stone 3/4-Inch, Item SPV.0035.001.

A Description

This special provision describes excavation, preparing the surface, furnishing and installing washed stone $\frac{3}{4}$ -inch according to the plans. Complete in place at the location as designated on the plans, or as directed by the engineer and as hereinafter provided.

B Materials

Use materials that meet the requirements for size no. 1 crushed stone per standard spec 501.2.5.4 for coarse aggregate.

C Construction

Place Washed Stone $\frac{3}{4}$ -inch on the geotextile fabric to dimensions specified in the plans. Use mechanical or hand methods to shape and consolidate to provide a stable, even, and uniform surface as shown on the plans.

D Measurement

The department will measure Washed Stone $\frac{3}{4}$ -Inch by the cubic yard, acceptably completed, measured as the volume within the limiting dimensions the contract designates or the engineer establishes in the field.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0035.001	Washed Stone 3/4-Inch	CY

Payment is full compensation for providing, transporting, handling, and placing washed stone. Geotextile Type R fabric will be paid separately.

38. Gray Granite Chips, Item SPV.0035.002.

A Description

This work shall consist of furnishing and installing Gray Granite Chips within the areas as indicated on the plans.

B Materials

Gray Granite Chips shall be $\frac{3}{4}$ inch uniform in size. All fines shall be screened from the aggregate within a $\frac{1}{4}$ -inch tolerance. Gray Granite Chips shall be composed of fractured rocks that are naturally gray and silver in color. The material shall be free of organic and inorganic debris and trash.

Material shall be granite stone. Colored gravel shall not be allowed.

C Construction

After the planting is completed and all landscape materials have been installed, the contractor shall install the Gray Granite Chips to a 4" depth and fully cover all weed barrier fabric. The contractor is responsible for assuring the 4" depth throughout the beds and will not be paid for applying at a thicker depth unless specifically directed in the field by the engineer.

Contractor shall take care to allow for the watering wells as shown on the planting details with the placement of the Gray Granite Chips.

Contractor shall ensure that all plant material and surrounding surfaces are free of Gray Granite Chips prior to leaving the job site.

D Measurement

The department will measure Gray Granite Chips by the cubic yard, acceptably completed, measured as the volume within the limiting dimensions the contract designates, or the engineer establishes in the field.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0035.002	Gray Granite Chips	CY

Payment is full compensation for furnishing and installing the Gray Granite Chips.

39. Outlet Structure, Item SPV.0060.001.

A Description

This special provision describes furnishing and installing an outlet structure with trash screen as shown in the plans, and as hereinafter provided.

B Materials

Furnish structure materials and inlet cover according to standard spec 611.

Furnish steel conforming to the requirements of standard spec 506.2.2.1.

Furnish bolts, nuts, and washers for the installation of the trash racks onto the Outlet Structure. Bolts, nuts, and washers shall be according to standard spec 513.2.2.5.

C Construction

Trash screen shall be pre-fabricated from steel and shall be galvanized after fabrication or be stainless steel. Shop drawings for the trash screen shall be submitted to the engineer for approval prior to obtaining the trash screen. Repair any galvanization that has been damaged according to the requirements of AASHTO M36M.

D Measurement

The department will measure Outlet Structure by each structure, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.001	Outlet Structure	EACH

Payment is full compensation for furnishing and installing all materials, drilling and connecting trash screen and water quality plate to structure.

40. Secure Slide Type Class IV 18-FT Gate, Item SPV.0060.002.

A Description

This work shall consist of furnishing and installing a Secure Slide Type Class IV 18-FT Gate by 6 feet high with gate opener that integrates with card access and exit underground ring as specified in building plans.

B Materials

Provide horizontal slide gate and equipment meeting ASTM F2200 for a Class IV gate with automated opening motor. Barbed wire shall be omitted.

Gate openers must integrate with card access and the exit underground ring.

Shop Drawings:

1. Supply shop drawings showing the gate system, including details of all major components.
2. Include details of gate construction, gate height, and post spacing dimensions.

C Construction

Construct the gate as per ASTM F2200 for a Class IV gate or as per manufacturer's recommendations.

D Measurement

The department will measure Secure Slide Type Class IV 18-FT Gate by each unit, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.002	Secure Slide Type Class IV 18-FT Gate	EACH

Payment is full compensation for providing and installing all materials necessary to complete the work.

41. Trash Receptacles, Item SPV.0060.003.

A Description

This special provision describes providing, furnishing, and installing trash receptacles with liner, complete and in place, at the locations as designated on the plans or as directed by the engineer.

B Materials

Trash receptacles shall be steel reinforced concrete with a smooth finish and gray color and include plastic liner. Trash receptacles shall have a plastic cover with flip type opening and include a liner for 53-gallon trash bag. Furnish five sets of catalogues cut and manufacturer's shop drawings to the engineer for approval before ordering.

Acceptable manufacturers are listed below.

1. Pre-Terra Products
PO Box 1520
Wausau, WI 54402-1520
(800) 388-8728
2. Environmental Features, Inc.
3. Quick Crete Products
4. Approved equal.

C Construction

Install trash receptacles in locations indicated on the plans or as directed by the engineer.

D Measurement

The department will measure Trash Receptacles as each individual unit, in place and acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.003	Trash Receptacles	EACH

Payment is full compensation for furnishing, hauling, and installing trash receptacles.

42. Fiber Optic Patch Panel, Item SPV.0060.004.

A Description

Furnish and install a fiber optic patch panel according to the following standards.

B Materials

Furnish a Fiber Optic Patch Panel capable of accommodating 12 count single-mode OS2 fiber and SC connectors and be designed to fit into one standard rack mount space. The body of the patch panel shall be black in color.

C Construction

Have a certified fiber optic technician perform work for fiber optic terminations, splicing and testing. Have a certified fiber optic technician supervise all fiber optic cable installation. Test the panel and demonstrate that all equipment is operational to the inspector. Ensure termination does not exceed attenuation limits specified in standard spec 678.3.4.

D Measurement

The department will measure Fiber Optic Patch Panel by each, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.004	Fiber Optic Patch Panel	EACH

Payment is full compensation for furnishing and installing the fiber optic patch panel.

43. Pipe Bollard, Item SPV.0060.005.

A Description

This item consists of furnishing and installing a pipe bollard according to the plans.

B Materials

See Division 5 of the SWEF\Post Building General Construction for the item Pipe Bollard.

C Construction

Construct pipe bollards as detailed in building plans at locations specified in plan details.

D Measurement

The department will measure Pipe Bollard by each, acceptably completed pipe bollard located outside of the building plans.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.005	Pipe Bollard	EACH

Payment is full compensation for furnishing and installing the pipe bollard.

44. Concrete Wheel Stops, Item SPV.0060.006.

A Description

This item consists of furnishing and installing a pre-cast concrete wheel stop according to the plans and as hereafter provided.

B Materials

The precast concrete wheel stop shall conform to the following dimensions: 6-foot length, trapezoidal shape with 8-inch base, 4-inch top and 6-inch minimum height or to a substantially equivalent design meeting the approval of the engineer.

C Construction

The precast concrete parking bumper shall be anchored to the surface by driving two ¾-inch by 18-inch steel rods into the pavement or as recommended by the manufacturer.

D Measurement

The department will measure Concrete Wheel Stops by each, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.006	Concrete Wheel Stops	EACH

Payment is full compensation for furnishing and installing the Concrete Wheel Stop.

45. SWEF\Post Building, Electrical Service, Item SPV.0060.010.

A Description

This work consists of all coordination, utility coordination and work by the contractor as required to provide electric service to the site, transformers, transformer pads and two electric service laterals to the Wrightstown SWEF/Post Building according to the plans, spec, WSEC and Kaukauna Utility requirements and as hereinafter provided.

Electric service 1 - General building electric service.

Electric service 2 – Fire Pump electric service.

Electrical service Laterals shall include any conduit, wire, disconnects, CT cabinets, meter sockets, transformer pads and any other items required by the Kaukauna Electric Utility for the electric service lateral from the utility transformers to the building. Contractor will be responsible for furnishing and installing all required items for the electric service and service lateral from the transformers to the building.

B (Vacant)

C Construction

Contractor makes all arrangements and coordinates electric utility service work with Kaukauna Utilities.

The electric utility company (Kaukauna Utilities) charges will be paid for separately by the department.

Material and work covered under this item includes all other work not completed by Kaukauna Utilities but necessary for complete installation.

Costs for temporary electrical service and electricity during construction will be the responsibility of the contractor.

D Measurement

The department will measure SWEF\Post Building, Electrical Service as each individual unit, in place and acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.010	SWEF\Post Building, Electrical Service	EACH

Payment is full compensation for providing and or coordinating overhead and/or underground electric service to the site at the proposed transformer locations and from the transformers to the SWEF\Post building, for transformer pads, meters; cabinets, disconnects all required equipment to facilitate the electric services installations and all associated coordination, permits, fees, labor, material, equipment, tools, and incidentals necessary to complete the work.

46. SWEF\Post Building, Natural Gas Service, Item SPV.0060.011.

A Description

This work consists of all coordination, work by utility, and work by contractor as required to provide underground natural gas service to new SWEF\Post Building.

B (Vacant)

C Construction

Contractor makes all arrangements and coordinates natural gas utility work with Wisconsin Public Service.

Utility provides natural gas service to the project SWEF\Post Building meter location.

The natural gas utility company (Wisconsin Public Service) charges shall be paid for separately by the department.

Contractor includes all other work not completed by Wisconsin Public Service but necessary for complete installation of service to building.

D Measurement

The department will measure SWEF\Post Building, Natural Gas Service as each individual unit, in place and acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.011	SWEF\Post Building, Natural Gas Service	EACH

Payment is full compensation for providing and coordinating underground natural gas service to new SWEF\Post Building, furnishing and installing system, and associated coordination, permits, fees, labor, material, equipment, tools, and incidentals necessary to complete the work as specified herein.

47. Sanitary Sewer Manhole w/Casting 5-FT Diameter, Item SPV.0060.020.

A Description

This special provision describes furnishing and installing new sanitary sewer manholes, castings and connecting to sanitary sewer pipe, all as shown on the plans according to standard spec 611 and as provided by these specifications.

B Materials

Precast concrete riser sections and appurtenant units (top and base slab, special sections, etc.) used in the construction of manholes will conform to the requirements of ASTM C 478, subject to the following provisions.

Base section shall have a 6-inch minimum thick integral floor slab with 4-inch thickness for walls and riser sections. Base section shall be cast monolithically.

Joints of riser sections are to be tongue and groove with gasketed joints. Top cone shall be eccentric. Inlet and outlet pipes will be joined to the structure with flexible, watertight rubber boot arrangement that allows differential settlement of the pipe and manhole to take place. Connecting pipes to structures with grouting only is not acceptable. Use A-Lok Products or approved equal for pipe seals.

Provide 12 inch wide steps, which shall be polypropylene coated steel. Steps shall be manufactured by M.A. Industries, Inc. or approved equal.

Sewer castings for sewer structures such as manhole frames and covers will conform to the requirements of ASTM A48 (gray iron castings), Class 35. Lid-to-frame surfaces on round casting assemblies will be machine milled to provide true bearing around the entire circumference.

Manhole castings shall be Neenah R-1500 with non-rocking lids and 2 concealed pick holes or approved equal.

Adjustment rings must be concrete if adjustment is a minimum of 4 inches and rubber if less than 4 inches of adjustment. Rubber adjusting rings shall be Infra-Riser as manufactured by GNR Technologies or equal. A minimum of 4 inches of adjusting rings shall be used between the manhole cone and casting and set in two rows of ½ inch Butyl-Lok preformed tape or equal, conforming to AASHTO M-198. Flex-seal Utility Sealant as manufactured by Sealing Systems Inc., 9350 County Road 19 Loretto, MN 55357 shall be used for internal manhole adjustment ring and casting sealant.

C Construction

C.1 Installation

- Place manholes on a minimum of 6 inches of Soil Class A-7 compacted to 95% Modified Proctor Density.
- Establish flow line and rim elevations from grade stake provided.
- Manholes shall be precast construction, unless shown otherwise.
- Provide manhole riser sections in a combination of lengths, which will minimize the number of joints.
- Seal manhole joints with 1¼-inch Butyl-Lok preformed tape or equal, conforming to AASHTO M-198.
- Adjusting rings:
 - a. Manhole casting shall be centered, brought to grade and embedded in a ¾-inch to 1-inch bead of adjusting ring and casting sealant.
 - b. A minimum of 4 inches of adjusting rings shall be used between the manhole cone and casting, and set in two rows of ½-inch Butyl-Lok preformed tape or equal, conforming the AASHTO M-198.
 - c. All adjusting rings less than four inches shall be rubber, a maximum of 3½-inch rubber rings shall be used, set in two rows of ½-inch, Butyl-Lok preformed tape or equal, conforming the AASHTO M-198.
 - d. Two-inch concrete adjusting rings are not allowed.
 - e. For manholes located in roadways, the upper two inches shall be rubber adjusting rings.
 - f. For manholes located in traffic lanes, use tapered rubber adjusting rings.
 - g. Maximum height of adjusting rings shall be 12 inches.
 - h. Coat outside of adjusting rings only with sewer joint compound per manufacturer's instructions and wrap the exterior surface with a min. 6 mil plastic covering. When watertight castings are shown on the plans, casting shall be anchored to the manhole structure.
- Pipe shall enter manholes through a flexible, watertight gasket or connector manufactured in accordance with ASTM C443 or C923.
 - a. Whenever practical, pipe opening shall be factory made using A-Lok or equal.
- The following shall be filled with mortar and finished smooth:
 - a. Lift holes.
 - b. Annular space around pipes: Interior bottom half only.
- Internal Manhole Adjustment Ring Sealing System Installation
 - a. Remove all loose protruding mortar, concrete, or brick that would interfere with the seal's performance.
 - b. Patching cement shall conform to requirements of the manufacturer. Any profiling cement work will require the contractor to contact the sealant manufacturer to determine in writing the proper time required for the cement to completely cure prior to installing this item.
 - c. The surface shall be sandblasted (minimum of 70CFM) and an acetone wet wipe to ensure a clean surface, as required by manufacturer.
 - d. Active leaks (infiltration) shall be corrected by a method approved by the engineer prior to installing an Internal Manhole Seal.
 - e. A blower or torch may be required to completely dry the substrate surface, or as recommended by manufacturer. Flex-Seal Utility Sealant or approved equal may require the proper mixing of agents, as recommended by the manufacturer's instructions.

- f. Ensure casting and structure surfaces are clean and dry where the primer is intended to adhere. After allowing for proper drying of primer to occur, sealant may be applied by brush as evenly as possible over the entire chimney area that includes 2 inches above the frame joint area, 2 inches below the top of the manhole cone, and the area above the manhole cone, including all extensions to the chimney area.

C.2 Inverts

- Furnish precast manholes with shop manufactured inverts.
- Shape and slope flow line of invert to match largest connecting pipe.
- Slope invert bench upward to manhole wall.

D Measurement

The department will measure Sanitary Sewer Manhole w/Casting 5-FT Diameter as each unit, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.020	Sanitary Sewer Manhole w/Casting 5-FT Diameter	EACH

Payment is full compensation for excavation, backfilling, compaction, removal, and disposal of excess or unsuitable materials, manhole, casting frame and lid, adjusting rings, adjustment, mortar, gaskets, rubber boots, mortar, inside drop pipe and fittings, concrete horseshoe and/or mortar encasing drop pipe, tee for drop pipe, connection to new pipes, and other items required for a complete installation.

48. Construction Staking Sanitary Sewer, Item SPV.0060.021.

A Description

This special provision describes performing Construction Staking Sanitary Sewer according to the applicable provisions of standard spec 650.

B (Vacant)

C Construction

Set and maintain construction stakes or marks as necessary to achieve the required accuracy and to support the method of operations. Set and maintain a minimum of two construction stakes to establish location and grade of sanitary sewer structures according to the plans and details for sanitary sewer structures. Set and maintain construction stakes to establish location and grade of sanitary sewer main. Provide stakes that establish the horizontal and grade elevation of sanitary main at intervals of 25 feet for a minimum of 100 feet from each structure and at intervals of 50 feet thereafter. Determine offsets in conjunction with contractor requirements. Verify the invert elevations of existing structures which are to remain and be connected into. Locate all stakes included in this bid item to within 0.02 feet horizontally and establish the grade elevation to within 0.01 feet vertically. Place additional intermittent stakes as necessary to provide staking information at critical areas such as utility, driveway, roadway, and structure crossings.

D Measurement

The department will measure Construction Staking Sanitary Sewer as each individual construction staking sanitary sewer structure, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.021	Construction Staking Sanitary Sewer	EACH

Payment is full compensation for locating and setting all construction stakes; and for relocating and resetting damaged or missing construction stakes.

49. Sanitary Sewer Cleanout, Item SPV.0060.022.

A Description

This special provision describes furnishing and installing new sanitary sewer sanitary service cleanout between a building connection or future connection and a sewer main as shown on the plans and provided by these specifications.

B Materials

Service tee wyes shall conform to materials specifications for adjacent pipe components. Provide fittings and pipe of each material type from the same manufacturer. Provide threaded PVC plug that matches pipe material type. Cleanout riser shall extend into cast iron casting. Casting shall be Neenah R-1975-A3 or approved equal.

Light duty: In earth or grass foot-traffic areas, provide a frost sleeve for DSPS 382.35 Requirements.

Heavy Duty: In vehicle traffic areas use top loading rated heavy duty, ASME A112.36.2M, round, cast-iron housing with clamping device and round secured, scoriated cast-iron cover. Include cast-iron ferrule with inside caulk or spigot connection and countersunk, tapered-thread, brass closure plug.

Frost sleeve shall be same material as specified for sanitary sewer piping.

C Construction

The location and size of sanitary sewer services as shown on the plans are approximate. Actual locations and size may vary from what is shown.

Installation of pipe shall conform to ASTM D 2321. There shall be no mixing of different manufacturer's pipe or fittings on a project. Compact haunching area to specified density required by ASTM D2321. Pipes shall be fitted together and matched so when laid they will form a sewer with a smooth and uniform invert.

Install gaskets and forms according to manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.

Trench Excavation Requirements shall conform to specifications listed within Sanitary Sewer special provisions.

Install riser pipe so that threaded plug is into the cast iron casting when completed. Cast iron casting to be installed with concrete pavement or HMA Pavement operations depending on final location of cleanout.

All trench excavation and backfilling, including backfill material, compaction, and dewatering shall be considered incidental. All work shall be done by open trench excavation.

Record the location, size, and number of cleanouts on services on a record drawing. Measure cleanout locations from the closest downstream sewer main. Submit sanitary record drawings to the engineer and Utility upon completion of the sanitary portion of the project.

D Measurement

The department will measure Sanitary Sewer Cleanout as each individual cleanout, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.022	Sanitary Sewer Cleanout	EACH

Payment is full compensation for excavation, backfilling, compaction, removal and disposal of excess material, service tee wye, riser pipe, plug, cast iron casting, adjustment, temporary adjustments or modifications for base trimming operations, any adjustments during concrete or HMA paving operations, and other items required for a complete installation.

50. Sanitary Manhole 8-Inch Core, Item SPV.0060.023.

A Description

This special provision describes connecting to a sanitary manhole with an 8-Inch core. The work shall be performed according to the Standard Specifications for Sewer and Water Construction in Wisconsin, 6th Edition and as hereinafter provided.

B Materials

Use materials conforming to Chapter 8 of the Standard Specifications for Sewer and Water Construction in Wisconsin, 6th Edition. Provide Kor-n-Seal flexible connector, or approved equal, in the tapped hole.

C Construction

Use a portable coring drill to produce a pipe opening that is round, clean, and free of any pitting of the concrete.

Make a watertight connection of the pipe to the sewer access structure with a Kor-n-Seal-flexible connector or approved equal. In the event this is not able to be constructed, after engineer approval, a rubber gasket, such as “water stop” or approved equal, shall be placed around the new PVC sanitary sewer main, along with non-shrink patching compound around this connection.

D Measurement

The department will measure Sanitary Manhole 8-Inch Core as each individual cored structure connection, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.023	Sanitary Manhole 8-Inch Core	EACH

Payment is full compensation for furnishing and placing all materials, including all masonry, disposing of surplus material, and for cleaning out and restoring the work site.

51. Connect to Existing Water Main, Item SPV.0060.030.

A Description

This special provision describes connecting new water main to existing water main as shown on the plans. The work shall be performed according to the Standard Specifications for Sewer and Water Construction in Wisconsin, 6th Edition and as hereinafter provided.

B Materials

Use materials consistent with Water Main and Water Main Fittings sections of these special provisions.

Seal abandoned pipes with materials required in the State of Wisconsin Standard Specifications 2024 Edition.

C Construction

Connecting to Existing Water Main will conform to industry standards. Only representatives of the owner are permitted to operate valves on existing system. The contractor will give the owner at least 72-hour notice when it is necessary to take an existing water main out of service.

Disinfect all connection materials with a 50 parts per million chlorine solution.

Disruption of water service will be during a low usage period or when it is the least inconvenient to the user. The contractor will have all proper materials and equipment immediately on hand when a water main is taken out of service for connection.

Seal all existing water main pipe left in place as described and required in standard spec 204.3.3.2.

See Water Main C900 6-inch, Item SPV.0090.31 for testing.

D Measurement

The department will measure Connect to Existing Water Main as a unit per each, regardless of size, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.030	Connect to Existing Water Main	EACH

Payment is full compensation for cutting existing water main, removing any plugs or pipe, connecting to existing water main, furnishing and placing all materials, including any required connecting sleeves and fittings; sealing any existing pipe left in place, and other items required for a complete installation.

52. Gate Valve and Box 6-inch, Item SPV.0060.031; Gate Valve and Box 8-inch, Item SPV.0060.032.

A Description

This work shall consist of furnishing and installing water main gate valves and valve boxes. The work shall be performed according to the Standard Specifications for Sewer and Water Construction in Wisconsin, 6th Edition and as hereinafter provided.

B Materials

Gate valves are to be resilient-seated valves meeting the requirements of A.W.W.A. Standard C515 and shall be designed for 200 psi working pressure. Manufacturer shall be American Flow Control Series 2500, or equal.

The gate valve body and bonnet shall be epoxy coated inside and out, conforming to AWWA C550. All bonnet bolts shall be Type 304 stainless steel. All stainless steel threads shall be coated with anti-seize compound prior to assembly.

Resilient encapsulating wedge valve shall be used in water main sizes 4-inch through 12-inch and waterway shall be smooth with no cavities or depressions in seat area. Valves shall open counter-clockwise and stem shall be non-rising.

Valve boxes shall be cast iron, three-piece, screw-type – Cast Iron with 5 ¼-Inch diameter shaft. Manufacturer shall be Clow, Tyler, Sigma, or equal. Lid shall be diameter drop type, anti-rattle and marked "Water." The base shall be round or oval, sized to fit valve. Provide valve box hangers and the manufacturer shall be Adaptor Inc. or equal.

C Construction

Set valves with stems vertical and plumb on subgrade material adequate to support valve assembly. Place concrete block under valve and firmly support valve boxes and maintain them center and plumb over the wrench nut of the valve utilizing adaptor. Verify that box remains plumb and centered during backfill, with box cover adjusted to the final surface or at such other level as may be directed. See detail in plans.

D Measurement

The department will measure Gate Valve and Box (size) as each individual valve, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.031	Gate Valve and Box 6-inch	EACH
SPV.0060.032	Gate Valve and Box 8-inch	EACH

Payment is full compensation for excavating, backfilling, dewatering, valve box and cover, gate valve adaptor, sheeting, polyethylene sheeting, shoring, for furnishing and installing gate valves, adjusting valve box height, for furnishing and installing bolts, nuts, and gaskets, and other items required to complete the work.

53. Remove and Replace Hydrant, Item SPV.0060.033.

A Description

This special provision describes removing the existing hydrant and furnishing and installing new fire hydrant, connecting couplings, crushed rock, polyethylene sheeting, concrete base, and blocking, all as shown on the plans. The work shall be performed according to the Standard Specifications for Sewer and Water Construction in Wisconsin, 6th Edition and as hereinafter provided.

B Materials

Fire hydrants are to meet the requirements of AWWA Standard C502. Hydrants shall be Waterous Pacer WB67 or approved equal by the village or engineer. The hydrants shall have two 2 1/2-inch hose connections and one 4.5-inch steamer connection with national standard threads and caps and chains. Hydrants shall have a 16-inch traffic breakoff. Hydrants shall open left and be provided with a drain to operate only when the hydrant is closed.

Hydrants will have a 6-inch mechanical joint hub with ASTM F593 and F594 type 304 stainless steel bolts and nuts, dry barrel with minimum 5 1/4-inch valve, an "O" ring stem seal, and pentagon nut type nozzle cups complete with chains, and have minimum 7.0 feet of cover above the top of the hydrant lead pipe to finished surrounding surface. Hydrants shall be painted red and include permanent markings with manufacturer's name, year of manufacture, and bury depth. Hydrants shall have minimum 250 psi working pressure and red in color. Hose nipples shall be bronze or non-corrosive. Operating stem nuts shall be 1 1/2 inches, from point to opposite flat and pentagon shaped.

Thrust blocks shall be constructed of concrete having a minimum 28-day compressive strength of 2,000 psi. Hardwood blocking may be used, if approved by the engineer. The minimum cement content shall be 4½ bags of cement per cubic yard of concrete. The allowable slump shall be 4 to 5 inches.

Cathodic test box shall have a cast iron rim and lid with terminal blocks, 2.5-inch shaft diameter, and a minimum 24 inches long ABS plastic body and flared base. Lid shall say water.

C Construction

Contact the Village of Wrightstown Water Utility 48 hours in advance of removing existing hydrant.

Locate fire hydrants as indicated in the plans, or as directed by the Village or engineer, and place as shown on the details of the plans. Verify that subgrade material is adequate to support hydrant and place thrust block according to drawing details. Hydrant leads shall be 6-inch minimum pipe diameter. Contractor may substitute ductile iron pipe Class 52 as hydrant leads, in lieu of C900 PVC upon approval by engineer and Village. If ductile iron pipe is used, pipe cost per linear foot shall be paid at the equivalent C900 bid price. Install and maintain hydrant in a plumb position with a block under the base.

Hydrants shall be located as shown or as required to provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians. When placed behind the curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than 18 inches nor more than 24 inches from the gutter face of the curb, unless otherwise shown on drawing details. When placed behind the curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than 18 inches nor more than 24 inches from the gutter face of the curb, unless otherwise shown on drawing details. All hydrants shall stand plumb within ¼-inch, 3 feet in all directions, and shall have their nozzles parallel with, or at right angles to the curb, with the pumper nozzle facing the curb, except that hydrants having two hose nozzles 90 degrees apart shall be set with each nozzle facing the curb at an angle of 45 degrees. Hydrants shall be set to the established grade, with nozzles at least 18 inches above the ground as shown or as required by the engineer.

Drainage shall be provided by placing crushed stone around the hydrant as shown on the detail. The minimum amount of crushed stone shall be 6 inches above the waste opening in the hydrant, and 1 foot around the hydrant.

Disinfect and test hydrants in conjunction with and as part of the mainline disinfection and testing process. Install tracer wire upside of hydrant and into cathodic test box. Cathodic test box shall be connected to the barrel of the hydrant and have the tracer wire connected to the terminal with a minimum of 1 foot of slack in the tracer wire inside the ABS plastic body. Use Cobra Access Point or equal on hydrants. See detail in plans.

Plug hydrant drain hole if hydrant is located where the groundwater is less than 8 feet. Also label hydrant with tag stating "Pump After Use."

D Measurement

The department will measure Remove and Replace Hydrant per each, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.033	Remove and Replace Hydrant	EACH

Payment is full compensation for removal of existing hydrant; for furnishing and placing all materials, including hydrant, crushed rock and concrete base, polyethylene sheeting, cathodic test box, block, and other items required for a complete installation.

54. Furnish and Install Hydrant, Item SPV.0060.034.

A Description

This special provision describes furnishing and installing new fire hydrant, connecting couplings, crushed rock, polyethylene sheeting, concrete base, and blocking, all as shown on the plans. The work shall be performed according to the Standard Specifications for Sewer and Water Construction in Wisconsin, 6th Edition and as hereinafter provided.

A minimum 7.5 feet of cover above the top of the hydrant lead pipe to finished surrounding surface is required.

B Materials

Fire hydrants are to meet the requirements of AWWA Standard C502. Hydrants shall be Waterous Pacer WB67 or approved equal by the village or engineer. The hydrants shall have two 2 1/2-inch hose connections and one 4.5-inch steamer connection with national standard threads and caps and chains. Hydrants shall have a 16-inch traffic breakoff. Hydrants shall open left and be provided with a drain to operate only when the hydrant is closed.

Hydrants will have a 6-inch mechanical joint hub with ASTM F593 and F594 type 304 stainless steel bolts and nuts, dry barrel with minimum 5 1/4-inch valve, an "O" ring stem seal, and pentagon nut type nozzle cups complete with chains, and have minimum 7.5 feet of cover above the top of the hydrant lead pipe to finished surrounding surface. Hydrants shall be painted red and include permanent markings with manufacturer's name, year of manufacture, and bury depth. Hydrants shall have minimum 250 psi working pressure and red in color. Hose nipples shall be bronze or non-corrosive. Operating stem nuts shall be 1 1/2 inches, from point to opposite flat and pentagon shaped.

Thrust blocks shall be constructed of concrete having a minimum 28-day compressive strength of 2,000 psi. Hardwood blocking may be used, if approved by the engineer. The minimum cement content shall be 4½ bags of cement per cubic yard of concrete. The allowable slump shall be 4 to 5 inches.

Cathodic test box shall have a cast iron rim and lid with terminal blocks, 2.5-inch shaft diameter, and a minimum 24 inches long ABS plastic body and flared base. Lid shall say water.

C Construction

Locate fire hydrants as indicated in the plans, or as directed by the Village or engineer, and place as shown on the details of the plans. Verify that subgrade material is adequate to support hydrant and place thrust block according to drawing details. Hydrant leads shall be 6-inch minimum pipe diameter.

Contractor may substitute ductile iron pipe Class 52 as hydrant leads, in lieu of C900 PVC upon approval by engineer and Village. If ductile iron pipe is used, pipe cost per linear foot shall be paid at the equivalent C900 bid price. Install and maintain hydrant in a plumb position with a block under the base.

Hydrants shall be located as shown or as required to provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians. When placed behind the curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than 18 inches nor more than 24 inches from the gutter face of the curb, unless otherwise shown on drawing details. When placed behind the curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than 18 inches nor more than 24 inches from the gutter face of the curb, unless otherwise shown on drawing details. All hydrants shall stand plumb within ¼-inch, 3 feet in all directions, and shall have their nozzles parallel with, or at right angles to the curb, with the pumper nozzle facing the curb, except that hydrants having two hose nozzles 90 degrees apart shall be set with each nozzle facing the

curb at an angle of 45 degrees. Hydrants shall be set to the established grade, with nozzles at least 18 inches above the ground as shown or as required by the engineer.

Drainage shall be provided by placing crushed stone around the hydrant as shown on the detail. The minimum amount of crushed stone shall be 6 inches above the waste opening in the hydrant, and 1 foot around the hydrant.

Disinfect and test hydrants in conjunction with and as part of the mainline disinfection and testing process. Install tracer wire upside of hydrant and into cathodic test box. Cathodic test box shall be connected to the barrel of the hydrant and have the tracer wire connected to the terminal with a minimum of 1 foot of slack in the tracer wire inside the ABS plastic body. Use Cobra Access Point or equal on hydrants. See detail in plans.

Plug hydrant drain hole if hydrant is located where the groundwater is less than 8 feet. Also label hydrant with tag stating "Pump After Use."

D Measurement

The department will measure Furnish and Install Hydrant per each, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.034	Furnish and Install Hydrant	EACH

Payment is full compensation for furnishing and placing all materials, including hydrant, crushed rock and concrete base, polyethylene sheeting, cathodic test box, block, and other items required for a complete installation.

55. Construction Staking Water Main, Item SPV.0060.035.

A Description

This special provision describes performing Construction Staking Water Main according to the applicable provisions of standard spec 650.3.2 and 650.3.6.

B (Vacant)

C Construction

Set and maintain construction stakes and marks as necessary to achieve the required accuracy and to support the method of operations. Set and maintain construction stakes to establish location of water mains and fittings. Provide stakes at 25-foot intervals to 100 feet from valves, the 50-foot intervals at any bends that are to be constructed. Locate all stakes included in this bid item to within 0.02 feet horizontally to 0.01 feet vertically.

Place additional intermittent stakes as necessary to provide staking information at critical areas such as utility, driveway, roadway, and structure crossing.

D Measurement

The department will measure Construction Staking Water Main as a single complete unit of work, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.035	Construction Staking Water Main	EACH

Payment is full compensation for locating and setting all construction stakes; for relocating and resetting damaged or missing construction stakes.

56. Maintain Water Service During Construction, Item SPV.0060.036.

A Description

This special provision describes maintaining water service to all collective customers (businesses and residences) throughout the construction project, as a single item covering all phases and portions of work, for the entire duration of the project.

B Materials

Use materials consistent with Water Main and Water Main Fittings sections of these special provisions and the details shown in the plans.

C Construction

Contractor to maintain continuous water service to all businesses and residences during construction whether using the existing water main and services or setting up one or more temporary water systems that receive the approval of the Village of Wrightstown. Safe water samples shall be taken of the temporary water lines prior to placing them in service, matching the requirements of the Water Main specification.

D Measurement

The department will measure Maintain Water Service During Construction as each unit per project, acceptably completed. Item will be measured as one total unit for the entire project, regardless of number of connections, setups, phases, or time duration necessary for maintaining water service throughout the total period of construction.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.036	Maintain Water Service During Construction	EACH

Payment is full compensation for connecting to existing water main, cutting pipes, providing and installing fittings and adaptors, connections, temporary accommodations, coordination, excavations, backfilling, compaction, piping, removals, maintenance, pedestrian accommodations, Village and resident communication, testing, and other items required to complete the installation and successfully maintain continuous water service to all customers throughout construction.

57. Lighted Bollard, Item SPV.0060.050.

A Description

This special provision describes furnishing and installing bollard lighting assemblies as shown in the plans. This work shall be according to the plans and as hereinafter provided.

B Materials

Lighted bollard shall conform to the following requirements:

- Bollards shall be a minimum of 36-inches tall.
- Maximum diameter of 19-inches.
- Reinforced shaft to prevent knockdowns from minor collisions.
- Maximum of 50W.
- Output between 1,000 and 2,500 lumens.
- 4K color temperature.
- Optical I.P. Rating of 65 or greater.
- All components U.L. listed for wet locations.

Furnish a complete list of documentation according to standard spec 651.2 and the following requirements. Furnish the following list of documentation detailing the characteristics of the decorative light units:

- Engineer's verification showing the light pole and concrete foundation design criteria.
- Graphical depiction showing verification of the light unit arrangement and all accessories are in the correct orientation.
- Light pole color and finish sample.
- Paint finish durability information.
- Cut sheets, warranty information and parts list for all equipment.

C Construction

According to the plans and standard spec 657 and manufacturer requirements.

D Measurement

The department will measure Lighted Bollard as each individual installation, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.050	Lighted Bollard	EACH

Lighted Bollard is full compensation for furnishing all materials and installing a complete unit as described above.

58. SWEF\Post Building, General Construction, Item SPV.0060.100.

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SECTION 00 72 10 – General Conditions

PART 1 – GENERAL

1.1 GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

- A. “General Conditions of the Contract for Construction,” AIA Document A201, 2017 Edition, is hereby made a part of this Project Manual, except as amended by Document 00 73 10 (Supplementary Conditions) and may be obtained at the AIA website: www.AIA.org or seen at the office of the Architect.
- B. Should any provision conflict with the owner’s “Request for Bid” and “Standard Terms and Conditions”, the more stringent requirement will apply.

END OF SECTION 00 72 10

END OF DIVISION 00 - CONTRACTING REQUIREMENTS

DIVISION 01 – GENERAL REQUIREMENTS

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SECTION 01 11 00 – Summary of Work

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Work included in Contract Documents.
 - 2. Federal Bidding Requirements.
 - 3. Focus on Energy Requirements.
 - 4. Work Sequence.
 - 5. Contractor Use of Premises.
 - 6. Occupancy Requirements.
 - 7. Products Ordered in Advance.
 - 8. Owner Furnished Products.
 - 9. Work Restrictions.

1.2 DEFINITIONS

- A. "Primary Contractor", "General Contractor", and "Lead Contractor": Refers to the General Building Contractor, who is responsible for the work described in Divisions 1-33.
- B. "Standard Specifications": Refers to the State of Wisconsin, Department of Transportation, Standard Specifications for Highway and Structure Construction, Edition of 2024.
- C. "Roadway Special Provisions": Refers to the requirements for the roadway portion of the project.
- D. "Building Specifications": Refers to the building specifications Divisions 1-33.

1.3 WORK INCLUDED IN CONTRACT DOCUMENTS

- A. Description of the Building Project:
 - 1. This project is a new, two story, 34,262 SF building for the Wisconsin State Patrol and Safety and Weight Enforcement Facility (SWEF) departments, to be located near Wrightstown, Wisconsin. The building will include both SWEF and Regional State Patrol Post functions including, but not limited to: vehicle inspections, inspection operations, vehicle maintenance garage, telecom operations, dispatch, law enforcement administrative offices, training classrooms, conference rooms, evidence storage and various support spaces. The general public will have 24-hour access to the south vestibule and associated toilet rooms, and limited access to the rest of the facility.

1.4 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.

1.5 FOCUS ON ENERGY REQUIREMENTS

- A. This project has been approved by the Focus on Energy Program. Refer to Section 01 33 00 Submittal Procedures and Section 01 60 00 Product Requirements for more information.

1.6 WORK SEQUENCE

- A. The Work sequence for Divisions 1 through 33 will be the General Building Contractor's responsibility to coordinate with the owner, the E/A, and all required trades.

1.7 PERMITS

- A. Local building permits shall be the responsibility of the General Building Contractor.

1.8 CONTRACTOR USE OF PREMISES

- A. Confine operations at Site to areas permitted under contract or as directed by Owner or E/A.
- B. Conform to site rules and regulations affecting Work while engaged in Project construction.
- C. Construction personnel may park only in areas designated by the Owner.
- D. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor air intakes.
- E. Damaged Property:
 - 1. Patch and/or clean existing improvements and restore damage of property on, or adjacent to Site occasioned by this Work, including, but not limited to, lawns, walks, curbs, pavements, roadways, structures, and utilities which are cut or damaged by operations and are not designated for removal, relocation, or replacement in the course of construction.

2. Public Property or Utilities: Comply with laws, ordinances, rules, regulations, standards, orders of utility owner or any public authority having jurisdiction.
3. Provide written acceptance of restoration work by authority or Owner.

F. Building Security

1. During construction or until such time as the keys to the project have been turned over to the Owner, the General Building Contractor shall be responsible for the security of the project.
2. The General Building Contractor shall give full cooperation to the Owner, E/A, and all other Prime Contractors working on the project for entry into the project during normal working week.
3. An accurate record of persons entering and leaving the site shall be available to the Owner and E/A at any time.

1.9 OCCUPANCY REQUIREMENTS

A. General Requirements:

1. Cooperate with Owner to minimize conflict and to facilitate Owner's operations, if any.
2. Schedule the Work to accommodate this requirement.
3. Coordinate activities which could cause interruption to Owner's activities.
4. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
5. Owner will occupy some portion of the premises near the end of the construction period, with the exception of areas under construction.
 - a. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities, unless receiving written permission from Owner and authorities having jurisdiction.
 - b. Maintain existing exits, unless otherwise indicated.

B. Owner Occupancy of Completed Areas of Construction:

1. Owner reserves the right to place and install equipment as necessary in completed areas of the facilities and to occupy such completed areas prior to Substantial Completion according to the Supplementary Conditions. Such use shall not constitute acceptance of such portions of the Work or relieve the General Building Contractor of any obligations except for improper use or damage caused by employees or agents of Owner.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
3. Mechanical and electrical systems shall be fully operational and required tests and inspection successfully completed.
4. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of building.
5. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.10 PRODUCTS ORDERED IN ADVANCE

A. Storage:

1. Products will be allowed to be stored at the Site prior to commencement of construction activities.
2. General Building Contractor shall store such items as directed by Owner.

1.11 OWNER FURNISHED PRODUCTS

- A. Items furnished by Owner will be identified in the Drawings and/or the Specifications.
- B. Refer to Section 01 64 00 Owner-Furnished Products for more information.
- C. Owner's Responsibilities:
 - 1. Arrange for, and deliver Owner reviewed Shop Drawings, Product Data and samples to General Building Contractor.
 - 2. Arrange and pay for product delivery to Site in a timely manner to avoid delays to the project schedule.
 - 3. At time of delivery, inspect products jointly with General Building Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for manufacturer's warranties, inspections, and service.
- D. General Building Contractor's Responsibilities:
 - 1. Confirm and coordinate purchases with Owner to ensure timely delivery and avoid delays to the project schedule.
 - 2. Review Owner reviewed Shop Drawings, Product Data and samples.
 - 3. Receive and unload products at Site; inspect for completeness or damage, jointly with Owner.
 - 4. Provide support systems to receive Owner's equipment.
 - 5. Protect Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
 - 6. Install and otherwise incorporate Owner-furnished items into the Work.
 - 7. Repair or replace items damaged after receipt, except that damage caused by Owner's employees or agents.

1.12 WORK RESTRICTIONS

- A. On-Site Work Hours:
 - 1. Normal business working hours of 7:00 AM to 7:00 PM Monday through Friday.
 - 2. Weekend hours: As coordinated with the A/E and Owner and Owner.
 - 3. Hours for utility shutdowns: As coordinated with the Owner.
 - 4. Hours for core drilling or noisy activity: As coordinated with the Owner.
- B. Existing Utility Interruption:
 - 1. Do not interrupt utilities serving facilities occupied by Owner or others without written permission by A/E.
 - 2. Notify A/E not less than 3 days in advance of proposed utility interruptions.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01 11 00

SECTION 01 25 13 – Product Substitution Procedures

PART 1 – GENERAL

1.1 SUMMARY

- A. Administrative and procedural requirements for handling requests for substitutions for the BUILDING portion of this contract only. Refer to “Submittals” in the Roadway Special Provisions for non-building substitutions.
- B. All substitution requests during pre-bid must be submitted per FDM Procedure 19-22-5 using the Question and Answer (Q/A) feature within the Bid Express website (www.bidx.com).
- C. The following is not included in this Section:
 - 1. Procedural requirements governing contractor's selection of product options (refer to Section 01 60 00 Product Requirements).

1.2 DEFINITIONS

- A. Definitions used in this Article are not intended to change or modify the meaning of other terms used in the Contract Documents.
- B. Substitutions: Requests for changes in products, materials, equipment and methods of construction required by Contract Documents proposed by contractor.
- C. The following are not considered substitutions:
 - 1. Revisions to Contract Documents requested by Owner or E/A.
 - 2. Specified options of products and construction methods included in Contract Documents.
 - 3. Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.3 SUBMITTALS

- A. Substitution Request Prior to Bid:
 - 1. Substitution Requests are allowed prior to bid and shall meet the provisions of this Section and Section 01 33 00 - Submittal Procedures.
- B. Substitution Request After Bid: Requests for substitution will be considered if received within 60 days after commencement of the work. Requests received more than 60 days after commencement of the work may be considered or rejected at the discretion of E/A.
 - 1. Submit 3 copies of each request for substitution for consideration. Submit requests in the form and according to procedures required for change order proposals.
 - 2. Identify the product, or the fabrication or installation method to be replaced in each request. Include related specification section and Drawing numbers.
 - 3. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:
 - a. Product data, including drawings and descriptions of products, fabrication, and installation procedures.
 - b. Samples, where applicable or requested.
 - c. A detailed comparison of significant qualities of the proposed substitution with those of the work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.
 - d. Coordination information, including a list of changes or modifications needed to other parts of the work and to construction performed by Owner and separate contractors, that will become necessary to accommodate the proposed substitution.

- e. A statement indicating the substitution's effect on contractor's construction schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall contract time.
- f. Cost information, including a proposal of the net change, if any in the contract sum.
- g. Certification by the contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated.
- h. Include contractor's waiver of rights to additional payment or time, which may subsequently become necessary because of the failure of the substitution to perform adequately.

C. Substitution Conditions:

1. Contractor's substitution request will be received and considered by E/A when one or more of the following conditions are satisfied, as determined by E/A, otherwise requests will be returned without action except to record noncompliance with these requirements:
 - a. Extensive revisions to Contract Documents are not required.
 - b. Proposed changes are in keeping with the general intent of Contract Documents.
 - c. The request is timely, fully documented and properly submitted.
 - d. Contractors and suppliers will be expected to provide the specified product unless prior approval is received from E/A's office in sufficient time so that all bidders can be notified through an addendum.
 - e. The specified product or method of construction cannot be provided within the contract time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the work promptly or coordinate activities properly.
 - f. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
 - g. A substantial advantage is offered to Owner, in terms of cost, time, energy conservation, or other considerations of merit, after deducting offsetting responsibilities Owner may be required to bear. Additional responsibilities for Owner may include additional compensation to E/A for redesign and evaluation services, increased cost of other construction by Owner, or separate contractors, and similar considerations.
 - h. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where contractor certifies that the substitution will overcome the incompatibility.
 - i. The specified product or method of construction cannot be coordinated with other materials, and where contractor certifies that the proposed substitution can be coordinated.
 - j. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where contractor certifies that the proposed substitution provides the required warranty.
 - k. Where a proposed substitution involves more than one prime contractor, each contractor shall cooperate with the other contractors involved to coordinate the work, provide uniformity and consistency, and to assure compatibility of products.

- D. Limitations: Contractor's submittal and E/A's acceptance of Shop Drawings, Product Data, or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.
- E. Substitution Causing Redesign: E/A time for redesign as a result of substitution, will be charged to Owner, then deducted by Construction Change Directive from Contract Amount.
- F. E/A's Action:
 - 1. Request Prior to Bid or After Bid:
 - a. If necessary, E/A will request additional information or documentation necessary for evaluation of the request.
 - b. E/A will notify contractor of acceptance or rejection of the proposed substitution.
 - c. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the product specified by name.
 - d. Acceptance will be in the form of a change order.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

SUBSTITUTION REQUEST FORM

TO:

PROJECT: _____

SECTION NO.	ARTICLE NO.	SPECIFIED PRODUCT	PROPOSED SUBSTITUTION
_____	_____	_____	_____

- A. Does the substitution affect dimensions shown on Drawings? Yes ☐ No ☐
- B. Does the substitution affect other trades? Yes ☐ No ☐
- C. Does the manufacturer's guarantee differ from that specified? Yes ☐ No ☐
- D. If you indicated "Yes" to Items A, B, or C above, attach a thorough explanation on your company letterhead.
- E. If there are other differences between proposed substitution and specified product, attach a thorough explanation on your company letterhead. If differences are not noted and acknowledged in writing by E/A, product must comply with specification requirements.
- F. The proposed substitution was used within the last 24 months on the following project:
- Project Name _____
- Location _____
- E/A _____
- Telephone No. _____

All questions must be answered. Incomplete forms will not be reviewed.

Include a self-addressed, stamped envelope for reply.

Submitted By: _____

Signature

Firm

Address

Date

Phone

E-mail

For Use by Design Consultant

- ☐ Not Accepted, Not Enough Information
- ☐ Not Accepted, Does Not Appear to be Equal
- ☐ Accepted ☐ Accepted as Noted
- ☐ Received Too Late

By _____

Date _____

Remarks _____

END OF SECTION 01 25 13

SECTION 01 31 13 – Coordination

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Project Coordination
 - 2. Job Site Administration

1.2 COORDINATION BY GENERAL BUILDING CONTRACTOR

- A. Coordinate use of premises under general direction of E/A per the Owner.
- B. Coordinate scheduling, submittals, and Work to ensure efficient and orderly sequence of installation.
 - 1. Coordinate activities for mutual benefit and cooperate to facilitate the general progress of the Work.
 - 2. Each subcontractor shall be thoroughly familiar with all provisions governing the Work of other contractors and shall obtain from such contractors all information as may be required to coordinate Work with theirs.
 - 3. Each trade shall perform its Work in proper sequence and arrangement in relation to other activities and shall join his Work to that of others according to the intent of the Drawings and specifications.
 - 4. Each trade shall give due notice and proper information for any special provisions necessary in the placing or setting of Work that may come in contact with Work of other contractors.
- C. Inspect the Contract Documents for the Work of others that is inter-related and afford other trades every reasonable opportunity for the installation of their Work. Coordinate Work of various specification sections having interdependent responsibilities.
- D. Prepare coordination drawings where off-site fabricated products and materials are by separate entities and must accurately interface. Coordination drawings shall indicate how Work, shown by separate Shop Drawings, will interface and shall indicate sequence for installation. Contractors must supply shop drawings, if contractor fails to supply shop drawings/ fabrications drawings to the E/A, \$500 per missing drawing will be deducted from the total contract amount.
- E. Coordinate space requirements and installation of mechanical and electrical Work.
 - 1. Follow routing shown for pipes, ducts, and conduit as closely as practicable; place runs parallel with line of building.
 - 2. Utilize space efficiently to maximize accessibility for other installations, maintenance, and repairs.
 - 3. Conceal pipes, ducts, and wiring within the construction in finished areas, except as otherwise indicated.
 - 4. Coordinate locations of fixtures and outlets with finish elements.
 - 5. All final decisions as to the right-of-way and run of interfering pipes, ducts, etc., shall be made by E/A at Project meetings.

1.3 JOB SITE ADMINISTRATION

- A. Supervise and direct the Work. Employ and maintain a full time, qualified supervisor or superintendent to act as contractor's representative at the Site.
- B. Enforce good order and conduct among contractors, installers, and construction employees.
- C. Require installers to inspect conditions under which Work is to be performed. Installer shall report all unsatisfactory conditions in writing to contractor. Do not proceed with Work until unsatisfactory conditions have been corrected.

- D. Where installations include manufactured products, comply with manufacturer's applicable instructions and recommendations for installation to the extent that these instructions and recommendations are more explicit or more stringent than requirements indicated in the Contract Documents. Where manufacturer provides contradictory instructions, notify E/A immediately and request clarifications.
- E. Recheck measurements and dimensions of the Work, as an integral step of starting each installation.
- F. Coordinate enclosure of Work with required inspections and tests, so as to minimize necessity of uncovering Work for that purpose.
- G. Where mounting heights are not indicated, mount individual units of work at industry recognized standard mounting heights for the particular application indicated. Refer questionable mounting height choices to E/A.
- H. Supervise performance of the Work to ensure that none of the Work, whether completed or in progress, will be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- I. Clean and perform maintenance as frequently as necessary throughout construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Coordinate completion and clean-up of the Work.

1.4 SUBMITTALS

- A. Provide listing of contractor's principal staff assignments and consultants, including name, work address, and work, cell, and home telephone numbers.
- B. Provide the supervisor's or superintendent's name, work address, and work, cell, and home telephone numbers.
- C. Provide names, work address, telephone numbers, samples of signature, and limits of authority of each individual authorized to sign change orders, field modifications, and monthly pay requests for contractor.

1.5 FIELD CONDITIONS

- A. Before ordering material or commencing Work, check and verify all dimensions and conditions. Notify E/A of any omissions or discrepancies immediately.
- B. Field measurements shall be furnished in a timely manner to suppliers and fabricators who require them to complete their Work. Ascertain the requirement for such measurements at the earliest practical date and make every reasonable effort to expedite the affected Work.
- C. Conflicts: E/A has exercised reasonable professional care to ensure there are no conflicts between the Work of the various trades. Such conflicts, however, may exist and no warranty to the contrary is made or implied.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01 31 13

SECTION 01 31 19 – Project Meetings

PART 1 – GENERAL

1.1 SUMMARY

A. Procedures for Administration of Project Meetings:

1. Preconstruction Conference
2. Progress Meetings
3. Preinstallation Conferences

B. Related Sections:

1. Section 01 31 13 - Coordination
2. Section 01 33 00 - Submittal Procedures

1.2 PRECONSTRUCTION/SITE MOBILIZATION CONFERENCE

A. Scheduled by Contractor at Site after Notice of Award, prior to commencement of construction for:

1. Execution of Owner-Contractor Agreement and exchange of preliminary submittals if not previously completed.
2. Clarification of Owner and Contractor responsibilities in use of the Site and review of administrative procedures.

B. Attendees: Owner, A/E, Consultants, Contractors, major subcontractors, other concerned parties represented by persons familiar with and authorized to conclude matters relating to Work.

C. Agenda:

1. Items of significance that could affect progress including, but not limited to:
 - a. Submittal of executed bonds and insurance certificates.
 - b. Execution of Owner-Contractor Agreement if not previously completed.
 - c. Distribution of Contract Documents.
 - d. Use of premises by Owner and Contractor:
 - 1) Owner's requirements and occupancy.
 - 2) Construction facilities provided by Owner (if any).
 - 3) Temporary utilities provided by Owner (if any).
 - 4) Use of premises office, work, and storage areas.
 - 5) Parking.
 - e. Security and housekeeping procedures.
 - f. Submittals:
 - 1) Final list of subcontractors, suppliers, products.
 - 2) Schedule of Values.
 - 3) Progress Schedule. 2 week look ahead and 4 week look ahead schedules.
 - 4) Designation of responsible personnel:
 - a) Contractor's principal staff and consultants.
 - b) Contractor's superintendent or job foreman acting as Contractor's Site representative.
 - c) Owner's and Contractor's designated individuals authorized to sign Change Orders, field modifications, and monthly pay requests.

- g. Procedures for processing:
 - 1) Field decisions.
 - 2) Submittals:
 - a) Shop Drawings.
 - b) Product Data.
 - c) Samples.
 - 3) Substitutions.
 - 4) Applications for Payments.
 - 5) Proposal requests.
 - 6) Change Orders.
 - 7) Contract Closeout.
- h. Schedules:
 - 1) Tentative construction schedule.
 - 2) Critical Work sequencing.
 - 3) Progress meetings.
 - 4) Shut down of current owner operation need to be scheduled 72 hours prior to planned shut down.
- i. Procedures for testing.
- j. Equipment Deliveries and Priorities.
- k. Procedures for maintaining Record Documents.
- l. Requirements for startup of equipment: Inspection and acceptance of equipment put into service during construction period.
- m. Equipment deliveries and priorities.
- n. Security.
- o. Contractor responsibilities:
 - 1) Safety procedures.
 - 2) First aid.
 - 3) Progress Cleaning.
 - 4) Working Hours.

1.3 PROGRESS MEETINGS

- A. Contractor:
 - 1. The contractor will schedule and administer weekly construction progress meetings throughout progress of Work. The contractors shall make themselves, or a designee, available to attend the Project Meetings, unless specifically excused by the contractor.
- B. Attendees:
 - 1. Contractor, job superintendent, subcontractors and suppliers, other entity concerned with current progress or involved in planning, coordination or performance of future activities; Owner, A/E, professional consultants as appropriate to agenda.
 - 2. Attendees shall be familiar with Project and authorized to conclude matters relating to progress.

- C. Agenda:
1. Items of significance that could affect progress, including topics for discussion as appropriate to current status of Project, minimally:
 - a. Approval of minutes of last meeting.
 - b. Review of Work progress.
 - c. Field observations, problems and decisions.
 - d. Identifications of problems which impede planned progress.
 - e. Review of submittal schedule and status of submittals.
 - f. Review of off-site fabrication and delivery schedules.
 - g. Maintenance of progress schedule.
 - h. Corrective measures to regain projected schedules.
 - i. Planned progress during succeeding Work period.
 - j. Coordination of projected progress.
 - k. Maintenance of quality and work standards.
 - l. Effect of proposed changes on progress schedule and coordination.
 - m. Other business relating to Work.

1.4 PREINSTALLATION CONFERENCES

- A. When required in individual specification sections, or as requested by contractor, convene a preinstallation conference at Site prior to commencing Work of the Section.
- B. Attendees: Require attendance of entities directly affecting, or affected by, Work of the Section, including manufacturer's representative.
- C. Notification: Notify A/E 4 days in advance of meeting date.
- D. Items to note at Preinstallation Conferences:
 1. Review conditions of installation.
 2. Review preparation and installation procedures.
 3. Coordinate with related Work.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01 31 19

SECTION 01 32 16 – Progress Schedules

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Format
 - 2. Content
 - 3. Revisions to Schedules
 - 4. Submittals
- B. Related Sections:
 - 1. Section 01 11 00 - Summary of Work
 - 2. Section 01 33 00 - Submittal Procedures

1.2 FORMAT

- A. Prepare schedules as a horizontal bar chart with separate bar for each major portion of Work or Operation, identifying first workday of each week.
- B. Sequence of Listings: The Table of Contents of this Project Manual. The chronological order of the start of each item of work.
- C. Scale and Spacing: To provide space for notations and revisions.
- D. Sheet Size: Minimum 11 by 17 inches. Multiples of 8-1/2 by 11 inches.

1.3 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Identify Work of separate stages, separate floors, and other logically grouped activities.
- D. Provide sub-schedules to define critical portions of the entire schedule.
- E. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- F. Provide separate schedule of submittal dates for Shop Drawings, Product Data, and Samples, including Owner furnished products and products identified under Allowances, and dates reviewed. Submittals will be required from E/A. Indicate decision date for selection of finishes.
- G. Indicate delivery dates for Owner furnished products and products identified under Allowances.

1.4 REVISIONS TO SCHEDULES

- A. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
- B. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
- C. Provide narrative report to define problem areas, anticipated delays, and impact on schedule. Report corrective action taken, or proposed, and its effect including the effect of changes on schedules of separate contractors.

1.5 SUBMITTALS

- A. Submit initial schedules within 10 days after date of Notice to Proceed. After review, resubmit required revised data within 10 days.
- B. Submit revised Progress Schedule with every other Application for Payment.
- C. Submit 4 copies which will be retained by E/A.

- D. Distribute copies of reviewed schedules to Site file, subcontractors, suppliers, and other concerned parties.
- E. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01 32 16

SECTION 01 33 00 – Submittal Procedures

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative submittals.
 - a. Certificate of Insurance.
 - b. Performance and Payment Bonds.
 - c. Contractors and Materials List.
 - d. Construction Progress Schedule.
 - e. Submittal Schedule.
 - f. Schedule of Values.
2. Design submittals including:
 - a. Product data.
 - b. Shop drawings.
 - c. Samples.
 - d. Design Data.
 - e. Test Reports.
3. Quality control submittals.
 - a. Statement of Qualification.
 - b. Statement of Compliance.
 - c. Professional Certification.
 - d. Quality Control.
4. Focus on Energy submittals.
5. Contract closeout submittals.
6. Procedure for submitting, reviewing, and resubmitting.

1.2 ADMINISTRATIVE (PROJECT START-UP) SUBMITTALS

- A. Certificate of Insurance: Refer to Standard Specifications 107.26.
- B. Performance and Payment Bonds: Refer to Standard Specifications 102.8.
- C. Contractors and Materials List: Submit Contractors and Materials List.
 1. Include only products included in the original Bidding Documents, Addenda, and other Modifications.
 2. Subcontractors: Provide names, addresses, and telephone numbers, indicating which specification section will be performed by each subcontractor.
 3. Material Suppliers: Provide names, addresses, and telephone numbers, indicating which specification section will be performed by each material supplier.
 4. Materials: Identify materials and equipment by brand and model including items specified using reference standards or descriptive specifications without naming a specific product or manufacturer.
 5. DO NOT include proposed substitutions with Materials List. To obtain approval of proposed substitutions comply with requirements of Section 01 25 13 Product Substitution Procedures.
- D. Construction Progress Schedule: Refer to Standard Specifications 108.4 and Section 01 32 16 Construction Progress Schedule.
 1. Format, level of detail, and updates as directed by E/A for the owner.

- E. Submittal Schedule: Provide a Submittal Schedule for Product Data, Shop Drawings, and Samples to E/A coordinated with Construction Progress Schedule including Architect's review period.
 - 1. Coordinate submittals of related items.
 - 2. Updates: Submit a revised Submittal Schedule when changes occur and identify those changes since previous submittal schedule.
- F. Schedule of Values: Submit contractor's Schedule of Values as directed by E/A.

1.3 DESIGN SUBMITTALS

- A. Product Data: Standardized information published by manufacturer. At least one of manufacturer's original published literature; other copies may be legible reproductions. When Product Data is requested by Section include at the following information.
 - 1. Manufacturer's specifications and technical data including performance data, color selection charts, construction and fabrication details and installation instructions.
 - 2. Mark-up charts, drawings and diagrams to delete information which is not applicable to this Project and to identify products or models, and optional features and accessories to be furnished for this Work.
 - a. Identify applicable performance characteristics and capacities.
 - b. Show dimensions and clearances required.
 - c. Identify any items / features in the submission that are available only with a surcharge or long-lead time.
 - 3. Clearly mark each copy to identify pertinent products or models being proposed.
 - 4. Modify drawings and diagrams to delete information not applicable to this Project.
- B. Shop Drawings: Customized documents prepared by contractor or on contractor's behalf for a specific item of work. Submit not less than the following information in a clear and thorough manner. Do not reproduce Contract Documents for use as Shop Drawings, however it is acceptable to use contract Document files as "backgrounds".
 - 1. Cross-reference details in Shop Drawings to applicable Contract Documents using same sheet and detail, schedule or room-numbers used in Contract Documents. Do not submit or reproduce Contract Documents as Shop Drawings.
 - 2. Include manufacturer's specifications and technical data including performance/load criteria, construction, and fabrication details.
 - 3. Show dimensions and clearances required and relations to adjoining work.
- C. Samples: Samples are physical pieces of specified material that display properties to be evaluated or approved by Architect. Unless otherwise indicated, printed, photographic or other graphic representations of material are not acceptable. Label each sample, giving full information.
 - 1. Material Samples shall display functional characteristics of product. Where specified submit whole assemblies with integral parts, accessories and attachment devices. Coordinate material sample submittals with submittals from other Sections for interfacing work.
 - 2. Color Selection Samples shall show full range of colors, textures and patterns available for Architect's selection. Identify items in submission that are available only with a surcharge or long-lead time, unless specified as "custom color".
 - 3. Record Samples are samples made by contractor, or on contractor's behalf, to meet requirements of Contract Documents. Submit Record Samples in sizes large enough or as sets of samples to display full range of variation expected in finished work. Size or number of pieces specified is minimum; provide larger samples or more pieces where required to depict range of finish variation. Record Samples will be used by Architect to evaluate completed work for compliance with Contract Documents.

- D. Design Data: Design calculations, mix designs, analyses, or other data pertaining to a part of work.
- E. Test Reports:
 - 1. Reports signed by authorized official of testing laboratory that a material, product, or system has been tested in accord with the specified requirements. Testing must be performed within three years of date of contract award for the project.
 - 2. Report that includes findings of a test required to be performed by the contractor on an actual portion of the work or prototype prepared for the project prior to shipment to the job site.
 - 3. Report of finding of a test made at the job site or on a sample taken from the job site, on a portion of work during or after installation.
 - 4. Investigation reports.
 - 5. Daily logs and checklists.
 - 6. Final acceptance test and operational test procedures.

1.4 QUALITY CONTROL SUBMITTALS

- A. Submit in compliance with Section 01 45 10 Quality Control for Building Construction.
- B. Statement of Qualification: Submittal required to indicate experience or other evidence of qualification as defined in the Contract Documents.
- C. Statement of Compliance: Submittal to indicate a product complies with the Contract Documents.
- D. Professional Certification: Submittal required to document professional certification of the portion of Work required by the Contract Documents.
- E. Quality Control: Submittal required to document quality control procedures and activities.
 - 1. Source Quality Control: Tests and certifications as described in SOURCE QUALITY CONTROL article in Part 2 of sections.
 - 2. Material Qualification Test: Submittal required directly from testing lab to indicate a proposed material complies with Contract Document requirements.
 - 3. Field Quality Control: Tests and certifications as described in FIELD QUALITY CONTROL article in PART 3 of the technical section within Contract Documents.
 - 4. Soils Engineer Certification: Submittal required from Soils Engineer or their authorized technician indicating confirmation of required inspection and observed required by the Contract Documents.

1.5 FOCUS ON ENERGY SUBMITTALS

- A. Submit in compliance with Section 01 60 00 Product Requirements.

1.6 CONTRACT CLOSEOUT SUBMITTALS

- A. Submit in compliance with Section 01 77 00 Closeout Procedures.

1.7 PROCEDURES FOR SUBMITTING

- A. Timeline for Submittals: Transmit submittals within time frame to prevent delay in construction activities or compromise review process. Comply with the following requirements.
 - 1. Administrative (Project Start-up) Submittals: As directed by the Owner, but not less than 10 days before first application of payment for construction activities.
 - 2. Product Data, Shop Drawings, and Sample Submittals: Submit prior to starting fabrication and according to Submittal Schedule.
 - 3. Quality Control Submittals: Make submittals promptly to not cause construction delay.

- B. Transmittal: Accompany submittals with a completed Submittal Transmittal Form. Sample form is included at the end of this Section.
1. Failure to comply will result in return of submittal without review.
- C. Electronic Submittal Procedures – Number of Copies Required: unless otherwise indicated, not less than the following:
1. Product Data (copies of brochures, catalog cuts, or technical data): 8 ½ x 11 full color, pdf format.
 2. Shop Drawings: 11 x 17 pdf format.
 3. Samples and Color Charts: 2 sets hard copy originals to engineer.
 4. Informational Submittals: 8 ½ by 11 full color, pdf format.
 5. Transmit design submittals to engineer.
- D. Architect's Review Stamps: Provide 4 inch wide by 8-inch-high blank space at lower right corner of each drawing sheet and on cover of product data submittals for use by Architect.
- E. Trade Contractor's Review Process: Contractor's stamp, Subcontractor's stamp as applicable, initialed or signed, certifying prior review of submittal, verification of products, field measurements and field construction criteria and coordination of information within submittal with requirements of Work and of Contract Documents has been performed prior to making submission.
1. Field dimensions required for communicating Design Intent.
 2. Relation to adjacent or critical features of Work.
 3. Submittals not signed and dated by contractor will be returned without review and comment.
 4. Submittal without field measurements or coordination with other trades will be returned without review and comment.
- F. Project Identification: Locate the following information on each submittal where practical and on the accompanying transmittal.
1. Date of submission and dates of previous submissions.
 2. Project title.
 3. Contract identification.
 4. Names of the contractor, supplier, manufacturer.
 5. Identification of products with reference to Specification Section number, and paragraph number.
 6. Reference to Drawing numbers.
- G. Scope of Submittals: Submittals for each portion of the Work shall be complete and accurate. Incomplete or partial submittals will be rejected and will require resubmittal.
1. Submittals may be made of portions of the Work, but each Submittal shall be complete in respect to the information necessary for proper review by Architect and their consultants.
 2. Submittals shall be combined to ensure "design intent" of the system assembly.
 3. Cross out non-related material to submittal.
- H. Product Data, Shop Drawings, Samples, and Quality Control Submittals: Coordinate each submittal with requirements of the Work, Construction Progress Schedule, and Contract Documents

1. Determine and verify:
 - a. Field measurements.
 - b. Catalog numbers and similar data.
 - c. Conformance with Contract Documents.
 - d. Coordination with other work.
2. Notify Architect in writing, at time of submittal, of minor deviations in submittals from requirements of the Contract Documents. Do not submit requests for substitutions as part of this submittal process. Refer to Section of 01 25 13 – Substitution Procedures.

1.8 PROCEDURE FOR REVIEWING

- A. Submittals will be reviewed by Architect with the following actions:
 1. "No Exception Taken" indicates submittal conforms to "design intent" of the Work. Contractor at their discretion may proceed with fabrication, procurement, and installation.
 2. "Make Corrections Noted, No Resubmission Required" indicates submittal, after indicated corrections are made, would conform to the "design intent" of the Work. Contractor at their discretion may proceed with fabrication, procurement, and installation.
 3. "Make Corrections Noted, Submit Corrected Copy" indicates the noted revisions are such that a corrected copy is required for review to confirm the revisions have been understood and made. Contractor may proceed at their discretion with fabrication and procurement and installation. Contractor shall be responsible for correctly interpreting and implementing revisions.
 4. "Rejected, Revise and Resubmit" and "Rejected, Submit Specified Item" indicates submittal does not conform to the "design intent". Resubmittal is required.
 5. "Resubmit with Related Assembly Items" requests submittal of related items for an assembly to permit a coordinated review. Review will not start until related items are submitted.
 6. "No Action Required" indicates contractor may proceed without review of submittal by Architect based on the provisions of the Contract Documents. This does not relieve contractor of requirements of Contract Documents.
 7. Clarification – Record Only Submittals: Purpose/intent for Submittals identified as (for Record Only) is to provide Owner and Architect with specific product information or material samples for record purposes.
 - a. Record Only Submittals will be reviewed and filed by Architect for use by Owner. No further action will be taken, including return of submittal to Contractor or Trade Contractor if Architect determines submittal is according to Contract Documents.
 - b. If Architect determine submittal is not according to Contract Documents, submittal will be returned with comments for resubmission in a timely fashion.
- B. Review by Architect of submittals is not an authorization for Change Order. Any item requiring Change Order shall follow procedures described elsewhere in the Contract Documents.

1.9 PROCEDURE FOR RESUBMITTING

- A. Required Revisions: Make corrections or changes in submittals required by Architect and resubmit when Architect's stamp requires resubmittal.
 - 1. Clearly identify changes made other than those requested by Architect by "clouding" or other suitable means acceptable to Architect. Only changes that are "clouded" and changes requested by Architect will be reviewed on a resubmittal. Architect is not responsible for reviewing resubmittals that are not "clouded" on resubmittal.
- B. Resubmittal Review Fees: If Architect rejects (Rejected, Revise and Resubmit) Contractor's submittal more than two times for the same Specification Section, Architect will be compensated for additional reviews.
 - 1. Amount of such compensation will be incorporated by Change Order and deducted from Contractor's Application for Payment.
- C. Product Submittals: Revise initial submittal to comply with specified requirements.
- D. Contractor is responsible for delays caused by resubmittal process.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 01 33 00

SECTION 01 41 00 – Special Inspections and Tests

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes requirements for the following:
 - 1. Inspections by building officials.
 - 2. Structural tests and inspections.
 - 3. Special inspections.
 - 4. Structural observations.
- B. Related Documents:
 - 1. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

1.2 INTENT AND CONDITIONS

- A. Intent:
 - 1. Define and coordinate structural testing and special inspection services.
 - 2. Define and coordinate conventional testing and inspection services.
 - 3. Provide greater confidence that the specified work is constructed in compliance with the contract documents and Chapter 17 of the International Building Code, current referenced Edition.
 - 4. Testing and Inspection services are intended to assist in determining probable compliance of the work with requirements specified. These services do not relieve the contractor of responsibility for compliance with the requirements of the contract documents.
- B. Conditions:
 - 1. If inspection of fabricator's work is required, the Owner's representative may require testing and inspection of the work at the plant before shipment. Owner, Architect and Structural Engineer of Record (SER) reserve the right to reject material not complying with the contract documents.
 - 2. Testing and inspection shall be performed according to the industry standard used as the reference for the specific material or procedure unless other criteria are specified. In the absence of a referenced standard, tests shall be accomplished according to generally accepted industry standards.
 - 3. Work shall be checked as it progresses, but failure to detect any defective work or materials shall in no way prevent later rejection if defective work or materials are discovered, nor shall it obligate Owner to accept such work.

1.3 RELATED REQUIREMENTS

- A. Refer to PART 2 for technical scope sections regarding specific qualifications, inspections, tests, frequency and standards required.

1.4 DEFINITIONS

- A. Testing – Evaluation of systems, primarily requiring physical manipulation and analysis of materials, according to approved standards.
- B. Inspection – Evaluation of systems, primarily requiring observation and engineering judgment.
- C. Structural Testing and Special Inspection – Structural Testing and Special Inspection Services herein include items required by the IBC and other items which in the professional judgment of the Structural Engineer of Record, are critical to the integrity of the building structure.
- D. Architect of Record – The prime consultant in charge of overall design and coordination of the project.

- E. Structural Engineer of Record (SER) – The Licensed Engineer in responsible charge of the structural design for the project.
- F. Licensed Structural Engineer: – A professional engineer with education and experience in the design of structures similar to this project licensed to practice in the state in which the project is located.
- G. Testing Agency (TA) – The properly qualified firm performing testing services.
- H. Special Inspector (SI) – A properly qualified individual or firm performing special inspections.
- I. Building Official – The Officer or his duly authorized representative charged with the administration and enforcement of the Wisconsin State Building Code.
- J. Continuous –The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.
- K. Periodic –The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.
- L. Structural Observations: Part time or intermittent observation of work in addition to inspections required by the Code and identified by the Architect of Record or Structural Engineer of Record related to the oversight and quality assurance of the Project.

1.5 REFERENCES

- A. International Building Code (Edition as adopted by the Authority having Jurisdiction)

1.6 STRUCTURAL TESTS AND SPECIAL INSPECTIONS

- A. Contractor will engage a qualified testing agency to conduct structural tests and special inspections according to Chapter 17 of the International Building Code, requirements of state and local authorities having jurisdiction. Testing agency's work will include the following:
 - 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
 - 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 - 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect, through Construction Manager, with copy to Contractor and to authorities having jurisdiction.
 - 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 - 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 - 6. Retesting and re-inspecting corrected work.
- B. Provide related services as required for structural tests and special inspections. Coordinate, and make requests and notifications to design professionals and building officials when work is ready for inspection.
- C. Provide Contractor's Statement of Responsibility according to Section 1706 of the International Building Code.
- D. Structural Testing and Special Inspections for this Project include categories as follows:
 - 1. Cast-in-place concrete construction.
 - 2. Unit masonry construction.
 - 3. Structural steel construction.
 - 4. Cold-formed metal framing construction.
 - 5. Soils.

6. Sprayed fire-resistant materials.
 7. Fire-resistant penetrations and joints.
 8. Other testing and inspections as required by building officials of AHJ.
- E. Structural Observations for this Project include:
1. Concrete construction.
 2. Structural steel construction.
 3. Cold-formed metal framing construction.

1.7 QUALITY ASSURANCE

- A. Testing Agency (TA) Qualifications: The testing agency shall be an approved independent testing agency acceptable to the Owner, Architect, SER and as noted below:
1. Authorized to operate in the state in which the project is located and experienced with the requirements and testing methods specified in the technical scope sections of PART 2.
 2. Meeting applicable requirements of Section 1.04 "References".
 3. Testing equipment shall be calibrated at reasonable intervals by devices of accuracy traceable to either the National Institute of Standards and Technology (NIST), or to accepted values of natural physical constants.
- B. Special Inspector (SI) – The special inspector shall be under the direct supervision of a registered civil/structural engineer, experienced with the type of work requiring structural testing and special inspection.
1. The categories of special inspector are:
 - a. Special Inspector - Technical I, II, and III: Usually an employee of a testing agency.
 - b. Special Inspector - Structural I and II: Preferably an employee of the SER's firm.
 2. Unique special inspector requirements, for specific materials and system, are noted in related technical specification sections.

1.8 RESPONSIBILITIES

- A. Structural Testing and Special Inspections:
1. Special Inspectors:
 - a. Sign the Structural Testing and Special Inspection Summary Schedule in conjunction with other responsible parties prior to commencement of construction.
 - b. If requested, attend a pre-construction meeting to review the scope of structural testing and special inspection.
 - c. Use the approved design drawings and specifications, supplemented by the approved shop drawings for review of the work.
 - d. Test and/or inspect the work assigned for conformance with the building department approved design drawings, specifications and applicable material and workmanship provisions of the Code. Perform testing and inspection in a timely manner to avoid delay of work.
 - e. Bring discrepancies to the immediate attention of the contractor for correction, confirm that they are corrected and, if uncorrected after a reasonable period of time, bring to the attention of the Structural Engineer of Record, the Building Official, and to the Architect.

- f. Submit test and/or inspection reports to the Building Official, Contractor, the Structural Engineer of Record, and other designated persons according to the Structural Testing and Special Inspection Summary Schedule.
 - g. Submit a final signed report stating whether the work requiring special inspection was, to the best of the inspector's knowledge, in conformance with the approved plans, specifications and the applicable workmanship provisions of the Code.
- 2. Testing Agency:
 - a. Sign the Structural Testing and Special Inspection Summary Schedule in conjunction with other responsible parties prior to commencement of construction.
 - b. If requested, attend a pre-construction meeting to review the scope of structural testing and special inspection.
 - c. When engaged as a special inspector, provide structural testing and special inspection services as previously described.
- 3. Architect of Record (or other prime consultant):
 - a. Complete and sign the Structural Testing and Special Inspection Summary Schedule in conjunction with other responsible parties prior to commencement of construction. Provide a completed copy of the schedule to all signed parties including Building Official.
 - b. If appropriate, arrange and attend a pre-construction meeting to review the scope of structural testing and special inspection. Include Contractor, Building Official, SER, Testing Agency and other parties concerned.
 - c. Coordinate the flow of reports and related information to expedite resolution of construction issues.
- 4. Structural Engineer of Record (SER):
 - a. Identify items requiring structural testing and special inspection including special cases.
 - b. Define "type" of special inspector required for "description" of work indicated on the structural testing and special inspection schedule.
 - c. Complete and sign the Structural Testing and Special Inspection Summary Schedule prior to commencement of construction.
 - d. If requested, attend a pre-construction meeting to review the scope of structural testing and special inspection.
 - e. Review reports submitted by special inspectors.
 - f. If engaged as a special inspector, provide structural testing and special inspection services as previously described.
- 5. Contractor:
 - a. Establish direct funding to provide for cost of structural testing and special inspection services.
 - b. Sign the Structural Testing and Special Inspection Summary Schedule in conjunction with other responsible parties prior to commencement of construction.
 - c. If requested, attend a pre-construction meeting to review the scope of structural testing and special inspection.
 - d. Post or make available the Structural Testing and Special Inspection Summary Schedule within its office at the job site. Also, provide adequate notification to those parties designated on the schedule so they may properly prepare for and schedule their work.

- e. Provide the special inspectors access to the approved design drawings, approved shop drawings and specifications at the job site.
 - f. Review reports submitted by special inspectors.
 - g. Retain at the job site all reports submitted by the special inspectors for review by the building official upon request.
 - h. Correct in a timely manner, deficiencies identified in inspection and/or testing reports.
 - i. Provide the special inspector safe access to the work requiring inspection and/or testing.
 - j. Provide labor and facilities to provide access to the work and to obtain, handle and deliver samples, to facilitate testing and inspection and for storage and curing of test samples.
 - k. Verification of conformance of the work within specified construction tolerances is solely the contractor's responsibility.
6. Fabricator:
- a. Sign the Structural Testing and Special Inspection Summary Schedule in conjunction with other responsible parties prior to commencing construction.
 - b. Submit a Certificate of Compliance to the Building Official, Special Inspector, and Structural Engineer of Record that the work was performed according to the approved plans and specifications.
7. Building Official (Typical responsibilities noted for information only):
- a. Determine work, which in the Building Officials opinion, involves unusual hazards or conditions according to the IBC.
 - b. Review special inspector qualifications.
 - c. Accept and sign the completed Structural Testing and Special Inspection Summary Schedule.
 - d. Review all fabricators who perform work in their shop, which requires special inspection.
 - e. Review reports and recommendations submitted by the special inspectors.
 - f. Review the "final signed reports" submitted by the special inspector(s). These documents should be accepted and approved by the building department prior to issuance of a Certificate of Occupancy.
8. Owner:
- a. Provide special inspector with approved design drawings, specifications and approved shop drawings.
 - b. Provide special inspectors and testing agencies with full access to site at all times.
 - c. Sign the Structural Testing and Special Inspection Summary Schedule in conjunction with other responsible parties prior to commencement of construction.
- B. Conventional Testing and Inspections and Observations:
1. Testing Agency:
- a. Test or inspect the work assigned, for conformance with building department approved plans, specifications and applicable workmanship provisions of the IBC.

- b. Bring non-conforming items to the immediate attention of the contractor, and if uncorrected to the Architect of Record.
 - c. Submit test and/or inspection reports to the Architect of Record, the Contractor and other designated persons.
- 2. Contractor:
 - a. Provide adequate notification to testing agency so they may properly prepare for and schedule their work.
 - b. Provide testing agency with access to the approved design drawings, approved shop drawings and specifications at the job site.
 - c. Correct in a timely manner, deficiencies identified in test and/or inspection reports.
 - d. Provide testing agency with safe access to the work requiring testing and inspection.
 - e. Provide labor and facilities to provide access to the work and to obtain and handle samples, to facilitate testing and inspection and for storage and curing of test samples.
 - f. Verification of conformance of the work within specified construction tolerances is solely the contractor's responsibility.
- 3. Architect of Record (or other prime consultant):
 - a. Coordinate the flow of reporting and related information to expedite resolution of construction issues.
- C. Inspections by Building Official
 - 1. Contractor shall provide adequate notice for inspections performed by the Building Official, as required by the IBC, the Local Building Code, and local ordinance.
- D. Periodic Site Observations by Design Consultant
 - 1. Special structural testing and inspections, conventional testing and inspections, and periodic inspections by the Building Official do not preclude the normal field involvement and site observations by Architect or Structural Engineer of Record, nor shall it relieve the contractor of any responsibility to complete the work according to the approved drawings and specifications.
- E. Limits of Authority
 - 1. Testing agents and/or special inspectors may not waive or alter contract requirements or approve or accept any portion of the work unless specifically authorized by the Architect or Structural Engineer of Record. They may not assume any duties of the contractor, and they have no authority to stop or reject "Work".

1.9 PAYMENT

- A. Contractor shall directly employ and pay for services of the special inspectors to perform required Structural Testing and Special Inspections.
- B. Contractor shall employ and pay for services of the testing agency to perform required Conventional Testing and Inspections.
- C. Unless noted otherwise, the contractor shall provide and pay for all materials, samples, mock-ups, and assemblies required for testing and inspection and shall pay for all shipping costs related to delivery of this work. Testing agency will pay for shipping costs of samples transported from site to lab.
- D. If exploratory work is required to determine the cause of defects, the cost of such work shall be paid by the contractor, if the work is found to be defective, in the judgment of the Architect/Engineer. Contractor shall reimburse the Owner for all costs incurred in this event.

- E. Any tests required to qualify the contractor, or the workmen for any phase of the work, shall be performed at no additional cost to the Owner.

1.10 INSPECTION NOTICE

- A. Contractor shall provide minimum of 24 hours' notice for all items requiring testing or inspection. Items requiring testing and inspection services prior to or during placement shall not be placed until testing and inspection services are available. Items requiring testing and inspection services after placement shall not be enclosed or obscured until testing and inspection services are performed.

1.11 REPORTS

- A. Testing agency and/or special inspectors shall submit reports according to the Structural Testing and Special Inspections Summary Schedule and shall conduct and interpret tests and inspections and state in each report whether; (1) test specimens and observations comply with Contract Documents, and specifically state any deviations, (2) record types and locations of defects found in work, (3) record work required and performed, to correct deficiencies.
- B. Reports for structural testing and special inspection, shall be submitted in timely manner to the Contractor, Building Official, SER, and Architect of Record.
 - 1. Submit reports for ongoing work, to provide the information noted below:
 - a. Date issued.
 - b. Project title and number.
 - c. Firm name and address.
 - d. Name and signature of tester or inspector.
 - e. Date and time of sampling.
 - f. Date of test or inspection.
 - g. Identification of product and specification section.
 - h. Location in project, including elevations, grid location and detail.
 - i. Type of test or inspections.
 - j. Results of tests or inspections and interpretation of same.
 - k. Observations regarding compliance with Contract Documents or deviations there from.
 - 2. Submit a final signed report stating whether the work requiring special inspections was, to the best of the inspector's knowledge, in conformance with the approved plans, specifications and the applicable workmanship provisions of the code.
- C. Reports for conventional testing and inspections shall be submitted in a timely manner to the Contractor and the Architect of Record.

1.12 FREQUENCY OF TESTING AND INSPECTIONS

- A. For detailed requirements see technical sections of PART 2.

1.13 PROTECTION AND REPAIR

- A. Upon completion of testing, sample-taking, or inspection, the contractor shall repair damaged work and restore substrates and finishes to eliminate deficiencies, including deficiencies in the visual qualities of exposed surfaces, as judged solely by the Architect/Engineer of Record. Protect work exposed by or for testing and/or inspection and protect repaired work. Repair and protection is the contractor's responsibility, regardless of the assignment of responsibility for testing and/or inspection.

1.14 TESTS TO DEMONSTRATE QUALIFICATION

- A. If the contractor proposes a product material, method, or other system that has not been pre-qualified, the Architect may require applicable tests, to establish a basis for acceptance or rejection. These tests will be paid for by the contractor.

- B. The Architect/Engineer of Record reserves the right to require certification or other proof that the system proposed, is in compliance with any tests, criteria or standards called for. The certificate shall be signed by a representative of an independent testing agency.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 STATEMENT OF SPECIAL INSPECTIONS

- A. Structural Testing and Special Inspection Program Summary: Refer to Structural Drawings.
- B. Statement of Special Inspections Form: Following Section 01 45 10.
 - 1. The parties involved shall complete and sign the Statement of Special Inspections Form. The Program, including Summary Schedule, shall be submitted to the building official for approval prior to issuance of a building permit.
 - 2. The Form includes the following:
 - a. A specific listing of the items requiring inspection and testing.
 - b. The associated technical scope sections that define the applicable standards by which to judge conformance with the approved plans and specifications according to the IBC. The technical scope sections should also include the degree or basis of inspection and testing; i.e., intermittent/will-call or full-time/continuous.
 - c. The frequency of reporting, i.e., weekly, monthly, per test/inspection, per floor, etc.
 - d. The parties responsible for performing the inspection and testing work.
 - e. The required acknowledgments by each designated party.

END OF SECTION 01 41 00

SECTION 01 45 10 – Quality Control for Building Construction

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Administrative and procedural requirements for quality control.
 - 2. Inspection and testing services to assist in determination of work with specifications and regulations.
 - 3. Requirements for contractor cooperation.
 - 4. Responsibility for payment.
 - 5. Required tests identified in individual specifications sections.
- B. General Building Contractor Responsibility: These required services do not relieve the contractor of responsibility for compliance with any requirements.
- C. Related Sections:
 - 1. Section 01 31 19 - Project Meetings
 - 2. Section 01 74 20 - Construction Waste Management

1.2 REFERENCES

- A. IBC Code: Currently in effect and adopted by state in which Project is located.
- B. ASTM:
 - 1. D3740 - Minimum Requirements for Agencies Engaged in Testing or Inspection of Soil and Rock
 - 2. E329 - Requirements for Agencies Engaged in Testing or Inspection of Materials Used in Construction

1.3 DEFINITIONS

- A. Quality Control: Inspections, tests, related actions including reports, performed by independent agencies and governing authorities, as well as directed by contractor.

1.4 SUBMITTALS

- A. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards (NBS) during most recent tour of inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- B. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full time registered Specialist and responsible officer.
- C. After each inspection and test, submit two written copies of report to E/A and to Contractor no later than 3 working days after completion of inspection or test. Include:
 - 1. Date issued
 - 2. Project title and number
 - 3. Name of inspector
 - 4. Date and time of sampling or inspection
 - 5. Identification of product and Specifications Section
 - 6. Location in the Project
 - 7. Type of inspection or test
 - 8. Date of test
 - 9. Results of tests
 - 10. Conformance with Contract Documents
- D. When requested by E/A, provide interpretation of test results.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Comply with requirements of ASTM D3740 and E329.
- B. Testing:
 - 1. Contractor shall employ and pay for services of an independent testing laboratory to perform specified inspection and testing.
 - 2. Employment of testing laboratory shall in no way relieve contractor of obligation to perform work according to requirements of Contract Documents.
- C. Laboratory Qualifications:
 - 1. Qualified according to referenced ASTM standard to acceptance of E/A.
 - 2. Authorized to operate in state in which Project is located.
 - 3. Staff: Maintain a full time registered Engineer Specialist on staff to review services.
 - 4. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards (NBS) Standards or accepted values of natural physical constants.
- D. Mockups:
 - 1. Before installing work that requires mockups, construct mockups for form of construction and finish.
 - 2. Construct mockups in location and in size indicated, or as approved by E/A. Notify E/A five (5) days in advance of mockup construction.
 - 3. Mockups will demonstrate workmanship and the proposed range of aesthetic design.
 - 4. Obtain E/A approval of mockup prior to starting work, fabrication, and construction. Approval of mockup does not constitute approval of deviation from the contract documents, unless such deviation is specifically approved by E/A in writing.
 - 5. Mockups to remain during construction, in an undisturbed condition, to compare with completed work.
 - 6. Unless otherwise indicated, mockup is to be demolished and removed when directed by E/A.

1.6 RESPONSIBILITIES

- A. General Building Contractor Responsibility:
 - 1. Quality control testing or inspections identified in this section and elsewhere, to be the General Building Contractor's responsibility.
 - 2. Code Compliance Testing: Quality control required by codes or ordinances, or by plan approval authority, made by legally constituted authority unless otherwise provided in Contract Documents.
 - 3. Verification of conformance of the Work within specified construction tolerances.
 - 4. Contractor's Convenience Testing.
 - 5. Notify E/A and laboratory 24 hours prior to expected time for operations requiring inspections and testing services.
 - 6. Provide incidental labor and facilities to:
 - a. Provide access to Work to be tested.
 - b. Obtain and handle samples at the Site or at source of products to be tested.
 - c. Facilitate tests and inspections, and storage and curing of test samples.

7. Coordinate with each independent agency the sequence of activities to accommodate required services with minimum delay in progress of Work and to avoid removing and replacing Work. Schedule times for quality control.
 8. Coordinate concrete floor slab and concrete topping requirements with concrete contractor, concrete floor mix designs, and floor covering manufacturers' requirements, prior to placement. The General Building Contractor is responsible for all required testing and necessary mitigation of the concrete floor slabs in preparation for floor covering installations.
 9. Pest Control: The General Building Contractor is responsible for maintaining a pest-free construction site during construction. The contractor will employ a pest control service when necessary.
- B. Owner Responsibility: Quality control not specifically indicated as General Building Contractor's responsibility, or to be provided by another identified entity.
- C. Laboratory Responsibility:
1. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 2. Promptly notify E/A and contractor of observed irregularities or non conformance of Work or Products.
 3. Perform additional inspections and tests required by E/A.
 4. Limits on Laboratory Authority:
 - a. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - b. Laboratory may not approve or accept any portion of the Work.
 - c. Laboratory may not assume any duties of contractor.
 - d. Laboratory has no authority to stop the Work.
- D. Retest Responsibility:
1. Where results of quality control prove unsatisfactory and do not indicate compliance of related Work with requirements of the Contract Documents, retests are responsibility of contractor, regardless of whether the original test was contractor's responsibility.
 2. Retest of Work revised or replaced by contractor is contractor's responsibility, where required tests were performed on original Work.
 3. Retesting costs will be deducted from Contract amount by Change Order.
 4. Provide 2 retests for each failed test.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 ADJUSTING

- A. Upon completion of quality control performed on Work, repair damaged Work, restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes. Comply with Contract Document requirements for "Cutting and Patching."

3.2 PROTECTION

- A. Protect Work exposed by or for quality control service activities and protect repaired Work.

3.3 RESPONSIBILITY FOR ADJUSTING AND REPAIR

- A. General Building Contractor's responsibility, regardless of assignment elsewhere, is responsible for quality control. The General Building Contractor is responsible for all adjusting and repair and may utilize subcontractors for adjustment and repair.

3.4 FIELD QUALITY CONTROL

- A. Secure inspection and acceptance of subgrades and fill layers before subsequent construction is permitted.
- B. The following inspections and testing shall be conducted by an Independent Testing Agency, arranged by General Building Contractor, approved by Owner, and paid for by contractor with the results being reported to E/A, Building Inspector, contractor and Structural Engineer of Record.
 - 1. Excavating, Filling, Grading:
 - a. Compaction testing for building pads or paved areas: 1 test per 2,500 square feet per 12-inch lift; minimum 3 tests.
 - b. Foundation wall backfill: 1 test per 100 feet or less of wall length, but no fewer than 2 tests.
 - c. Footing subgrades: At least 2 tests of each soil stratum to verify design bearing capacities.
 - d. Utility trenches: 1 test per 300 cubic yards (CV) of backfill material.
 - e. Roadway / parking lot grading: 1 test per 1000 cubic yards (CV) of embankment material.
 - 2. Proof rolling of parking areas and sidewalks subject to vehicular traffic.
 - 3. Concrete Specimens:
 - a. Compression Testing:
 - 1) Cast 3 cylinders per set:
 - a) One at 7 days
 - b) Two at 28 days
 - c) One for hold
 - 2) Cast one set of cylinders for every 50 yards or fraction thereof, of cast-in-place concrete, but no fewer than one set.
 - 3) Field cure cylinders (2 per set) to check concrete strength prior to critical shoring removal.
 - b. Standard Field Tests to be performed on fresh concrete each time cylinders are cast:
 - 1) Slump
 - 2) Air Content
 - 3) Temperature
 - c. Proposed Design Mixes
 - 4. Concrete Floor Slabs and Concrete Toppings:
 - a. Provide in-situ relative humidity and temperature, moisture vapor emission, and surface pH testing on all concrete specified to be covered with floor coverings or resinous coatings, as required by floor covering manufacturer. Testing to include concrete placed below, on, and above grade.
 - b. Testing to be scheduled no less than one (1) or more than three (3) weeks prior to scheduled flooring installation.

- c. Test sites should be maintained at the same temperature and humidity conditions as those anticipated during normal occupancy. These temperature and humidity levels should be maintained for 48 hours prior and during test period.
 - d. Number of test sites as required by ASTM standards or floor covering manufacturer's recommendations.
 - e. Refer to floor covering and coating specification sections and manufacturer's recommendations for testing requirements.
 - f. In-Situ Relative Humidity and Temperature:
 - 1) Test using a digital, calibrated probe.
 - 2) Test at 40% of concrete thickness.
 - g. Moisture Vapor Emission:
 - 1) Test using Calcium Chloride Test kit.
 - 2) Use wide range pH paper, and distilled or de-ionized water.
 - h. Surface pH Level:
 - 1) Perform pH test at or near the in-situ humidity and moisture vapor emission test site.
 - 2) Use wide range pH paper, and distilled or de-ionized water.
- 5. Welding: All structural welding including welding of reinforcing steel.
- 6. High strength bolting.
- C. Additional Tests: Owner may arrange and pay for the following including, but not limited to:
 - 1. Masonry Units: For specific lots of materials to be used, test or review submitted product certifications for each type of masonry unit.
 - a. Industry Standards:
 - 1) Compressive strength and absorption as follows:
 - a) Hollow load bearing units - ASTM C90.
 - b) Solid load bearing units - ASTM C145.
 - c) Non-load bearing units - ASTM C129.
 - b. Prism testing: One set every 5,000 square feet of wall area during construction.
 - c. Grout strength testing for core filled masonry walls: Minimum compressive strength - 2,500 psi.
 - 2. Aluminum Windows: Test procedures, test pressures, and performance of AAMA 101.
 - 3. Exterior Shell: Infra-red thermography testing of entire building shell, both interior and exterior, if required.
- D. Fabricator:
 - 1. The following inspections shall be arranged and paid by the fabricator of products with the results being reported to E/A, Building Inspector, General Building Contractor and Structural Engineer of record.
 - a. Prestressing reinforcing and tendons for concrete.
 - b. Shop welding of steel fabrications used for structural purposes.

END OF SECTION 01 45 10

SECTION 01 51 00 – Temporary Utilities

PART 1 – GENERAL

1.1 SUMMARY

- A. Temporary utilities and services including, but not limited to:
 - 1. Temporary utility installation.
 - 2. Water Supply.
 - 3. Temporary Electrical Work.
 - 4. Temporary Lighting.
 - 5. Telephone Service.
 - 6. Temporary Heat.
 - 7. Storm and Sanitary Sewer.
- B. Related Sections:
 - 1. Section 01 56 10 - Temporary Facilities & Installations
 - 2. Divisions 22, 23, and 26 for Temporary Utilities.

1.2 REFERENCES

- A. American National Standards Institute (ANSI) - A10 Series Safety Requirements Standards
- B. Factory Mutual Engineering & Research Corporation (FM)
- C. National Electrical Contractors Association (NECA) - NJG-6 - Temporary Job Utilities and Services
- D. National Electrical Manufacturer's Association (NEMA).
- E. National Fire Protection Association (NFPA):
 - 1. 70 - National Electrical Code.
 - 2. 241 - Safeguarding Construction, Alteration, and Demolition Operations.
- F. Underwriter's Laboratory (UL).

1.3 QUALITY ASSURANCE

- A. Comply with requirements of local laws and regulations governing construction and local industry standards, in the installation and maintenance of temporary utilities and services.
- B. Comply with requirements of NECA NJG-6, NFPA 241, ANSI A10 Series Standards.
- C. Comply with applicable NEMA, NECA, and UL standards and governing regulations for materials and layout of temporary electric service.
- D. Where local laws and regulations conflict with the requirements of NEMA, NFPA, ANSI, or NECA, comply with the most stringent requirements.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Provide all required materials and equipment for temporary utilities and services.
- B. Used materials and equipment may be used, if acceptable to E/A, and the authority having jurisdiction over the property.
- C. Provide only materials and equipment that are suitable for intended use and comply with appropriate standards.

2.2 UTILITIES

- A. Where local utility company provides only a portion of temporary utility, provide remainder with matching, compatible materials and equipment. Comply with utility company's recommendations and requirements.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Provide each temporary utility and service ready for use at each location when utility or service is first needed.
- B. Locate temporary utilities and services where they will serve Project and result in minimum interference with performance of the Work.
- C. Maintain, relocate, modify, and extend utilities and services as required during course of Work.
- D. Use qualified tradesperson for installation of temporary utilities and services.

3.2 UTILITY INSTALLATION

- A. Coordinate with Utility Companies:
 - 1. Determine requirements, time constraints, etc. for installing temporary service to the Site, or to make connections to existing service.
 - 2. Arrange with utility companies for service interruption, where necessary, to make connections for temporary services.

3.3 WATER SUPPLY

- A. The General Building Contractor will:
 - 1. Supply water used for construction purposes, until the permanent water service is installed, inspected and approved for permanent use.
 - 2. Secure water necessary for construction and testing and pay service connection charges.
 - 3. Coordinate and facilitate the Plumbing Trade to supply and maintain any temporary water supply.
 - 4. Prevent waste of water.
 - 5. Trades shall provide their own hose or piping from hose bibbs.
- B. Immediately after award of contract, the Plumbing Trade shall make arrangements for maintaining temporary connections and extension of existing water service facilities.
 - 1. As soon as possible, the Plumbing Trade shall install the permanent main into the building and provide a temporary gate valve, extend piping, provide temporary water meter, and provide two 3/4 inch hose bibbs on each floor, located as directed.
 - 2. Provide two 3/4 inch hose bibbs outside of the building at suitable locations for construction purposes as directed.
 - 3. Permanent risers may be used for temporary service.
- C. The Plumbing Trade shall supply, maintain the installation, and remove it when directed by the General Building Contractor, and shall provide necessary patching of surfaces and structure after each temporary service is removed.
- D. Where available supply of potable water is inadequate, provide non-potable water for purposes other than drinking and washing.
- E. Where non-potable water is used, for construction purposes, provide warning signs on the discharge end of each length of hose and at the shut-off nozzles.

- F. Where shut-off nozzles are used at water hose discharge, provide heavy-duty abrasion-resistant hoses with a pressure rating greater than the maximum pressure of the water distribution system.
- G. Trades needing a larger source of water are responsible for the source and distribution.
- H. Sterilize temporary water piping for potable water prior to use.
- I. Maintain distribution system to avoid damage to existing or new construction.
- J. Avoid damage to permanent plumbing at source of temporary water.
- K. Lavatory and slop sinks used by workmen shall be kept clean and sanitary at all times.
- L. Immediately after award of contract, the Plumbing Trade shall make arrangements to begin underground sewer work and shall complete sewer work, including required backfilling, as soon as possible.

3.4 TEMPORARY ELECTRICAL WORK

- A. See Section 26 01 15 Temporary Service for electrical service requirements and usage.
- B. The General Building Contractor shall pay for all electrical energy consumed for construction purposes for all trades including temporary offices, for operation of ventilating equipment, and for testing and operating of all equipment.
- C. When permanent power and lighting systems are in operation, they may be used for construction purposes.
- D. Whenever an overhead floor or roof deck has been installed, install temporary lighting adequate to provide sufficient illumination for safe work and traffic conditions in area of Work.
- E. Install service and grounding in compliance with NFPA 70. Include necessary meters, transformers, overload protected disconnect, and main distribution switch gear.
- F. Connect temporary service to local electric power company main as directed by electric company officials.
- G. Install temporary service with an automatic ground-fault interrupter feature, activated from circuits of the system.
- H. Install circuits of adequate size and proper characteristics for each use.
 - 1. Run wiring overhead and rise vertically where wiring will be least exposed to damage from construction operations.
 - 2. Install rigid steel conduit or equivalent raceways for wiring that must be exposed on grade, floors, decks, or other areas of possible damage or abuse.
- I. Provide identification/warning signs at power outlets that are other than 110 to 120 volt power.
- J. Provide polarized outlets for plug-in type outlets, to prevent insertion of 110 to 120 volt plugs into higher voltage outlets.
- K. Use only grounded extension cords.
 - 1. Use "hard-service" cords where exposed to abrasion and traffic.
 - 2. Use single lengths or waterproof connectors to connect separate lengths of electric cords.

3.5 TEMPORARY LIGHTING

- A. Install local switching of temporary lighting, spaced to allow lighting to be turned off in patterns to conserve energy and retain light suitable for work-in-progress, access traffic, security check, and Project lock-up.
- B. The temporary lighting system shall be sufficient to enable all trades to safely complete their work and to enable the General Building Contractor to check all work as it is being done. Illumination levels shall meet or exceed the requirements of 29 CFR 1926.56 Illumination (OSHA regulations). See Section 26 01 15 Temporary Service for more information.

- C. Install and operate temporary lighting that will fulfill security and protection requirements, without the necessity of operating entire temporary lighting system.
- D. Provide general service incandescent lamps of wattage required for adequate illumination.
- E. Protect lamps with guard cages or tempered glass enclosures.

3.6 TELEPHONE SERVICES

- A. Each contractor shall make its own arrangements for telephone service.
- B. Pay costs of installation, maintenance, removal, and service charges.
- C. Maintain telephone contact until Substantial Completion of the Work, unless otherwise directed by E/A.

3.7 TEMPORARY HEAT

- A. Provide temporary heat for performance of the Work, curing or drying of recently installed work, or protection of work-in-place from adverse effects of elements.
- B. All heating required after enclosure of the building up to Substantial Completion shall be classified as TEMPORARY HEAT. Enclosure is defined in Section 01 56 00 Temporary Facilities and Installations.
- C. It shall be the responsibility of the General Building Contractor to see that every precaution is used to prevent unnecessary escape of heat.
- D. For installations that are not connected to central plant steam or central plant hot water, the General Building Contractor shall pay the fuel costs for temporary heat for both permanent heating systems used for temporary heat and/or temporary heating systems used for temporary heat.
- E. The General Building Contractor shall pay for all electrical energy consumed for temporary heat.
- F. The Heating Trade shall provide one of the following systems or a combination thereof, for furnishing temporary heat:
 - 1. Permanent heating system may be used for temporary heating. If permanent system is used, the Heating Trade shall install in their permanent location heating coils or connectors as approved by General Building Contractor, with controls to maintain temperatures required. Temporary filters shall be used in the permanent system. Provide bases, shields, etc. around heating elements to prevent too rapid drying of adjacent concrete, masonry, or plaster. Relocation of some of the permanent heating system equipment may be required during construction to prevent interference with new construction. Temporary units may be installed in such areas during the time permanent equipment is not operating due to relocation.
 - 2. The distribution piping of the permanent heating system may be utilized for supply and return to unit heaters on each floor in lieu of temporary piping, provided approved connections, controls, and protection of such piping is maintained.
 - 3. If the permanent air system is used during temporary heating period, temporary filters shall be provided in the system, and they shall have efficiency equal to the permanent filters. The return air ductwork shall be protected from construction dirt by temporary filters placed over return openings.
- G. If the Heating Trade does not have one of the above systems in operation by the time the building is enclosed, then the Heating Trade shall provide, maintain, and supervise the operation of temporary portable units with necessary automatic controls to provide required temperatures.
 - 1. Current required may be taken from the temporary electrical service. See "Temporary Electrical Work" above.
 - 2. Cost of fuel to operate portable units shall be paid by the General Building Contractor.

3. All electrical wiring required for temporary heating units shall be furnished and installed by Heating Trade, from temporary wiring service. Electrical wiring to permanent equipment used for temporary heating that has been mounted in its permanent location shall be wired by trades skilled in that work.
 4. Provide temporary heating units, tested and labeled by UL, FM, or other recognized trade association related to the fuel being consumed. Select units known to be safe and without deleterious effect upon work-in-place or being installed.
 5. Except where conditions make it necessary to use another system, and where use of the permanent heating system is available and authorized by E/A, provide properly vented self-contained liquid propane gas or fuel oil heaters with individual space thermostatic controls for temporary heat.
 6. Do not use open burning or salamander type heating units unless authorized by E/A.
- H. Coordinate ventilation requirements to produce indicated ambient condition required, to prevent accumulations of dust, fumes, vapors or gases, and to minimize consumption of fuel or energy.
- I. The Heating Trade must ascertain if heating equipment will operate on the temporary electrical service available. If service is insufficient to operate equipment, Heating Trade shall make other arrangements.
- J. The Heating Trade shall be responsible for the proper adjustment and maintenance of the system, and shall supervise and be responsible for the operation of the system used for temporary heating until the Owner occupies the building. Supervision shall include periodic checking of operation as required.
- K. Coordinate use of existing facilities with Owner if required.
- L. Extend and supplement with temporary units as required to maintain specified conditions for construction operations, and to protect materials and finishes from damage due to temperature or humidity.
- M. Maintain a minimum temperature of 50 degrees F and a maximum temperature of 60 degrees F in permanently enclosed portions of the structures and areas where finished Work has been installed.
1. For a period of at least ten (10) days prior to the placing of interior woodwork, and throughout the placing of other finishes, varnishing, painting, etc. and until Substantial Completion, the temperature in the spaces involved shall be not less than 70 degrees F, nor more than 80 degrees F. Temperatures shall be maintained by the Heating Trade.
- N. The temporary heating system shall be removed by the Heating Trade after the permanent heating system has been installed and operating. Surfaces and structure shall be patched as required. Temporary heating equipment shall be relocated by the Heating Trade as required during construction to prevent interference with new construction.
- O. At completion of construction work or when temporary heat is no longer required, Heating Trade must repair any damage done to permanent equipment during temporary heating period and also perform the necessary cleaning of all ducts and equipment. The Heating Trade shall provide permanent filters to the complete satisfaction of the General Building Contractor.

3.8 STORM AND SANITARY SEWER

- A. If existing sewers are available for temporary drainage near Site prior to completion of permanent sewers, provide temporary connections to remove effluent that can be lawfully discharged into sewers.
1. If existing sewers cannot be used for discharge, provide drainage ditches, dry wells, waste stabilization ponds, and similar discharge facilities to remove effluent that can be lawfully discharged in that manner.

2. If neither existing sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.
- B. Before discharge of liquid wastes into sewers or drainage facilities, filter out excessive amounts of soils, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways.
- C. Provide temporary filter beds, settlement tanks, separators, and similar devices to purify effluent.
- D. Maintain temporary sewers and drainage facilities in a clean, sanitary condition.
- E. Provide and maintain temporary earthen embankments and similar barriers in and around construction excavations and subgrade construction, sufficient to prevent flooding.
- F. Do not discharge construction water offsite. Onsite discharge shall comply with all state, local and federal requirements and applicable permits.
- G. Do not discharge construction water onsite unless all necessary permits have been obtained.

3.9 OPERATION, TERMINATION, AND REMOVAL

- A. Enforce strict discipline in use of temporary utilities and services at the Site.
 1. Limit availability of temporary utilities and services to essential and intended uses to minimize waste and abuse.
 2. Do not permit temporary installations to be abused or endangered.
 3. Do not allow hazardous, dangerous, or unsanitary conditions to develop or persist on Site.
- B. Operate temporary utilities and services in a safe and efficient manner.
 1. Do not overload temporary utilities and services .
 2. Protect from damage by freezing temperatures and similar elements.
 3. Prevent water-filled piping from freezing by use of ground covers, insulation, draining, or by temporary heating.
 4. Maintain distinct markers for underground lines.
 5. Protect from damage during excavation operations.
- C. Unless E/A requests that it be maintained for a longer period of time, remove each temporary utility and service promptly when no longer needed, when it has been replaced by the authorized use of a permanent utility or service, or no later than Substantial Completion.
- D. Complete or restore permanent Work which may have been delayed because of interference with temporary utilities and services.
- E. Repair damaged Work, clean exposed surfaces, and replace Work which cannot be satisfactorily repaired.
- F. Materials and facilities that constitute temporary utilities and services are, and will remain, the property of contractor.
- G. At Substantial Completion, clean and renovate permanent utilities and services that have been used to provide temporary utilities and services during construction, including but not limited to:
 1. Replace air filters and clean inside of ductwork and housings.
 2. Replace significantly worn parts and parts that have been subject to unusual operating conditions.
 3. Replace lighting system lamps that are burned out or noticeably dimmed.

SECTION 01 56 10 – Temporary Facilities & Installations

PART 1 – GENERAL

1.1 SUMMARY

- A. Temporary Facilities:
 - 1. Field Offices.
 - 2. Sanitary Facilities.
- B. Temporary Installations:
 - 1. Temporary Controls.
 - 2. Temporary Fencing.
 - 3. Barriers and Enclosures.
 - 4. Hoisting and Scaffolding.
 - 5. Signs.
 - 6. Cold Weather Protection.
 - 7. Fire Protection.
- C. Related Sections:
 - 1. Section 01 11 00 - Summary of Work
 - 2. Section 01 51 00 - Temporary Utilities
 - 3. Section 01 74 20 - Construction Waste Management
 - 4. Section 01 74 23 - Final Cleaning
 - 5. Section 01 77 00 - Closeout Procedures

1.2 REFERENCES

- A. American National Standards Institute (ANSI) - A10 Series Safety Requirements Standards
- B. Factory Mutual Engineering & Research Corporation (FM)
- C. National Electrical Contractors Association (NECA) - NJG-6 - Temporary Job Utilities and Services
- D. National Electrical Manufacturer's Association (NEMA).
- E. National Fire Protection Association (NFPA):
 - 1. 70 - National Electrical Code.
 - 2. 241 - Safeguarding Construction, Alteration, and Demolition Operations.
- F. Underwriter's Laboratory (UL).

1.3 QUALITY ASSURANCE

- A. Comply with requirements of local laws and regulations governing construction and local industry standards, in the installation and maintenance of temporary facilities and installations.
- B. Comply with requirements of NECA NJG-6, NFPA 241, ANSI A10 Series Standards.
- C. Where local laws and regulations conflict with the requirements of NEMA, NFPA, ANSI, or NECA, comply with the most stringent requirements.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Provide all required materials and equipment for temporary facilities and installations.

- B. Used materials and equipment may be used, if acceptable to E/A and the authority having jurisdiction over the property.
- C. Provide only materials and equipment that are suitable for intended use and comply with appropriate standards.
- D. Materials and equipment to be contractor's options.
- E. Temporary materials remain the property of the contractor.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Provide each temporary facility and installation ready for use at each location when facility or installation is first needed.
- B. Locate where they will serve Project and result in minimum interference with performance of the Work.
- C. Maintain, relocate, modify, and extend as required during course of Work.
- D. Use qualified tradesperson for installation.
- E. Install in a safe, weather tight condition.
- F. Maintain proper shoring or bracing to prevent failure.

3.2 FIELD OFFICE

- A. The General Building Contractor shall provide and maintain a field office during the entire duration of the construction project.
- B. In addition to his own office, the General Building Contractor shall provide a temporary field office at the site for the E/A.
- C. Each office area shall be provided with a large, smooth-top worktable, one office desk w/lock, four chairs, a four drawer file with lock, including janitorial service.
- D. A Large room for project meetings shall be provided as well.
- E. The General Building Contractor shall coordinate additional field offices with subcontractors and vendors.

3.3 SANITARY FACILITIES

- A. The General Building Contractor shall provide and maintain in clean condition temporary toilets for use of all contractor's employees with weathertight, well ventilated enclosures.
- B. Comply with City and State Health and Sanitation regulations.

3.4 TEMPORARY CONTROLS

- A. Site Access Route: Locate and limit site access as indicated on the Drawings, or as otherwise approved by E/A, Owner, or local authority having jurisdiction over public roads in vicinity of site.
 - 1. Maintain site entrances in a condition which will prevent racking or flow of mud onto public rights-of-way; remove immediately materials spilled, dropped, washed, or tracked from vehicles onto public roadways or into storm drains.
 - 2. Notification: Notify local authorities having jurisdiction of existing damage in adjacent streets or improvements such as paving, curbs, gutters, sidewalks, and alley surfacing prior to start of work.
- B. Contractor's Staging Area: Locate staging area where indicated on the Drawings, or as otherwise approved by E/A or Owner.
- C. Dewatering during Construction: Water control, bailing, or well point equipment necessary to keep excavation and trenches free from accumulation of water during the entire progress of this Work shall be the responsibility of the contractor performing said excavation and trenching due to their scope of work, unless specifically indicated otherwise.

1. Discharge water in compliance with local, state, and DNR pollution control requirements.
2. Obtain discharge permits where required.
3. Coordinate location, extent, and duration with General Building Contractor, E/A, and Owner.

3.5 TEMPORARY FENCING

- A. The General Building Contractor shall provide a neat appearing and movable prefabricated chain link security fence, to be located as indicated on the Drawings or as directed by E/A. Fencing to include contractor's staging areas and perimeter of exterior excavations for new footings and foundations. Provide gates for pedestrian and vehicle traffic as required by the job conditions, properly constructed, and braced, complete with hinges, hasps, and padlocks in number and location required for proper control, delivery, and distribution of materials and equipment.
- B. It shall be the responsibility of the General Building Contractor to repair, properly maintain, and adjust the configuration of the temporary fence as required by job conditions and project phasing to keep the site secure.
- C. The temporary fence shall be a minimum of 6'-0" high (2"x2" chain link fabric). No gap greater than 2" shall be permitted between the fencing/gates and the ground and/or between the fencing/gates and buildings/structures (new or existing).
- D. Barricade Fencing: Plastic barricade type fencing shall be used for utility trenching.
- E. All protective fencing shall be maintained in an upright, orderly fashion throughout the construction schedule. In areas where existing trees are to be protected, the area inside the protective fencing shall not be used for any purpose related to construction activities, such as material storage, vehicle parking, portable toilets, or other disruptive activities that would result in damage of any kind to the site inside the fence.
- F. Refer to Drawings for additional notes.
- G. The General Building Contractor shall remove the temporary fencing when the project is completed.

3.6 BARRIERS AND ENCLOSURES

- A. Enclosure: Before the building, or portion thereof, can be considered enclosed, the General Building Contractor shall have advanced the construction of the building to conform with the following requirements.
 1. The exterior walls should be erected to full thickness and height shall extend to the top of the horizontal level which encloses the space intended to receive heat. If erection of full thick walls is not feasible, erection of back-up wall only will be accepted if approved weatherproofing of back-up materials is provided to avoid damage to back-up materials.
 2. The horizontal slab, which will serve as the overhead enclosure of the spaces to receive heat (whether it be the roof slab or intermediate floor slab), shall have all openings covered with closures capable of sustaining any loads imposed thereon. The entire overhead enclosure shall be made weatherproof.
 3. Provide approved translucent material for temporary enclosure of window openings if they have not been glazed. Plain or reinforced polyethylene film or other suitable translucent material will be acceptable, provided it is installed in or on a well-fitting rigid wood frame and kept in good repair. This means of temporary enclosure shall be used for other minor openings in walls.
 4. Construct temporary walls as required to protect contents and to separate the interior enclosed sections from the interior open sections of the building during construction. Temporary walls must provide protection from dirt, dust, and drafts.
 5. Provide exterior doors with hinges, self-closing devices, and locks.
 6. Make suitable provisions for passage of air to permit proper drying out of the building.

7. At end of day's work, securely close temporary enclosures. Padlock exterior doors and supervise effectiveness of enclosures. Replace or repair as necessary.
 8. Where reference is made to a "portion of the building", it is intended to mean definable areas of the building such as a group of floor levels, or an entire wing of the building. It is not intended to require a room-by-room or erratic piece-meal enclosure operation, but shall provide for an orderly expansion of large adjacent or related areas to be enclosed, which are advantageous to the progress of the work.
- B. Provide temporary enclosures as specified, indicated, or inferred inside and outside the building for safety, prevention of trespassing, and protection against the weather.
1. Temporary enclosures shall not block required legal egress routes.
 2. Construct enclosures of steel studs and joist framing covered with fire-treated plywood, gypsum board, or other suitable panels to comply with required fire separations or fire-resistant construction as determined by authority having jurisdiction, and as acceptable by E/A.
 3. Provide protection against rain, wind, snowstorms, heat, and other weather conditions to maintain Work free from injury or damage.
 4. Adjust location as work progresses.
- C. Provide temporary, weather tight enclosures for openings in exterior surfaces for protection of materials and to prevent unauthorized access.
- D. Temporary enclosures will provide acceptable conditions for the progress of the work, and prevent damage due to freezing or frost action.

3.7 HOISTING AND SCAFFOLDING

- A. Contractor Hoisting: The General Building Contractor shall provide equipment, labor, means and operations to perform and complete the work utilizing the contractor's own hoisting equipment, and agrees to use the hoisting equipment in such a manner as to keep interference with the work of other contractors to a minimum.
1. Hoisting Equipment Tie-offs: Hoisting equipment shall not be attached to the building structure without prior written authorization of the E/A.
 2. Compliance with Regulations: Hoisting equipment and its operation shall meet applicable codes, laws, statutes, ordinances, rules, regulations, and legal requirements. It shall be installed, operated, relocated, removed and maintained by certified mechanics and operators and the General Building Contractor will reasonably cooperate in its application and use so there shall not be a conflict with operations and installation with other contractors.
 3. All power systems, communication systems, related connections, fuel consumption and other similar items for the equipment shall be provided by requiring hoisting equipment.
- B. Scaffolding: Scaffolding necessary to perform the Work of this contract shall be provided by the General Building Contractor.
1. Scaffolding systems shall comply with all applicable codes, laws, statutes, ordinances, rules, regulations and legal requirements.
 2. Scaffolding systems shall be designed, if required, by a registered engineer and installed, maintained, operated, relocated, and removed by licensed operators.
 3. Scaffolding shall be affixed to the building structure without prior written authorization of the E/A.
 4. The General Building Contractor is entirely responsible for design, engineering, structural integrity, installation, maintenance, safety, relocations, and removal of the complete scaffolding system.

5. The General Building Contractor agrees to cooperate in a reasonable manner in the application and use of the scaffolding in order that (a) operations and installation of other contractors are maintained and smooth and (b) interferences and conflicts are kept to a minimum.

3.8 SIGNS

A. Temporary Signs:

1. Provide and maintain temporary warning signs and other temporary signs required for safe and proper execution of Work.
2. Except for "Safety Signs", which may be required by authorities having jurisdiction, do not install billboards, advertisements, or other similar signs unless approved by E/A.

B. Sign Maintenance:

1. Protect signs from damage and maintain in first class condition and in proper position until Substantial Completion unless approval is given by E/A for removal at an earlier date.

3.9 COLD WEATHER PROTECTION

- A. All heating and protective covering, required to protect the work from injury due to freezing and moisture during the construction period and prior to enclosure of the building, shall be classed as COLD WEATHER PROTECTION. Such protection shall be provided and paid for by the General Building Contractor.
- B. Heat required to protect materials from injury due to freezing during the construction period and prior to enclosure, shall be provided by means of portable heating units intended for this purpose.
- C. All heating units must be approved types. Proper ventilation must be provided. The use of temporary units whose product of combustion will damage fresh concrete, mortar, or other building materials, will not be allowed. Use of coke or oil salamanders is prohibited.
- D. If electrical power is required for oil or gas portable heating units, it may be taken from the available temporary power source and paid for by the General Building Contractor.
- E. Heating units and the area surrounding the units shall be kept in a clean and safe condition.

3.10 FIRE PROTECTION

- A. The General Building Contractor shall provide and maintain in working order, during the entire construction period, a minimum number of fire extinguishers on each floor level of the building per the fire authority having jurisdiction, and one in the temporary office.
- B. Extinguishers shall be non-freeze type such as A-B-C rated dry chemical, of not less than 10-pound capacity each. In addition, any subcontractor who maintains an enclosed shed on the site shall provide and maintain, in an accessible location, one or more similar non-freezing type fire extinguisher in each enclosed shed.

3.11 OPERATION, TERMINATION, AND REMOVAL

- A. Enforce strict discipline in use of temporary facilities and installations at the Site.
 1. Limit availability to essential and intended uses to minimize waste and abuse.
 2. Do not permit temporary installations to be abused or endangered.
 3. Do not allow hazardous, dangerous, or unsanitary conditions to develop or persist on Site.
- B. Operate temporary facilities and installations in a safe and efficient manner.
 1. Do not overload temporary services or facilities.
 2. Protect from damage by freezing temperatures and similar elements.
 3. Prevent water-filled piping from freezing by use of ground covers, insulation, draining, or by temporary heating.

- 4. Maintain distinct markers for underground lines.
- 5. Protect from damage during excavation operations.
- C. Unless E/A requests that it be maintained for a longer period of time, remove each temporary facility and installation promptly when no longer needed, when it has been replaced by the authorized use of a permanent facility, or no later than Substantial Completion. Dispose of materials properly as required.
- D. Complete or restore permanent Work which may have been delayed because of interference with temporary facility or installation.
- E. Repair damaged Work, clean exposed surfaces, and replace Work which cannot be satisfactorily repaired.
- F. At Substantial Completion, clean and renovate permanent facilities and installation that have been used to provide temporary services and facilities during Work.

END OF SECTION 01 56 10

SECTION 01 60 00 – Product Requirements

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Administrative and procedural requirements governing:
 - a. Products.
 - b. Delivery, storage and handling.
 - 2. Products shall contain no asbestos containing material (ACM).

1.2 PRODUCT DEFINITIONS

- A. Products:
 - 1. Unless indicated otherwise, the term “products” represents new material, machinery, components, equipment, fixtures, and systems forming the Work.
 - 2. Does not include machinery and equipment used for preparation, fabrication, conveying, or erection of the Work.
- B. Named Products: Items identified by manufacturer’s product name, including make or model designation, indicated in the manufacturer’s published product literature, that is current as of the date of the Contract Documents.
- C. Materials: Products that are substantially shaped, cut, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed as part of the Work.
- D. Equipment: A product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.
- E. Buy America Provision
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal for more information.

1.3 PRODUCT QUALITY ASSURANCE

- A. Source Limitations: To the fullest extent possible, provide products of the same kind, from a single source.
- B. Limited Quantities:
 - 1. When specified products are available only from sources that do not or cannot produce a quantity adequate to complete Project requirements in a timely manner, consult with E/A for a determination of the most important product qualities before proceeding.
 - 2. Qualities may include attributes relating to:
 - a. Visual appearance.
 - b. Strength.
 - c. Durability.
 - d. Compatibility.
 - 3. When a determination has been made, select products from sources that possess these qualities to the fullest extent possible.

1.4 PRODUCT REQUIREMENTS

- A. Minimum Requirements: Comply with specifications and referenced standards or products listed in the Project Manual or on the Drawings. The products indicated are for reference only and should be used as such. Other products that meet or exceed the specifications of those items listed may be allowed to be incorporated into the work, provided the product is submitted to, and subsequently approved by, the A/E ten (10) days prior to installation.

- B. Buy America: Absent an approved waiver, products must meet the Buy America Provision requirements as outlined elsewhere in this proposal package.
- C. Product Provision: Provide products complete with all accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and for the intended use and effect.
- D. Components: Items required to be supplied in quantity within a specification section shall be the same and shall be interchangeable.
- E. Compatibility of Options: When Contractor is given the option of selecting between two (2) or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.
- F. Existing Products: Do not use materials and equipment removed from existing premises, except as specifically required or permitted by Contract Documents.
- G. Nameplates:
 - 1. Except for required labels and operating data, do not attach or imprint manufacturer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.
 - 2. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on an accessible surface that is not conspicuous.
 - 3. Equipment Nameplates:
 - a. Provide permanent nameplate on each item of service-connected or power-operated equipment.
 - b. Locate on an easily accessible surface that is inconspicuous in occupied spaces.
 - c. Provide the following information and other essential operating data on nameplate:
 - 1) Name of product and manufacturer.
 - 2) Model and serial number.
 - 3) Capacity.
 - 4) Speed.
 - 5) Ratings.

1.5 CONTRACTORS' RESPONSIBILITIES FOR BUY AMERICA

- A. All products must meet Buy America requirements as outlined in the Buy America Provision located elsewhere in this proposal package.
- B. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.
- C. Contractors shall comply with Buy America requirements, including coordination with manufacturers, distributors, and suppliers to correct deficiencies in any Buy America documentation.
- D. By submitting an application for payment, based in whole or in part on furnishing equipment or materials, Contractors certify that such equipment and materials, to the contractor's knowledge, are compliant with Buy America requirements.

1.6 CONTRACTORS' RESPONSIBILITIES FOR FOCUS ON ENERGY (FOE)

- A. Materials, products and equipment must meet minimum requirements as specified in this proposal package.
- B. Contractor shall provide documentation of installed materials, products, and equipment as required by the Focus on Energy program. Documentation shall be provided to the FOE verification team by either:

1. Granting access to submittals through the contractor's project management platform or software.
2. Transmitting copies of all submittals in electronic format (PDF).

1.7 DELIVERY, STORAGE, AND HANDLING

A. General Requirements:

1. Deliver, store and handle products according to the manufacturer's recommendations.
2. Schedule and coordinate the delivery of materials to ensure personnel and equipment will be available at the Site.
3. Sequence deliveries to avoid delays but minimize on-site storage.
4. Prevent damage, deterioration, soiling, and loss, including theft.
5. Repair or replace damaged materials at no additional cost to Owner.

B. Packing and Shipping: Deliver products to the jobsite in manufacturer's sealed containers bearing the manufacturer's name and brand, and appropriate UL labels for fire hazard and fire resistance classification.

C. Acceptance at Site:

1. Promptly inspect shipments to ensure that:
 - a. Products comply with requirements.
 - b. Quantities are correct.
 - c. Products are undamaged.
2. Replace damaged or defective materials.

D. Storage and Protection:

1. Store with manufacturer's seals and labels intact and legible.
2. Store sensitive products in weather-tight, climate-controlled enclosures.
3. Cover products subject to deterioration with impervious sheet covering, providing ventilation to avoid condensation.
4. For exterior storage of fabricated products, place on sloped supports, above ground.
5. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
6. Provide off-site storage and protection when Site does not permit on-site storage or protection.
7. Protect stored materials from damage by adjacent work, falling debris, or equipment.
8. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under required conditions.

1.8 PRODUCT SELECTION

- A. Product selection is governed by the Contract Documents, and governing regulations by previous project experience.
- B. Buy America Compliance: Based on vendor and manufacturer information, to the best of Architect's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.
- C. Proprietary Specification Requirements: Where only a single product or manufacturer is named, provide the product indicated. No substitutions will be permitted.

- D. Semi-Proprietary Specification Requirements:
1. Where two or more products or manufacturers are named, provide one of the products indicated. No substitutions will be permitted.
 2. Where products or manufacturers are specified by name, accompanied by the term "or equal," or "or approved equal", comply with the Contract Document concerning "substitutions" to obtain approval for use of an unnamed product.
 3. Contractors and suppliers will be expected to provide the specified product unless prior approval is received from E/A's office in sufficient time to notify Bidders through addendum.
- E. Descriptive Specification Requirements: Where specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the minimum characteristics and otherwise complies with Contract requirements.
- F. Performance Specification Requirements:
1. Where specifications require compliance with performance requirements, provide products that comply with these (minimum) requirements, and are recommended by the manufacturer for the application indicated.
 2. Manufacturer's recommendations may be contained in published product literature, or by the manufacturer's certification of performance.
 3. General overall performance of a product is implied where the product is specified for a specific application.
- G. Compliance with Standards, Codes and Regulations: Where the specifications only require compliance with an imposed code, standard or regulation, select a product that complies with applicable standards, codes and regulations.
- H. Visual Matching:
1. Where specifications require matching an established sample, E/A's decision will be final on whether a proposed product matches satisfactorily.
 2. Where no product available within the specified category matches satisfactorily but complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product, or for noncompliance with specified requirements.
- I. Visual Selection: Where specified product requirements include the phrase "...as selected from manufacturer's standard or exotic colors, patterns, textures..." or a similar phrase, select a product and manufacturer that comply with other specified requirements. E/A will select the color, pattern and texture from the product line selected.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 CLEANING AND PROTECTION

- A. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 01 60 00

SECTION 01 64 00 – Owner-Furnished Products

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements governing:
 - 1. Products furnished by Owner.
 - 2. Items that are to be included in the bid.
- B. The following is not included in this Section:
 - 1. Material or equipment manufactured or fabricated by contractor.
 - 2. Materials or equipment for which contractor would be the vendor, needed to make the equipment operational.
- C. Related Sections:
 - 1. Section 01 31 13 - Coordination
 - 2. Section 01 45 10 - Quality Control for Building Construction
 - 3. Section 01 60 00 - Product Requirements

1.2 REGULATORY REQUIREMENTS

- A. Applicable Codes and Regulations:
 - 1. Work shall be executed, inspected and/or tested in strict accordance with all local, county, and/or state laws, rules, ordinances or regulations and Owners' Insurance Underwriters.
 - 2. Comply with the regulations of plumbing, heating, and building inspection authorities having jurisdiction and with requirements of local utilities.
 - 3. Material, workmanship, or arrangements inferior to that required by these specifications, even though approved by above listed authorities, is not permitted.
- B. Certifications:
 - 1. Furnish applicable certificates of inspection and approval from authorities having jurisdiction.
 - 2. Should any changes be necessary in the Drawings or specifications to obtain permits, secure approval, or to accommodate Owner-purchased product, contractor shall immediately inform E/A.
 - 3. Certificates for approval or acceptance of Work shall be obtained in duplicate form, duly signed by the proper authorities, and forwarded to E/A upon completion of the Work.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, storage, and handling requirements of Section 01 60 00 apply to this Section.
- B. Acceptance at Site:
 - 1. Schedule and coordinate the delivery of materials purchased by Owner so that personnel and equipment will be available at the Site.
 - 2. When materials purchased by Owner are delivered to the Site, they will be received, inspected, unloaded, and stored by contractor responsible for their installation.
 - 3. Promptly inspect shipments to ensure that:
 - a. Products comply with requirements.
 - b. Quantities are correct.
 - c. Products are undamaged.

4. Do not accept damaged or unsuitable materials. Promptly notify Owner of unacceptable products.
5. Space for product storage shall be coordinated with Owner.
6. Keep constant check on progress of Work to ensure proper preparation and installation of Owner-purchased products.
7. Make periodic inspections of Work in progress and notify E/A when each portion of the Work is complete and ready for inspection.
8. Packings slips to Owner.
9. Subcontractor shall note on invoice the approval to pay, dated and signed by an authorized agent of the subcontractor, indication of acceptance of quality and quantity, then forward to Owner for payment.

PART 2 – PRODUCTS

2.1 PRODUCTS PURCHASED OR PROVIDED BY OWNER (FIXTURES AND EQUIPMENT)

- A. The Owner Furnished products / materials include:
 1. Furniture.
 2. Appliances.
 3. Direct Digital Control System for HVAC: refer to section 23 09 24.
 4. Toilet Accessories: refer to Section 10 28 13.
 5. Telecommunications/Data Equipment.
- B. Contractor shall confirm and coordinate purchases with Owner to ensure timely delivery and avoid delays to the project schedule.
- C. Contractor shall be responsible to exercise due care to ensure that Owner purchased equipment is protected from damage prior to installation, and accept responsibility for damages while connecting the specific equipment.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Contractor shall, at its sole expense, and as part of its Contract obligations, supply materials and equipment necessary to install Owner-purchased products.
- B. Contractor shall have the same responsibilities for installation of materials and equipment provided by Owner as he would have if purchased by contractor.

END OF SECTION 01 64 00

SECTION 01 73 00 – Execution Requirements

PART 1 – GENERAL

1.1 SUMMARY

- A. This section specifies general procedural requirements governing execution of the Work including, but not limited to:
 - 1. Construction Layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Sleeves and Openings.
 - 5. Cutting and Patching
 - 6. Coordination of Owner-furnished and Owner-installed products.
 - 7. Progress cleaning.
 - 8. Starting and adjusting.
 - 9. Protection of installed construction.
 - 10. Correction of the Work.
- B. Related Sections:
 - 1. Division 01 Sections.
 - 2. Individual technical sections in Divisions 2-33.

1.2 SUBMITTALS

- A. Qualification Data: For land surveyor to demonstrate their capabilities and experience, include lists of completed projects with project names and addresses, names and addresses of E/As and Owners, and other information specified.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- D. Final Property Survey: Submit two print copies and one electronic version showing the Work performed and record survey data.

1.3 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Existing Utilities:
 - 1. The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 - 2. Before construction, verify the location and invert elevation at points of connection of storm sewer and water service piping; and underground electrical services.

3. Furnish location data for work related to the Project that must be performed by public utilities serving the Project site.
- B. Acceptance of Conditions:
1. Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - a. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1) Description of the Work.
 - 2) List of detrimental conditions, including substrates.
 - 3) List of unacceptable installation tolerances.
 - 4) Recommended corrections.
 - b. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - c. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - d. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - e. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify E/A not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without E/A's written permission.
- C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit other construction, verify dimensions of other construction by field measurement before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to the E/A. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on the Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify E/A promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of the Project.

2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 3. Inform installers of lines and levels to which they must comply.
 4. Check the location, level and plumb, of every major element as the Work progresses.
 5. Notify E/A when deviations from required lines and levels exceed allowable tolerances.
 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations (refer to structural plans for detail denoting control between site and foundation).
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by E/A.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
1. Do not change or relocate existing benchmarks or control points without prior written approval of E/A. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to E/A before proceeding.
 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation as indicated.
1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts and wiring in finished areas, unless otherwise indicated.
 4. Maintain a minimum headroom clearance of 8 feet (2.4 m) in spaces without a suspended ceiling.

- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights as directed by the E/A.
 - 2. Allow for building movement, including thermal expansion and contraction.
- G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 SLEEVES AND OPENINGS

- A. Each contractor requiring sleeved openings shall furnish all sleeves required for their penetrations whether or not they are responsible for providing the respective openings. Contractors furnishing sleeves to others for installation shall do this in a timely manner so as not to impede the project schedule.
- B. Openings shown on the structural and/or architectural drawings shall be the responsibility of the General Building Contractor. Sleeves furnished by other contractors for openings shown on the structural and/or architectural drawing shall be installed by the General Building Contractor.
- C. Openings that are required and are not shown on the structural and/or architectural drawings shall be the responsibility of the contractor requiring the openings. The contractor requiring the opening shall install sleeves for these opening or cut openings as needed (including floor openings within chases).
- D. Individuals skilled in such work shall accomplish installation of sleeves and openings.
- E. Each contractor shall be responsible for coordinating locations of their sleeves with work of other trades.
- F. Each contractor who requires sleeves and/or openings shall submit to the E/A for review and approval, layout drawings of all such required sleeves and/or openings. Sleeve and openings layout drawings shall be received by the E/A a minimum of two weeks prior to installation of the sleeves and openings. Sleeve and opening sizes and locations shall be dimensioned from column lines and floor elevations or from a point of reference approved by the E/A.

3.7 CUTTING AND PATCHING

- A. Refer to Section 01 73 29 Cutting and Patching for more information.

3.8 OWNER-FURNISHED AND OWNER-INSTALLED PRODUCTS

- A. The General Building Contractor shall coordinate Owner-furnished products with the Owner. Refer to Section 01 64 00 Owner Furnished Products for more information.
- B. The General Building Contractor shall coordinate Owner-installed products with the Owner.
 - 1. Site Access: Provide access to project site for Owner's construction forces.

2. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
 - a. Construction Schedule: Inform Owner of General Building Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - b. Pre-installation Conferences: Include Owner's construction forces at pre-installation conferences covering portions of the Work that are to receive Owner's work. Attend pre-installation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.9 PROGRESS CLEANING

- A. General:
 1. Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - a. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris, if temperature is expected to rise above 80 degrees F (27 degrees C).
 - b. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - a. Remove liquid spills promptly.
 - b. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
- H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.10 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.11 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.12 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

SECTION 01 73 29 – Cutting and Patching

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Procedures for administration of cutting and patching of existing structures and buildings.
 - a. Submittals.
 - b. Quality assurance.
2. Materials.
3. Examination: Site conditions.
4. Preparation:
 - a. Temporary Support.
 - b. Protection.
5. Construction:
 - a. Special techniques.
 - b. Interface with others.
6. Cleaning.

B. Related Sections:

1. Section 01 33 00 - Submittal Procedures
2. Individual Specification Sections inferred by Cutting and Patching required.

1.2 SUBMITTALS

A. Refer to Section 01 33 00 – Submittal Procedures.

B. Schedules:

1. Initial Schedule:
 - a. 5 days prior to proposed start of work, submit to E/A six (6) copies of schedule of work involving cutting or patching.
2. Utility Schedule:
 - a. Include with initial schedule the following utility information:
 - 1) Which utilities will be disturbed or affected, including those that will be relocated or temporarily out-of-service.
 - 2) Length of time service will be disrupted.
3. Revised Schedules: Submit six (6) copies of updated schedules not less than once per week.

C. Structural Elements: Where cutting and patching involves addition to reinforcement to structural elements, submit six (6) copies of Shop Drawings including all details and structural calculations showing how reinforcement is integrated with the original structure.

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Personnel: Employ skilled workers.

B. Regulatory Requirements:

1. Structural Work Limitations:

- a. Do not cut and patch structural elements in manner to reduce load-carrying capacity or load-deflection ratio. Obtain acceptance of cutting and patching proposal before cutting and patching following structural elements:

- 1) Foundation construction.
- 2) Bearing walls.
- 3) Structural concrete.
- 4) Structural steel.
- 5) Lintels.
- 6) Structural decking.
- 7) Miscellaneous structural metals.
- 8) Equipment supports.

- b. Operational and Safety Limitations:

- 1) Do not cut and patch operating elements or safety related components in manner to reduce their capacity to perform as intended or result in increased maintenance or decreased operational life and safety. Obtain acceptance of cutting and patching proposal before cutting operating elements or safety related systems.

- 2) Visual Requirements:

- a) Do not cut and patch construction exposed on exterior or in occupied spaces in manner to, in E/A's opinion, reduce structure's/building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace work cut and patched in visually unsatisfactory manner. If possible, retain project contractors to patch following categories of exposed work, otherwise engage other recognized experienced, specialized firms including, but not limited to:

- (1) Special concrete finishes.
- (2) Masonry.
- (3) Stucco and plaster.
- (4) Acoustical ceilings.
- (5) Ceramic tile.
- (6) Flooring.
- (7) Roofing.

- C. Preinstallation Meetings: Before proceeding, meet at Site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures, resolve potential conflicts before proceeding.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Identical to existing materials. If not available or not usable where exposed surfaces are involved, match existing adjacent surfaces to fullest extent possible with regard to visual effect. Use materials whose installed performance equals or surpasses that of existing materials.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Site Conditions: Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. If unsafe or unsatisfactory conditions are encountered, correct before proceeding.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of work to be cut.
- B. Protection:
 - 1. Prevent damage to existing construction. Protect portions of project that might be exposed during work from adverse weather conditions.
 - 2. Avoid interference with use of or free passage to adjoining areas.
 - 3. Take necessary precautions to avoid cutting existing pipe, conduit, ductwork.

3.3 CONSTRUCTION

- A. Special Techniques:
 - 1. Cutting:
 - a. General:
 - 1) Use methods least likely to damage elements to be retained or adjoining construction. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2) Equipment:
 - a) Hand or small power tools designed for sawing or grinding. For concrete and masonry, use cutting machine such as carborundum saw or diamond core drill.
 - 3) Existing finished surfaces: Avoid marring; cut or drill from exposed or finished side into concealed surfaces.
 - 4) Excavating and Backfilling: Comply with requirements of applicable Sections of Division 31.
 - 5) Utility services:
 - a) Where services are shown or required to be removed, relocated or abandoned, bypass before cutting.
 - b) Cut off pipe or conduit in walls or partitions to be removed.
 - c) Cap, valve or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture, other foreign matter after by-passing and cutting.
 - b. Patching:
 - 1) Seams: Durable, invisible as possible.

- 2) Exposed finishes:
 - a) Restore, extend finish restoration into retained adjoining construction in manner to eliminate evidence of patching and refinishing.
 - b) Where finished areas extend into others, patch and repair floor and wall surfaces in new space to provide even surface of uniform color and appearance. Remove existing floor and all coverings, replace with new materials, if necessary to achieve uniform color and appearance.
 - c) Where patching occurs in smooth painted surface, extend final paint coat over entire unbroken area containing patch, after patched area has received primer and second coat.
 - d) Patch, repair, rehang existing ceilings as necessary to provide even plane surface of uniform appearance.

B. Interface with Others: Cut to provide for installation of other components or performance of the reconstruction activities and subsequent fitting and patching required to restore surfaces to original condition.

3.4 CLEANING

- A. Thoroughly clean areas, spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty, similar items. Thoroughly clean piping, conduit, similar features before painting or other finishing is applied. Restore damaged pipe covering to original condition.

END OF SECTION 01 73 29

SECTION 01 74 20 – Construction Waste Management

PART 1 – GENERAL

1.1 SUMMARY

- A. Administrative and procedural requirements for salvaging, recycling, and disposing of nonhazardous demolition and construction waste.

1.2 PERFORMANCE GOALS AND REQUIREMENTS

- A. Salvage/Recycle Requirements: Owner's goal is to salvage and recycle as much nonhazardous demolition and construction waste as possible including the following materials:
 - 1. Salvage, Demolition and Construction Waste:
 - a. Concrete and asphalt
 - b. Rough hardware.
 - c. Doors, frame, and hardware.
 - d. Equipment.
 - e. Piping.
 - f. Supports and hangers.
 - g. Electrical conduit.
 - h. Copper wiring.
 - i. Lighting fixtures.
 - j. Lamps and ballasts.
 - k. Electrical devices.
 - l. Switchgear and panelboards.
 - m. Transformers.
- B. Owner shall be given the "right of first refusal" on all items removed from the project work area. Items not taken by the Owner shall be recycled or disposed of per these specifications.

1.3 SUBMITTALS

- A. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations, and whether organization is tax exempt.
- B. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations and whether organization is tax exempt.
- C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them, including manifests, weight tickets, receipts, and invoices.
- D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them, including manifests, weight tickets, receipts, and invoices.
- E. Coordinate with Owner regarding salvaged waste materials to Owner prior to recycling or properly disposing of waste.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Waste Management Coordinator: Knowledgeable in waste management practices.
 - 2. Refrigerant Recovery Technician: Certified by EPA-approved certification program.

- B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 – EXECUTION

2.1 PLAN IMPLEMENTATION

- A. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator:
 - 1. Engage or appoint a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall make documentation available immediately upon request by A/E or Owner.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Site.
- D. Site Access and Temporary Controls:
 - 1. Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 2. Designate and label specific areas on Site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

2.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work:
 - 1. None
- B. Doors and Hardware:
 - 1. Brace open end of door frames.
 - 2. Except for removing door closers, leave door hardware attached to doors.

2.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to contractor.
- C. Procedures:
 - 1. Separate recyclable waste from other waste materials, trash, and debris.
 - 2. Separate recyclable waste by type at Site to the maximum extent practical.
 - 3. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Site.
 - 4. Include list of acceptable and unacceptable materials at each container and bin.
 - 5. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 6. Stockpile processed materials on-site without intermixing with other materials.
 - a. Place, grade, and shape stockpiles to drain surface water.
 - b. Cover to prevent windblown dust.

2.4 RECYCLING DEMOLITION WASTE

- A. Wood Materials:
 - 1. Sort and stack members according to size, type, and length.
 - 2. Separate lumber, engineered wood products, panel products, and treated wood materials.

- B. Metals: Separate by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- C. Piping:
 - 1. Reduce piping to straight lengths and store by type and size.
 - 2. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- D. Lighting Fixtures: Separate lamps by type and protect from breakage.
- E. Electrical Devices and Conduit: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

2.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets and bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets:
 - a. As much as possible, require deliveries using pallets to remove pallets from Site.
 - b. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 - 1. Clean Cut-offs of Lumber: Coordinate with Owner. If Owner does not grind them, properly dispose of the material.

2.6 DISPOSAL OF WASTE

- A. Reuse or return packaging material to suppliers or manufacturers as much as possible.
- B. Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- C. Burning: No burning allowed.
- D. Disposal: Transport waste materials off Owner's property and legally dispose of them, or as noted above.

SUMMARY OF SOLID WASTE DISPOSAL AND DIVERSION

Project: _____

Project Number: _____

Contractor Name: _____

License
Number: _____

Solid Waste Material	Date Material Disposed/ Diverted	Amount Disposed/ Diverted (ton or cu.yd.)	Municipal Solid Waste Facility (name, address, & phone number)	Recycling/Reuse Facility (name, address & phone number)	Comments (if disposed, state why not diverted)
Asphalt					
Concrete					
Metal					
Wood					
Debris					
Glass					
Clay Brick					
Paper Cardboard					
Plastic					
Gypsum					
Paint					
Carpet					
Other					

Signature: _____

Date: _____

Please provide comments and suggestions on back of form for increasing amount of recycled materials and improving solid waste prevention and recycling efforts during construction.

END OF SECTION 01 74 20

SECTION 01 74 23 – Final Cleaning

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for the final cleaning at Substantial Completion.
 - 1. Special cleaning requirements for specific elements of the Work are included in the individual technical sections of the specifications.
 - 2. General cleanup and waste removal requirements are included elsewhere in the Standard Specifications.
 - 3. Unless noted otherwise, each contractor is responsible for final cleaning of their own work. The General Building Contractor is responsible for coordination of final cleaning where more than one contractor is involved in final cleaning a single area or piece of equipment.
 - 4. Environmental Requirements: Conduct cleaning and waste disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and anti-pollution regulations.
- B. Related Sections:
 - 1. Section 01 45 10 - Quality Control for Building Construction
 - 2. Section 01 51 00 - Temporary Utilities
 - 3. Section 01 56 10 - Temporary Facilities & Installations
 - 4. Section 01 74 20 - Construction Waste Management
 - 5. Section 01 77 00 - Closeout Procedures
 - 6. Individual technical sections.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 FINAL CLEANING

- A. Conduct cleaning and waste-removal operations to comply with local laws and ordinances, and federal and local environmental and antipollution regulations. Employ experienced workers or professional cleaners for final cleaning.
- B. Comply with manufacturer's written instructions.
- C. Comply with safety standards for cleaning and disposal.
 - 1. Do not burn waste materials.
 - 2. Do not bury debris or excess materials on Owner's property.
 - 3. Do not discharge volatile, harmful, or dangerous materials into drainage systems.
 - 4. Remove waste materials from Site and dispose of lawfully.
- D. Where extra materials of value remain after completion of associated construction have become the Owner's property, dispose of these materials as directed.
- E. Clean Site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

- F. Clean each surface or unit to condition expected in a commercial building cleaning and maintenance program, including but not limited to:
 - 1. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - 2. Remove labels that are not permanent.
 - 3. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - 4. Replace parts subject to unusual operating conditions.
 - 5. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
- G. Remove temporary protection and facilities installed during construction to protect previously completed installations during the remainder of the construction period.
- H. Complete cleaning operations prior to requesting inspection for Certification of Substantial Completion for the entire Project or a portion of the Project. Complete Checklist 'A' (located at the end of this section), sign form, and submit to E/A.

SECTION 01 74 23 - FINAL CLEANING

CHECKLIST 'A'

To be completed by the General Building Contractor:

- ☐ Clean the Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste materials, litter and foreign substances. Sweep paved areas broom clean. Remove petro-chemical spills, stains and other foreign deposits. Rake grounds that are neither planted nor paved, to a smooth even-textured surface.
- ☐ Remove tools, construction equipment, machinery and surplus material from the site.
- ☐ Remove snow and ice to provide safe access to the building.
- ☐ Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
- ☐ Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- ☐ Wash concrete floors in unoccupied spaces.
- ☐ Vacuum carpet and similar soft surfaces, removing debris and excess nap. Shampoo if required.
- ☐ Adjust and clean as required in individual technical sections.
- ☐ Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
- ☐ Remove labels that are not permanent labels.
- ☐ Touch-up and otherwise repair and restore marred exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored, or that show evidence of repair or restoration. Do not paint over "UL" and similar labels, including mechanical and electrical name plates.
- ☐ Wipe interior surfaces of all cabinetwork including shelves, vertical dividers, and drawers.
- ☐ Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings and other foreign substances.
- ☐ Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- ☐ Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills. Clean ducts, blowers, and coils if units were operated for temporary facilities during construction.
- ☐ Clean light fixtures, lamps, globes and reflectors to function with full efficiency. Replace burned out bulbs, and defective and noisy starters in fluorescent and mercury vapor fixtures.
- ☐ Leave the Project clean and ready for occupancy.

I certify that the above list has been completed.

By (signature): _____

Name: _____

Title: _____

END OF SECTION 01 74 23

SECTION 01 77 00 – Closeout Procedures

PART 1 – GENERAL

1.1 SUMMARY

- A. Administrative and procedural requirements for contract closeout, including:
 - 1. Procedures for Substantial Completion.
 - 2. Procedures for Final Acceptance.
 - 3. Closeout Submittals.
 - 4. Transfer of Site to Owner.
- B. Related Sections:
 - 1. Section 01 51 00 - Temporary Utilities
 - 2. Section 01 56 10 - Temporary Facilities & Installations
 - 3. Section 01 74 23 - Final Cleaning
 - 4. Section 01 78 23 - Operation & Maintenance Data
 - 5. Section 01 78 39 - Project Record Documents
 - 6. Specific requirements for individual units of work are included in appropriate technical sections

1.2 SUBSTANTIAL COMPLETION

- A. Comply with requirements and provisions of the Standard Specifications and Special Provisions.
 - 1. System commissioning is part of the construction process. Documentation and testing of systems, as well as training of Owner's operation and maintenance personnel, is required in cooperation with the Owner.
- B. General Building Contractor's Procedures prior to Request for Inspection: Complete the following before requesting A/E's inspection for certification of Substantial Completion for each phase of work. List items that are incomplete in request.
 - 1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
 - a. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
 - 2. Advise Owner of pending insurance change-over requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, occupancy permits, releases, and similar documents.
 - 4. Submit bonding and insurance and lien waivers:
 - a. Consent of Surety to Reduction In or Partial Release of Retainage (if Performance Bond provided).
 - b. Provide lien waivers if requested by the A/E or the Owner.
 - 5. Remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
 - 6. Perform final cleaning and submit Checklist 'A'. See Section 01 74 23 Final Cleaning.
 - 7. Submit Closeout Procedures Checklist 'B' (located at the end of this section).

- C. General Building Contractor's Request for Inspection: When contractor considers the Work in compliance with requirements of Substantial Completion, submit the following to the E/A.
 - 1. A written notice that the Work, or designed portion thereof, is substantially complete.
 - 2. A list of items to be completed or corrected.
- D. E/A's Inspection Procedures: On receipt of a request for inspection, the E/A shall:
 - 1. Conduct an inspection for Substantial Completion.
 - 2. Review General Building Contractor's list and supplement the list of items to be completed or corrected, indicating items which must be completed or corrected before Work can be determined to be substantially complete.
 - 3. Prepare the Certificate of Substantial Completion following the inspection, or advise the General Building Contractor of construction that must be completed or corrected before the certificate will be issued.
- E. General Building Contractor's Corrective Actions Required prior to Substantial Completion: Contractor shall take necessary action to promptly complete and correct items on the work list that must be completed prior to Substantial Completion.
 - 1. When contractor has completed the open items, provide written notice to the E/A with an updated list of work items that have been completed, and those items that have been identified by the E/A that can be completed by Final Completion that are still outstanding, and that the Work is now ready for inspection.
- F. E/A's Re-Inspection: On receipt of a request for inspection, the E/A shall:
 - 1. Repeat inspections to ensure Work is substantially completed.
 - 2. Results of the completed inspection will form the basis of requirements for Final Acceptance.
 - 3. Prepare the Certificate of Substantial Completion following the inspection, or advise the General Building Contractor of construction that must be completed or corrected before the certificate will be issued.
- G. Re-Inspection Fees: Should the E/A be required to perform a second re-inspection due to failure of the Work to comply, the Owner may:
 - 1. Compensate the E/A for such additional services.
 - 2. Owner will deduct the amount of such compensation from the final payment to the General Building Contractor.
 - 3. Obtain and submit releases enabling Owner unrestricted use of the Work and access to services and utilities.

1.3 FINAL ACCEPTANCE

- A. Preliminary Procedures: Before requesting final inspection for certification of Final Acceptance and final payment, complete the following. List exceptions in the request.
 - 1. Submit final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and complete operations where required. Conform to the requirements of the Standard Specifications.
 - a. Lien Waivers (from all subcontractors and suppliers).
 - 2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
 - 3. Submit a certified copy of E/A's Substantial Completion inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved, and the list has been endorsed and dated by the E/A.

4. Submit final meter readings for utilities, records of stored fuel, and similar data as of the date of Substantial Completion, or when Owner took possession of and responsibility for corresponding elements of the Work.
 5. Submit Consent of Surety to final payment.
 6. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 7. Engage an experienced, licensed exterminator to make a final inspection and to rid Project of rodents, insects, and other pests. Provide written report to Owner.
- B. Notification for Final Acceptance: When General Building Contractor considers the Work is complete, contractor shall submit written certification to the E/A indicating:
1. Contract Documents have been reviewed.
 2. Work has been inspected for compliance with Contract Documents.
 3. Equipment and systems have been tested in the Owner's presence.
 4. Items on punch list for Substantial Completion have been fully completed or corrected.
 5. Contractor's closeout submittals have been properly assembled and submitted.
 6. Work has been completed in compliance with Contract Documents and is ready for final inspection.
- C. The E/A and Owner's Representatives will make an inspection to verify status of completion with reasonable promptness after receipt of contractor's written certification.
- D. If Owner's Representative or E/A considers there is incomplete or defective work:
1. E/A will promptly notify General Building Contractor in writing, listing the incomplete or defective Work.
 2. Contractor shall promptly take steps to remedy the stated deficiencies and send E/A a second written certification that the Work is complete.
- E. When the E/A finds Work is acceptable under the Contract Documents, E/A will request that the General Building Contractor make closeout submittals.
- F. Re-inspection Procedures: The E/A will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the E/A.
1. Upon completion of reinspection, E/A will prepare a Certificate of Final Acceptance or advise the General Building Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
 2. If necessary, re-inspection will be repeated.

1.4 CLOSEOUT SUBMITTALS

- A. Before requesting final inspection for certification of Final Acceptance and Final Payment, the General Building Contractor shall prepare and submit the following:
1. Project Record Documents, including subcontractors' "As-Built Documents". See Section 01 78 39 Project Record Documents for more information.
 2. Operating and Maintenance Manuals. See Section 01 78 23 Operation & Maintenance Data.
 3. Owner has been instructed in proper operation and maintenance of equipment and materials. See Section 01 78 23 Operation & Maintenance Data – Checklist 'C'.
 4. Special Warranty Manuals.
 5. Start-up and Commissioning Reports, required by Contract Documents including final test and balance reports.

6. Evidence of compliance with requirements of authorities having jurisdiction.
 7. Owner's acknowledgement that spare parts and extra materials have been received in the proper amounts, and stored in locations as indicated by the Owner.
- B. When Owner has determined the Work is acceptable under the Contract Documents, and confirmed by the E/A, the General Building Contractor shall prepare and submit the final Application for Payment together with the following:
1. Contractor's Affidavit of Payment of Debts and Claims.
 2. Contractor's Affidavit of Release of Liens.
 3. Contractor's lien waiver in the full amount of the Contract Sum.
 4. Lien waivers from Contractor, subcontractors, and major material suppliers who have furnished materials or labor for subcontractor. Lien waivers shall be in the full amount of the contract involved.
 5. Consent of surety to final payment on Consent of Surety Company to Final Payment form.
- 1.5 TRANSFER OF SITE TO OWNER
- A. Deliver tools, spare parts, extra materials and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 - B. Change door locks to Owner's access. Advise Owner's personnel of changeover in security provisions.
 - C. Advise Owner of changeover in heat and other utilities.
 - D. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

**SECTION 01 77 00 - CLOSEOUT PROCEDURES
CHECKLIST 'B'**

Prior to submitting the request for Substantial Completion, the General Building Contractor is responsible for the following:

- ☐ Submit a list to the E/A of incomplete items, stating reasons why each of the items is incomplete. The General Building Contractor shall stipulate a monetary value to complete each item.
- ☐ Notify the Owner thirty (30) days prior to any insurance coverage changes. Copy the E/A on this correspondence.
- ☐ Submit all warranties, maintenance contracts, and required operating instructions to the E/A for review and distribution to the Owner. See Section 01 78 23 Operation & Maintenance Data for timing.
- ☐ Obtain the Certificate of Occupancy to allow the Owner's full and unrestricted use of the project. General Building Contractor to check with all authorities having jurisdiction (AHJ). Submit to the E/A for review and distribution to the Owner.
- ☐ Submit record documents that show all changes made during construction, including all drawings, specifications, and addenda. Submit to the E/A for distribution to the Owner. See Section 01 78 39 Project Record Documents.
- ☐ Deliver to the Owner material replacement and maintenance stock as called for in the specifications.
- ☐ Complete the keying schedule, and deliver to the Owner with properly tagged master, submaster, room and special keys. Make final changes to lock cylinders and coordinate shifting building security to the Owner.
- ☐ Instruct the Owner to operate and maintain all systems and equipment. Submit completed copies of Checklist 'C' from Section 01 78 23 Operation & Maintenance Data to the E/A.
- ☐ Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
- ☐ Complete final clean up requirements, including touch up painting. Restore all damaged finishes. Submit completed checklist 'B' to the E/A. See Section 01 74 23 Final Cleaning.
- ☐ Consent of Surety provided for release of retention.
- ☐ Submit all required guarantees, certificates of inspections, and bonds. Sign a written guarantee at the completion of the work that covers all items requiring guarantees under the specifications. Submit copies to the Owner and E/A.

I certify that the above list has been completed. I hereby request the E/A's inspection for Substantial Completion.

By (signature): _____

Name: _____

Title: _____

END OF SECTION 01 77 00

SECTION 01 78 23 – Operation and Maintenance Data

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for operation and maintenance data:
 - 1. Operating and maintenance manuals.
 - 2. Material finish and maintenance information.
 - 3. Owner training and instruction.
- B. Related Sections:
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 01 77 00 - Closeout Procedures
 - 3. Division 2 -32 - Individual Technical Sections

1.2 SUBMITTALS

- A. Refer to Section 01 33 00 - Submittal Procedures.
- B. The General Building Contractor is responsible for submitting maintenance manuals for all Work. Where a manual includes information on installations by more than one contractor, the contractor who is the principal source of information shall receive information from other contractors, coordinate and collate information into a unified manual, and provide binders and submittal as required.
- C. Form and Format:
 - 1. Print:
 - a. Organize operation, maintenance data for equipment prepared in the form of an instruction manual of manageable size.
 - b. Bind into individual heavy-duty, 2-inch, 3-ring vinyl-covered binders with pocket folders, each set of data, marked with appropriate identification on both front and spine of each binder.
 - c. Text shall be manufacturer's printed data or typewritten data on 20-pound paper; page size 8-1/2-inch by 11-inch. Computer generated data shall be by letter quality printers or laser printers.
 - d. Clearly mark each sheet of product data to specify products, component parts, and data applicable to installation; delete inapplicable information.
 - e. Drawings and photographs shall have reinforced, punched binder tabs. Bind in with text, folding larger drawings to size of text pages.
 - 2. Electronic:
 - a. Provide an electronic version of the instruction manual in PDF form.
- D. Submittal Schedule:
 - 1. Submit 2 individually bound copies and one digital copy of preliminary draft of contents no later than 45 calendar days after approval of Shop Drawings.
 - 2. Submit 6 individually bound copies and two digital copies of completed data in final form not later than 7 calendar days prior to first instruction of Owner personnel.
 - 3. If instruction of Owner personnel is not required, submit completed data no later than 14 calendar days prior to final inspection.
 - 4. Submit 6 copies of additional requested data no later than 21 calendar days following instruction of Owner personnel.

1.3 QUALITY ASSURANCE

- A. Preparation of Project-specific data shall be by personnel trained and experienced in maintenance and operation of described products, equipment, systems, materials, or finishes.
- B. Photocopies: Drawings shall be legible and suitable for photocopying. All materials shall be reproducible. On material that contains data on several types/sizes/models of equipment, the specific type/size/model provided shall be clearly highlighted.

1.4 CONTENTS

- A. Table of Contents: Include with each volume, with tabs, with each product or system description identified. Manual to be organized systematically according to the Project Manual format. Include a list of each product included, identified by product name or other appropriate identifying symbol, and indexed to the content of the volume.
- B. Directory:
 - 1. List names, addresses and telephone numbers of:
 - a. E/A.
 - b. Contractor.
 - c. Manufacturers and suppliers, including local source of supplies and replacement parts.
- C. Data to be Included:
 - 1. System or equipment description with design factors and assumptions.
 - 2. Manufacturer's name, model number, and serial number of each component.
 - 3. Assembly, installation, alignment, inspection procedures.
 - 4. Critical tolerances.
 - 5. Startup procedures.
 - 6. Complete parts listing.
 - 7. Spare parts listing.
 - 8. Emergency instructions.
 - 9. Fabrication drawings.
 - 10. Copies of warranties.
 - 11. Recommended "turn-around" cycles.
 - 12. Inspection procedures.
 - 13. Shop Drawings and Product Data.
 - 14. Fixture lamping schedule.
- D. Data for Equipment and Systems:
 - 1. Provide manufacturer's printed operation and maintenance instructions.
 - 2. Provide sequence of operation and as-installed control diagrams by controls manufacturer.
 - 3. Provide composite wiring diagrams for supervisory control systems. Include wiring diagrams showing connections between equipment wiring, electrical wiring, and supervisory control system wiring.
 - 4. For equipment, include description of unit and component parts. Give function, normal operation characteristics and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replacement parts.
 - 5. For panelboard circuit directories, indicate electrical service characteristics, controls, and communications. Include as-installed color coded wiring diagrams.

6. Provide manufacturer's printed operation and maintenance instructions, including start-up, break-in, and normal operation instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operation instructions.
 7. For maintenance and preventative maintenance procedures include routine procedures; guide for "trouble-shooting;" and alignment, adjusting, balancing, and checking instructions.
 8. Provide servicing and lubrication schedule, and list of lubricants required.
 9. Provide manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance. Include recommended items and quantities to be stocked as spare parts.
 10. Maintenance contracts and green leases.
 11. In maintenance instructions, include attention to IAQ impacts of recommended maintenance procedures and materials.
- E. Data for Materials and Finishes:
1. For building products, applied materials, and finishes, include manufacturer's product data with catalog number, size, composition, color and texture designations, and reordering information for specially manufactured products.
 2. List instructions for care, maintenance, and preventative maintenance; include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
 3. For moisture-protection and weather exposed products, include manufacturer's product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

1.5 OWNER TRAINING AND INSTRUCTION

- A. The General Building Contractor shall arrange for each installer of operating equipment and other work requiring regular or continuing maintenance, to meet at Site with Owner's personnel to provide necessary basic instruction in proper operation and maintenance of entire work. Where installers are not experienced in required procedures, include instruction by manufacturer's representatives.
- B. Provide detailed review of following items:
1. Maintenance manuals.
 2. Record documents.
 3. Spare parts and materials.
 4. Tools.
 5. Lubricants.
 6. Fuels.
 7. Identification systems.
 8. Control sequences.
 9. Hazards.
 10. Cleaning materials and procedures.
 11. Warranties, bonds, maintenance agreements similar continuing commitments.
- C. As part of this instruction for operating equipment, demonstrate following procedures:
1. Start-up.
 2. Shut-down.
 3. Emergency operations.

4. Noise and vibration adjustments.
 5. Safety procedures.
 6. Economy and efficiency adjustments.
 7. Effective energy utilization.
- D. For equipment that requires seasonal operation, provide similar instruction during other seasons.
- E. Complete Checklist 'C', located at the end of this section, for each system requiring instruction or training, and submit signed copies to E/A prior to requesting Final Inspection.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION (NOT APPLICABLE)

To be completed by General Building Contractor

Training conducted by:

The General Building Contractor (GBC) shall meet with the Owner's personnel to provide instruction in proper operation and maintenance of equipment and materials. If the GBC is not experienced in procedures, provide instruction by manufacturer's representatives.

Include a detailed review of the following items:

- ☐ Maintenance manuals.
- ☐ Record documents.
- ☐ Spare parts and materials.
- ☐ Tools.
- ☐ Lubricants.
- ☐ Fuels.
- ☐ Identification systems.
- ☐ Control sequences.
- ☐ Hazards.
- ☐ Cleaning.
- ☐ Warranties and bonds.
- ☐ Maintenance agreements and similar continuing commitments.
- ☐ As part of instruction for operating equipment, demonstrate the following procedures:
 - ☐ Start-up.
 - ☐ Shutdown.
 - ☐ Emergency operations.
 - ☐ Noise and vibration adjustments.
 - ☐ Safety procedures.
 - ☐ Economy and efficiency adjustments.
 - ☐ Effective energy utilization.

I certify that I have completed the above review to the Owner's satisfaction.

Owner Signature _____ Representing _____ Date _____

GBC Signature	Representing	Date

Return signed and completed forms to the E/A prior to requesting Final Inspection.

SECTION 01 78 23 – OPERATION & MAINTENANCE DATA
CHECKLIST 'C'

To be completed by General Building Contractor
(Use as many forms as required by Specification Divisions 2 -32)

LIST OF REQUIRED OWNER TRAINING

I, the General Building Contractor (GBC) hereby certify that this is a full and complete listing of all Subcontractors, Installers and Vendors of operating equipment and other work which requires regular or continuing maintenance under my direct supervision. Owner training shall be provided for proper operation and maintenance of associated equipment and other work. If installers are not experienced in procedures, instruction by manufacturer's representatives will be provided.

Subconsultant Contractors, Installers and Vendors related to this project listed below:

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

I certify the above to be a full and complete list.

GBC Signature

Representing

Date

Return this completed, signed form to the E/A prior to requesting Final Inspection.

**SECTION 01 78 23 – OPERATION & MAINTENANCE DATA
CHECKLIST 'C'**

To be completed by Subcontractor, Installer or Vendor
(Use as many forms as required by Specification Divisions 2 -32)

Project Name: _____

Owner: _____

Building Component/System: _____

Training conducted by: _____

All Subcontractors, Installers, and Vendors of equipment and materials that require regular maintenance shall meet with the Owner's personnel to provide instruction in proper operation and maintenance. If Subcontractor, Installer, or Vendor is not experienced in procedures, provide instruction by manufacturer's representatives.

Include a detailed review of the following items:

- ☐ Maintenance manuals.
- ☐ Record documents.
- ☐ Spare parts and materials.
- ☐ Tools.
- ☐ Lubricants.
- ☐ Fuels.
- ☐ Identification systems.
- ☐ Control sequences.
- ☐ Hazards.
- ☐ Cleaning.
- ☐ Warranties and bonds.
- ☐ Maintenance agreements and similar continuing commitments.
- ☐ As part of instruction for operating equipment, demonstrate the following procedures:
 - ☐ Start-up.
 - ☐ Shutdown.
 - ☐ Emergency operations.
 - ☐ Noise and vibration adjustments.
 - ☐ Safety procedures.
 - ☐ Economy and efficiency adjustments.
 - ☐ Effective energy utilization.

I certify that I have completed the above review to the owner's satisfaction.

Subcontractor Signature Representing Date

Owner Signature Representing Date

Return signed and completed form to the General Building Contractor.

END OF SECTION 01 78 23

SECTION 01 78 39 – Project Record Documents

PART 1 – GENERAL

1.1 SUMMARY

A. Provide:

1. Project Record Documents, including but not limited to:
 - a. Record Drawings
 - b. Record Specifications.
 - c. Miscellaneous Record Submittals.

B. Related Sections:

1. Section 01 33 00 - Submittal Procedures
2. Section 01 78 23 - Operation & Maintenance Data
3. Section 01 77 00 - Closeout Procedures
4. Section 01 78 23 - Operation & Maintenance Data
5. Divisions 2 - 32 - Individual sections with listed requirements to provide record documents

1.2 QUALITY ASSURANCE

- A. Store Project Record Documents in the field office, apart from the Contract Documents used for construction.
- B. Do not use Project Record Documents for construction purposes.
- C. Maintain Project Record Documents in good order and in a clean, dry, legible condition.
- D. Documents shall be available at all times for the E/A's inspections.

1.3 RECORD DRAWINGS

A. Mark-up Procedure:

1. During construction, maintain one set of blue- or black-line white prints of Contract Drawings and Shop Drawings for Project Record Document purposes.
2. Mark these Drawings to show the actual installation where the installation varies from the installation shown originally. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
3. Items required to be marked include, but are not limited to, the following:
 - a. Dimensional changes to the Drawings.
 - b. Revisions to details shown on the Drawings.
 - c. Depths of foundations below the first floor.
 - d. Location and depth of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by change order or Construction Change Directive.
 - k. Changes made following the E/A's written orders.
 - l. Details not on original Contract Drawings.
4. Mark record sets with red erasable colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.

5. Mark important additional information that was either shown schematically or omitted from the original Contract Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, change order numbers, supplemental instruction numbers, construction bulletin numbers, and similar changes.
- B. Responsibility for Mark-up:
1. The General Building Contractor, whether the individual or entity is the installer, subcontractor, or similar entity, shall prepare the mark-up on the Project Record Drawings.
 2. Contractor shall:
 - a. Accurately record information in an understandable drawing manner.
 - b. Record data as soon as possible after obtaining it. Record and check the mark-up prior to enclosing concealed installations.
 - c. At the time of Substantial Completion, submit record drawings to the E/A for the Owner's records. Organize drawing into sets and bind with durable cover sheets that include appropriate identification, including titles, dates, and other information.

1.4 RECORD SPECIFICATIONS

- A. Mark-up Procedure:
1. During construction, maintain one set of the Project Specifications, including addenda and issued modifications, for Project Record Document purposes.
 2. Mark the Project Specifications to indicate information on concealed installations that would be difficult to identify or measure and record later.
- B. Responsibility for Mark-up:
1. Each prime contractor is responsible for marking up Sections that contain its own Work.
 2. The General Building Contractor is responsible for collecting marked-up record Sections from each of the other prime contractors. The General Building Contractor is responsible for collating these Sections, along with its own Sections, in proper numerical order, to form a complete set of Project Record Specifications.
 3. The General Building Contractor is responsible for submitting the complete set of Project Record Specifications upon completion to the E/A for the Owner's records.

1.5 MISCELLANEOUS RECORD SUBMITTALS

- A. Mark-up Procedure:
1. Refer to individual Specification sections for miscellaneous record keeping requirements and submittals in connection with various construction activities.
 2. Complete miscellaneous records immediately prior to Substantial Completion.
- B. Responsibility for Mark-up:
1. Each prime contractor is responsible for miscellaneous submittals and records that contain its own Work.
 2. The General Building Contractor is responsible for collecting miscellaneous submittals and records from each of the other prime contractors. The General Building Contractor is responsible for collating these records, along with its own records, in proper numerical order, into a single submittal. The Miscellaneous Record submittal shall be properly identified and bound or filled, and ready for use and reference.

3. The General Building Contractor is responsible for submitting the completed Miscellaneous Record submittal upon completion to the E/A for the Owner's records.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.1 RECORDING

- A. Post changes and modifications to the Documents as they occur. Do not wait until the end of the Project.

END OF SECTION 01 78 39

END OF DIVISION 01 – GENERAL REQUIREMENTS

DIVISION 03 – CONCRETE

TABLE OF CONTENTS

Section	Title
03 11 00	Concrete Forming
03 30 00	Cast-in-Place Concrete
03 41 00	Plant-Precast Structural Concrete
END OF INDEX	

SECTION 03 11 00 – Concrete Forming

PART 1 – GENERAL

- 1.1 SECTION INCLUDES
 - A. Design and installation of formwork with shoring, bracing and anchorage for cast-in-place concrete.
 - B. Coordination of work with Contractor for Cast-In-Place Concrete work scope.
- 1.2 REFERENCES
 - A. ACI 347 - Recommended Practice for Concrete Formwork
- 1.3 SUBMITTALS
 - A. Submit Product Data for form ties.
- 1.4 QUALITY ASSURANCE
 - A. The design, engineering, and proper construction of all formwork shall be the responsibility of the contractor.
 - B. Design formwork according to ACI 347.
- 1.5 PRODUCT HANDLING
 - A. Do not store forms or equipment on finished slabs.

PART 2 – PRODUCTS

- 2.1 FORM MATERIAL
 - A. Form Facing Material: Smooth faced, undamaged plywood or other panel type material approved by E/A.
 - B. The form facing material shall produce a smooth, hard, uniform texture on the concrete.
 - C. The arrangement of the facing material shall be orderly and symmetrical with the number of seams kept to a minimum.
 - D. Do not use facing material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface.
 - E. Fiber Tube Forms: Continuous laminated fiber tube with exterior moisture protection and non-adhering interior surface similar to "A Coated Sonotube" as manufactured by Sonoco Products, or approved equal.
 - F. Void Forms:
 - 1. Corrugated fiberboard forms impregnated with paraffin, as manufactured by firm regularly engaged in production of corrugated fiberboard forms.
 - 2. Design to safely support dead load of concrete and construction live loads for period of 2 weeks.

3. Design to prevent leakage of concrete or backfill materials and treat to prevent loss of strength and softening of form material due to moisture absorption.
 4. Size as shown on Drawings.
- 2.2 FORM TIES
- A. Form Ties: Factory fabricated, adjustable length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling concrete surfaces upon removal.
 - B. The portion of the tie remaining in the concrete after removal of the tie shall be at least 1 inch from the surface of the concrete.
 - C. Provide waterseals on all wall ties used in water containment structures and exterior walls.
- 2.3 FORM COATINGS
- A. Form Coatings or Release Agents: Commercially formulated chemical release agents containing no lubrication oil, conventional form oil, fuel oil, or kerosene. Containers shall have manufacturer's instructions for use printed thereon.
 - B. The form coating shall not penetrate, stain, or leave a residual film on the concrete surface and shall not attract dirt or other deleterious material.
- 2.4 ACCESSORIES
- A. Chamfer Strips: 3/4 inch by 3/4 inch wood or plastic strips.
 - B. Provide all anchorages, braces, and special forms required to construct cast-in-place concrete components shown on the Drawings.

PART 3 – EXECUTION

- 3.1 GENERAL
- A. Establish a benchmark in an accessible location and use as a reference point for various construction levels.
 - B. Verify lines, levels, and centers before proceeding with formwork.
 - C. Ensure that dimensions agree with the Drawings. Report any discrepancies to E/A before proceeding with Work.
- 3.2 FORMWORK DESIGN
- A. The design and construction of the formwork shall be the responsibility of the contractor.
 - B. Design formwork according to ACI 347.
 - C. Formwork shall be designed, erected, supported, braced, and maintained to safely support all vertical and lateral loads that might be applied until such loads can be supported by the concrete structure.
 - D. Camber formwork to compensate for anticipated deflections in the formwork prior to hardening of the concrete.
 - E. Provide positive means of adjustment of shores and struts.
 1. Take up all settlement during concrete placing operations.
 2. Securely brace forms against lateral deflections.
- 3.3 FORMWORK CONSTRUCTION
- A. Provide forms for all concrete work. Do not use earth cuts as forms for vertical surfaces.
 - B. Construct forms to conform to slopes, lines, and dimensions shown on the Drawings.
 - C. Forms shall be sufficiently tight to prevent loss of mortar from the concrete.
 - D. Place chamfer strips at all exposed corners.
 - E. Install all required openings, frames, pipe sleeves, cavities, slots, and other embedded items.

- F. Cut all holes in forms required for installation or embedment of concrete reinforcement bars and ties.
- G. Provide sharp clean corners at intersecting planes without visible edges or offsets. Back joints with extra studs or girts to maintain true, square corners.
- H. Provide temporary openings at the base of column forms and wall forms to facilitate cleaning and observation immediately before concrete is placed.
 - 1. Construct closures to ensure a tight fit flush with the adjoining surfaces.
- I. Provide runways for moving equipment.
 - 1. Provide runways with struts or legs and support directly on the formwork.
 - 2. Runways shall not rest on the reinforcing steel.
- J. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris before concrete is placed.
- K. Install Void Forms:
 - 1. Protect from moisture before concrete placement. Store above ground level in dry location.
 - 2. Do not use forms subjected to water, moist soils, or damp storage unless test loaded.
 - 3. Install on surface providing uniform support. Conform to recommendations of manufacturer.
 - 4. Protect from crushing and penetration of form at reinforcing steel supports and at other supports.

3.4 TOLERANCES

- A. Construct formwork so that concrete surfaces will conform with the following tolerances:
 - 1. Variation from Plumb:
 - a. In any 10 feet of length: 1/4 inch.
 - b. Maximum for entire length: 1/2 inch.
 - 2. Variation from the Level or Specified Grade:
 - a. In any 10 feet of length: 1/4 inch.
 - b. Maximum for entire length: 1/2 inch.
 - 3. Variation of the Linear Building Lines from Established Position in Plan and Related Position of Columns, Walls, Grade Beams and Partitions:
 - a. In any 20 feet of length: 1/2-inch.
 - b. Maximum for entire length: 1 inch.
 - 4. Variation in the Sizes and Locations of Sleeves, Floor Openings, and Wall Openings: 1/4-inch plus or minus.
 - 5. Variation in Cross-sectional Dimensions of Columns and Beams and in the Thickness of Slabs and Walls:
 - a. Minus: 1/4-inch.
 - b. Plus: 1/2-inch.
 - 6. Footings (tolerances apply to concrete dimensions only, not to positioning of reinforcing steel):
 - a. Variations in dimensions in plan:
 - 1) Minus: 1/2-inch.
 - 2) Plus: 1 inch.
 - b. Misplacement: 1 inch.

- c. Thickness:
 - 1) Decrease in thickness: 1/2-inch.
 - 2) Increase in thickness: No limit

7. Variations in Steps:

- a. In flight of stairs:
 - 1) Rise: 1/8 inch plus or minus.
 - 2) Tread: 1/4 inch plus or minus.
- b. In consecutive steps:
 - 1) Rise: 1/16 inch plus or minus.
 - 2) Tread: 1/8 inch plus or minus.

3.5 FORM SURFACE PREPARATION

- A. Clean surfaces of forms and embedded material of all accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed.
- B. Before placing the reinforcing steel or the concrete, cover the surfaces of the forms with an acceptable coating material that will effectively prevent absorption of moisture, prevent bond with the concrete, and not stain the concrete surfaces.
- C. Do not allow form coating material to stand in puddles in the forms.
- D. Form coating material shall not come in contact with hardened concrete against which fresh concrete is to be placed.
- E. Spray form coating on all concrete form surfaces, including wood forms for wall openings, keyway strips, and chamfer strips. Apply coatings according to manufacturer's instructions.

3.6 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used.
- B. Do not use split, frayed, delaminated, or otherwise damaged form facing material.

3.7 FORM REMOVAL

- A. Time specified below in this Article represents cumulative time during which temperature of concrete is maintained above 50 degree F (10 degree C) and for concrete without set-controlling admixtures.
 - 1. Reduce removal time in half for high-early strength cement concrete.
- B. Formwork for columns, walls, sides of beams, and other parts not supporting the weight of the concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations, but not less than 24 hours after completing concrete placement and finishing.
- C. Forms and shoring used to support the weight of concrete in beams, slabs, and other structural members shall not be removed in less than 10 days and not until the concrete has attained 3500 psi minimum compressive strength. Determine compressive strength by field-cured specimens.
- D. Once forms and shoring supporting beams, slabs, and other structural members have been removed, reshore concrete structural members at each level the same day such that all superimposed loads are uniformly distributed and transferred directly to the foundation through temporary supports.
 - 1. No construction or other live loads shall be permitted on the members, unless sufficient support is in place or concrete has attained full design strength and loads do not exceed the design maximum, as approved by E/A.

- E. Contractor shall be responsible for all damage resulting from removal of forms or premature overloading of structural members.
- F. Loosen wood forms for wall openings as soon as possible without damage to the concrete.

END OF SECTION 03 11 00

SECTION 03 30 00 – Cast-In-Place Concrete

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, reinforcement (Steel reinforcement bars, and Welded-wire reinforcement) mixture design, placement procedures, and finishes.
2. Form-facing material for cast-in-place concrete, Form liners, Insulating concrete forms, Shoring, bracing, and anchoring.

B. Related Requirements:

1. Section 014100 – Special Inspections and Testing.
2. Section 030130 – Maintenance of Cast in Place Concrete.
3. Section 033300 – Architectural Concrete.
4. Section 033536 – Polished Concrete Flooring.
5. Section 051200 – Structural Steel Framing.
6. Section 053113 – Steel Floor Decking.
7. Section 055000 – Metal Fabrications.
8. Section 072100 – Thermal Insulation.
9. Section 079200 – Joint Sealants.
10. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.
11. Division 32 Section "Concrete Paving" for concrete pavement and walks.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.
- C. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Owners designated representative
 - c. Independent testing agency responsible for concrete design mixtures.
 - d. Ready-mix concrete manufacturer.
 - e. Concrete Contractor.
 - f. Formwork Subcontractor.
 - g. Reinforcing Subcontractor.
2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control and reporting.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.

- c. Semirigid joint fillers.
- d. Vapor-retarder installation, mud slabs and waterproofing.
- e. Anchor rod and anchorage device installation tolerances.
- f. Cold and hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Methods for achieving specified floor and slab flatness and levelness.
- k. Floor and slab flatness and levelness measurements.
- l. Concrete repair procedures.
- m. Concrete protection and placement.
- n. Initial curing and field curing of field test cylinders
- o. Protection of field cured field test cylinders.
- p. Special considerations for early strength evaluation (CIPPOC, maturity meters, additional cylinders)
- q. Mix design and corrosion mitigation considerations.

1.4 Mass concrete considerations

1.5 SUBMITTALS

A. Product Data: For each of the following.

- 1. Vapor retarders.
- 2. Fiber Reinforcement
- 3. Floor and slab treatments.
- 4. Liquid floor treatments.
- 5. Curing materials.
 - a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
- 6. Joint fillers.
- 7. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

- 1. Mixture identification.
- 2. Minimum 28-day compressive strength.
- 3. Durability exposure class.
- 4. Maximum w/cm.
- 5. Calculated equilibrium unit weight, for lightweight concrete.
- 6. Slump limit.
- 7. Air content.
- 8. Nominal maximum aggregate size.
- 9. Macro-fiber reinforcement content.
- 10. Micro-fiber content.
- 11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.

12. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
 13. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
 14. Intended placement method.
 15. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings:
1. Sleeve and embedded conduit layout: Indicated proposed layout of plumbing, electrical, mechanical, teledata, architectural, etc. openings through each structural slab, beam and wall and conduit embedded in the structural elements. Indicate opening size and shape, and conduit diameter, spacing and elevation. Layout is subject to the approval of the Structural Engineer.
 2. Construction Joint Layout:
 - a. Supported slab construction joints required to complete the structure. Location of construction joints is subject to approval of the Design Professional.
 - 1) GC to coordinate construction joints with sensitive floor finish area.
 - b. Slab on grade construction and control joint plans illustrating column and wall conditions.
 3. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Informational Submittals
1. Qualification Data: For the following:
 - a. Installer: Include copies of applicable ACI certificates.
 - b. Ready-mixed concrete manufacturer.
 - c. Testing agency: Include copies of applicable ACI certificates.
 2. Material Certificates: For each of the following, signed by manufacturers:
 - a. Cementitious materials.
 - b. Admixtures.
 - c. Form materials and form-release agents
 - d. Steel reinforcement, accessories, corrosion treatments (epoxy plant certification)
 - e. Fiber reinforcement.
 - f. Waterstops
 - g. Curing compounds.
 - h. Floor and slab treatments.
 - i. Bonding agents.
 - j. Adhesives.
 - k. Vapor retarders.
 - l. Semirigid joint filler.

- m. Joint-filler strips.
 - n. Repair materials.
- 3. Material Test Reports and Product Data: For the following, from a qualified testing agency:
 - a. Portland cement or portland limestone cement
 - b. Fly ash.
 - c. Slag cement.
 - d. Blended hydraulic cement.
 - e. Silica fume.
 - f. Performance-based hydraulic cement.
 - g. Aggregates:
 - h. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
 - i. Admixtures:
 - 1) Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.
- 4. Research Reports:
 - a. For concrete admixtures according to ICC's Acceptance Criteria AC198.
 - b. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.
- 5. Preconstruction Test Reports: For each mix design.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.
 - 1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
 - 2. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
 - 3. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 - 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.

e. 28-day compressive strength.

f. Permeability.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94 and ACI 301.
- B. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Avoid damaging coatings on steel reinforcement.
- C. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
 - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 3. Do not use frozen materials or materials containing ice or snow.
 - 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
 - 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
 - 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 – PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.
- B. Formwork performance requirements:...

2.2 FORM-FACING MATERIALS

- A. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
 - 1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows
 - a. APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
 - b. APA Plyform Class I, B-B or better; mill oiled and edge sealed.
- B. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.
- D. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60, deformed bars, assembled with clips.
- E. Plain-Steel Wire: ASTM A 1064.
- F. Deformed-Steel Wire: ASTM A 1064.
- G. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.
- H. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064, flat sheet.
- I. Galvanized-Steel Welded-Wire Reinforcement: ASTM A 1064, plain, fabricated from galvanized-steel wire into flat sheets.
- J. Fabricating Reinforcement: Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 CONCRETE MATERIALS

- A. Source Limitations:
 - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.

2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
 3. Obtain aggregate from single source.
 4. Obtain each type of admixture from single source from single manufacturer.
- B. Cementitious Materials:
1. Portland Cement: ASTM C150, Type I/II, gray.
 2. Portland Limestone Cement: ASTM C595.
 3. Fly Ash: ASTM C618, Class C or F.
 4. Slag Cement: ASTM C989, Grade 100 or 120.
 5. Silica Fume: ASTM C1240 amorphous silica.
- C. Normal-Weight Aggregates: ASTM C33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
1. Alkali-Silica Reaction: Comply with one of the following:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested according to ASTM C1293.
 - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested according to ASTM C1567.
 - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested according to ASTM C1293 and categorized according to ASTM C1778, based on alkali content being calculated according to ACI 301.
 2. Maximum Coarse-Aggregate Size: Provide largest aggregate size that meets the following criteria:
 - a. 1/5 of narrowest dimension between sides of forms
 - b. 1/3 of depth of slabs
 - c. 3/4 of minimum clear distance between reinforcing bars or between bars and forms, whichever is least.
 - d. Maximum 1 inch nominal
 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Lightweight Aggregate: ASTM C330.
- E. Air-Entraining Admixture: ASTM C260.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C494, Type A.
 2. Retarding Admixture: ASTM C494, Type B.
 3. Water-Reducing and -Retarding Admixture: ASTM C494, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.
- G. Water and Water Used to Make Ice: ASTM C94, potable.

2.6 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Synthetic macro-fibers engineered and designed for use in concrete, complying with ASTM C1116, Type III, 1-1/2 to 2-1/4 inches (25 to 57 mm) long.

2.7 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
 - 1. Acceptable Products: One of the following:
 - a. Colloid Environmental Technologies Company; Volclay Waterstop-RX.
 - b. Progress Unlimited, Inc.; Superstop.
 - c. TCMiraDRI; Mirastop.

2.8 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 - 1. Acceptable Products: One of the following:
 - a. Fortifiber Corporation; Moistop Ultra 15.
 - b. Raven Industries Inc.; Vapor Block 15.
 - c. Reef Industries, Inc.; Griffolyn Type-65G.
 - d. W.R. Meadows, Sealtight Perminator.
 - e. Insulation Solutions, Inc.; Viper VaporCheck II.
 - f. Stego Industries, Stego Wrap 15.
 - 2. Vapor Retarder Permeance: Class I, 0.1 perm or less per ASTM E-96.

2.9 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
 - 1. Color:
 - a. Ambient Temperature Below 50 deg F: Black.
 - b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
 - c. Ambient Temperature Above 85 deg F: White.
- D. Water: Potable or complying with ASTM C1602.
- E. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
 - 1. Acceptable Products: One of the following:
 - a. Burke by Edoco; Aqua Resin Cure.
 - b. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
 - c. Euclid Chemical Company (The); Kurez DR VOX.
 - d. L&M Construction Chemicals, Inc.; L&M Cure R.
 - e. Meadows, W. R., Inc.; 1100 Clear.
 - f. Tamms Industries, Inc.; Horncure WB 30.
 - g. TCC Materials, ProSpec series.

- F. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
 - 1. Acceptable Products: One of the following:
 - a. Burke by Edoco; Cureseal 1315 WB.
 - b. Euclid Chemical Company (The); Super Diamond Clear VOX.
 - c. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - d. Meadows, W. R., Inc.; Vocomp-30.
 - e. Tamms Industries, Inc.; LusterSeal WB 300.
 - f. TCC Materials, ProSpec series.
- G. Clear, water-based, 40 percent alkylalkoxysilane penetrating sealer providing protection against moisture intrusion, freeze/thaw cycles, and chloride intrusion at slabs subject to vehicular traffic. Apply after membrane-forming curing compound.
 - 1. Acceptable Product: MasterProtect H 400 (formerly Enviroseal 40) by BASF.
 - 2. Protectosil® AQUA-TRETE® 40, Evonik Degussa A&S Division
 - 3. Iso-Flex 618-50 WB, LymTal International

2.10 RELATED MATERIALS

- A. Joint Sealant and Backer: Specified in Section 079200.
- B. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- C. Interior Bond Breaker Joint: 30 pound asphalt felt, unperforated.
- D. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- E. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- F. Floor Slab Protective Covering: Eight-feet-wide cellulose fabric.

2.11 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150 portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150 portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109/C109M.

2.12 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 2. Slag Cement: 50 percent by mass.
 3. Silica Fume: 10 percent by mass.
 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
 5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs concrete for parking structure slabs, and concrete with a w/cm below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 5. Use permeability-reducing admixture in concrete mixtures where indicated.
- E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.13 CONCRETE MIXTURES

- A. See S001 Structural notes for CONCRETE MIX DESIGN TABLE. Table includes:
 1. Minimum Compressive Strength.
 2. Maximum w/c.
 3. Air Content.
 4. Exposure classes F, S, W and C.
 5. Normal-weight concrete used for structural concrete elements typical.
 - a. Light weight where noted in TABLE.
- B. Slump Limit: Contractor shall submit slump criteria for engineer review. Slump shall not exceed 9 inches.

- C. Synthetic Macro-Fiber: Submit fiber manufacturer's documentation indicating that proposed macro fiber dosage will provide a minimum Fe3 value as follows according to ASTM C 1609.
1. Slab on grade: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 3.0 lb/cu. yd.
 2. Slab on deck: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 4.0 lb/cu. yd unless noted otherwise in the UL rating.
 3. Fe3 shall be defined as the RDT150 or Re3 (as determined through ASTM C1609 testing) multiplied by the flexural strength (Fr) of the concrete tested. (Fe3 = RDT150 x Fr)
 - a. 4" deep slab: Fe3 = 83 psi.
 - b. 5" deep slab: Fe3 = 97 psi.
 4. Maximum shrinkage of 0.04 percent per ASTM C 157. Submit ASTM C 157 results for at least 3 specimens and coordinate mix design with admixture manufacturer.

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94 and ASTM C1116, and furnish batch ticket information.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

2.15 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
1. Daily access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.

4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
 1. Do not construe tolerances for horizontal or vertical building line or footings to permit encroachment beyond legal boundaries.
- C. Compensation:
 1. Where necessary to maintain specified tolerances, camber formwork to compensate for anticipated deflection in formwork due to weight and pressure of fresh concrete and due to construction loads.
 - a. Contractor shall verify installed camber in all required slabs. Contractor shall provide Architect with survey indicating installed camber in formwork prior to concrete placement and a final survey after all shoring and re-shoring has been removed. Initial and final survey's are to be performed at the same location at the point of maximum specified camber.
 2. Construct forms for exposed concrete to allow for deflection and to eliminate bulges, offsets or other unsightly features in finished surfaces.
 3. Provide positive means of adjustment, such as wedges or jacks, for shores and struts and take up settlement during concrete placing operations.
- D. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 1. Smooth-Formed Finished Surfaces: Class A, 1/8 inch.
 2. Rough-Formed Finished Surfaces: Class C, 1/2 inch.
- E. Construct forms tight enough to prevent loss of concrete mortar.
- F. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

- M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 4. Install dovetail anchor slots in concrete structures where required.

3.5 INSTALLATION OF VOID FORMS AND SOIL RETAINERS

- A. Placement:
 - 1. Place forms on smooth, level, firm, dry surface.
 - 2. Butt carton forms tightly end to end and side to side, seam side down.
 - 3. Place cover sheets on carton forms and staple.
- B. Moisture Protection:
 - 1. Do not let carton forms become wet.
 - 2. Remove and replace wet cartons.
- C. Place soil retainers at edge of grade beams.

3.6 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.7 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E1643 and manufacturer's written instructions.
 - 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 - 2. Face laps away from exposed direction of concrete pour.
 - 3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
 - 4. Lap joints 6 inches and seal with manufacturer's recommended tape.

5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations according to vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.8 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
- G. Where concrete surface is exposed to weather or where rust would impair Architectural finishes, use galvanized or plastic accessories.
- H. Cover: Locate reinforcing to provide minimum concrete thickness according to ACI 318, unless noted otherwise on Drawings.
- I. Welded Wire Fabric Installation:
 1. Splice fabric so that overlap between outermost cross wires of each fabric sheet is minimum two wire spaces.
 2. Support fabric off grade or floor deck before placing concrete and wire together to prevent displacement of fabric during concrete placement.
 3. In structural concrete slabs over floor deck, locate fabric at center of slab depth, form top of slab to top of deck, unless noted otherwise on Drawings.
- J. Smooth Bars Dowels Installation:
 1. Center dowels on joints, position dowels at center of slab depth and align perpendicular to face of joints both vertically and horizontally.
 2. Within 30 minutes before placement of adjacent concrete along doweled joints, apply dowel coating on free ends of dowels.
- K. Fiber Reinforcement Installation:
 1. Install fiber reinforcement in concrete topping and slabs on grade.
 2. Use and proportion according to manufacturer's published recommendations.

3.9 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 - 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 6. Space vertical joints in walls no more than 40 feet on center. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to the greater of at least one-fourth of concrete thickness or 1 1/4" deep as follows:
 - 1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
 - 3. Ratio of long dimension to short dimension of slab panels created by control joints shall not exceed 1.5.
 - 4. Spacing of control joints shall align with column locations and not exceed the following:
 - a. Exterior Slabs = 24 times the slab thickness
 - b. Interior Slabs = 36 times the slab thickness
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
 - 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 - 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.10 WATERSTOP INSTALLATION

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.11 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 - 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 - 1. If a section cannot be placed continuously, provide construction joints as indicated.
 - 2. Deposit concrete to avoid segregation.
 - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 4. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Do not place concrete floors and slabs in a checkerboard sequence.
 - 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 3. Maintain reinforcement in position on chairs during concrete placement.
 - 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 5. Level concrete, cut high areas, and fill low areas.
 - 6. Slope surfaces uniformly to drains where required.

7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.12 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
 - b. Remove projections larger than 1 inch.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 Class D.
 - e. Apply to concrete surfaces not exposed to public view.
2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/4 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class B.
 - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
3. ACI 301 Surface Finish SF-3.0:
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/8 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class A.
 - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:
 - a. Perform no later than one day after form removal.
 - b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
 - c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
 - d. Maintain required patterns or variances as shown on Drawings or to match design reference sample, field sample panels, and/or mockups.
2. Grout-Cleaned Rubbed Finish:
 - a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
 - b. Do not clean concrete surfaces as Work progresses.

- c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
 - d. Wet concrete surfaces.
 - e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.
 - f. Maintain required patterns or variances as shown on Drawings or to match design reference sample, field sample panels, and/or mockups.
3. Cork-Floated Finish:
- a. Mix 1 part portland cement to 1 part fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint.
 - b. Mix 1 part portland cement and 1 part fine sand with sufficient water to produce a mixture of stiff grout. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
 - c. Wet concrete surfaces.
 - d. Compress grout into voids by grinding surface.
 - e. In a swirling motion, finish surface with a cork float.
 - f. Maintain required patterns or variances as shown on Drawings or to match design reference sample, field sample panels, and/or mockups.
4. Scrubbed Finish: After concrete has achieved a compressive strength of from 1000 to 1500 psi, apply scrubbed finish.
- a. Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed.
 - b. Rinse scrubbed surfaces with clean water.
 - c. Maintain continuity of finish on each surface or area of Work.
 - d. Remove only enough concrete mortar from surfaces to match design reference sample, field sample panels, and/or mockups.

C. Related Unformed Surfaces:

- 1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
- 2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.13 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish:
 - 1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
 - 2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
 - 3. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish or to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo <Insert locations>.

D. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, according to ASTM E1155, for a randomly trafficked floor surface:
 - a. Slabs on Ground:
 - 1) Specified overall values of flatness, FF 25; and of levelness, FL 20; with minimum local values of flatness, FF 17; and of levelness, FL 15 at carpeted slabs.
 - 2) Specified overall values of flatness, FF 35; and of levelness, FL 25; with minimum local values of flatness, FF 24; and of levelness, FL 17 at slabs with thin floor coverings.
 - 3) Specified overall values of flatness, FF 20; and of levelness, FL 15; with minimum local values of flatness, FF 10; and of levelness, FL 10 for noncritical floors such as mechanical rooms, non-public areas, and parking slabs.
 - b. Suspended Slabs:
 - 1) Specified overall values of flatness, FF 25; and of levelness, FL 20; with minimum local values of flatness, FF 17; and of levelness, FL 15.
 - 2) Specified overall values of flatness, FF 35; and of levelness, FL 20; with minimum local values of flatness, FF 24; and of levelness, FL 15 at slabs with thin floor coverings.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Architect before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 - 2. Coordinate required final finish with Architect before application.

3.14 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
 - 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 - 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 - 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - 2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
 - 3. Minimum Compressive Strength: 4000 psi at 28 days.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 - 6. Prior to pouring concrete, place and secure anchorage devices.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
 - 1. Cast-in inserts and accessories, as shown on Drawings.
 - 2. Screed, tamp, and trowel finish concrete surfaces.

3.15 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 - 1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
 - 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 - 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.

- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 2. Cure concrete containing color pigments according to color pigment manufacturer's instructions.
 3. If forms remain during curing period, moist cure after loosening forms.
 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheetting Materials: Cover exposed concrete surfaces with sheetting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
1. Begin curing immediately after finishing concrete.
 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12-inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.

- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- d. Floors to Receive Chemical Stain:
 - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
 - 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
 - 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
 - 4) Leave curing paper in place for duration of curing period, but not less than 28 days.
- e. Floors to Receive Urethane Flooring:
 - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

- 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.
 - 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
 - 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.
- f. Floors to Receive Curing Compound:
- 1) Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions.
 - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
 - 3) Maintain continuity of coating, and repair damage during curing period.
 - 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
- g. Floors to Receive Curing and Sealing Compound:
- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions.
 - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
 - 3) Repeat process 24 hours later and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.16 TOLERANCES

- A. Conform to ACI 117.

3.17 JOINT SEALING

- A. Prepare, clean, and install joint sealer according to manufacturer's written instructions.
1. Defer joint sealing until concrete has aged at least six months. Do not seal joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install joint sealer over joint backer.

3.18 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than 28 days' old.
 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
 4. Rinse with water; remove excess material until surface is dry.
 5. Apply a second coat in a similar manner if surface is rough or porous.

- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.19 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least six month(s).
 - 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.20 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces:
 - 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.21 FIELD QUALITY CONTROL

- A. Vapor Retarder Manufacturer's Field Service: Engage a site representative qualified by vapor retarder membrane manufacturer to inspect installation conditions, components, and installation, and furnish reports to Architect.

1. Provide written report that installation complies with manufacturer's written instructions.
 2. Remove and replace applications of vapor retarder where inspection indicates that it does not comply with specified requirements.
- B. Testing Agency: Owner will engage a special inspector and qualified testing and inspecting agency to perform tests and inspections and to submit reports.
1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured according to ASTM C31.
 2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports shall include reporting requirements of ASTM C31, ASTM C39, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Embedded items.
 5. Verification of use of required design mixture.
 6. Concrete placement, including conveying and depositing.
 7. Curing procedures and maintenance of curing temperature.

8. Verification of concrete strength before removal of shores and forms from beams and slabs.
 9. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. of concrete or 5000 sq feet of surface area of slabs or walls or fractions thereof of each concrete mixture placed each day.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C231 pressure method, for normal-weight concrete; ASTM C173 volumetric method, for structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C1064:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 5. Unit Weight: ASTM C567 fresh unit weight of structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 6. Compression Test Specimens: ASTM C31:
 - a. At a minimum, cast and laboratory cure two sets of two 6-inch by 12-inch or two sets of three 4-inch by 8-inch cylinder specimens for each composite sample.
 - b. Cast, initial cure, and field cure two sets of two 6-inch by 12-inch or two sets of three 4-inch by 8-inch cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C39. Required Sampling Frequency
 - a. Walls and Columns:
 - 1) 1 set of lab cured at 7 days
 - 2) 1 set each of lab and field cured at 28 days
 - 3) 1 set of lab cured at 56 days
 - b. Foundations and All Other Structural Concrete:
 - 1) 1 set of lab cured at 7, 28, and 56 days
 - c. A compressive-strength test shall be the average compressive strength from a set of specimens obtained from same composite sample and tested at age indicated.
 8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests:
 - a. The contractor is responsible for additional testing as required for form removal, post-tensioning, reshoring, etc.
 - b. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - c. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength shall be according to ACI 301 section 1.6.6.3.
12. Additional testing and inspecting, at contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness according to ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

3.22 PROTECTION

- A. Protect concrete surfaces as follows:
 1. Protect from petroleum stains.
 2. Diaper hydraulic equipment used over concrete surfaces.
 3. Prohibit vehicles from interior concrete slabs.
 4. Prohibit use of pipe-cutting machinery over concrete surfaces.
 5. Prohibit placement of steel items on concrete surfaces.
 6. Prohibit use of acids or acidic detergents over concrete surfaces.
 7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
 8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 03 30 00

SECTION 03 41 00 – Plant-Precast Structural Concrete

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide precast reinforced concrete units as follows:
 - 1. Deck panels.
 - a. Hollow-core slab units.
 - 2. Wall panels, including spandrel panels.
 - a. Insulated
 - b. Non-insulated.
 - 3. Accessories.
 - a. Bearing pads.
 - b. Core end plugs.
 - c. Clips, hangers.
 - d. Joint sealant.
 - e. Embed plates.
 - f. Weeps as may be recommended by the manufacturer.
- B. Furnish the following for other sections to install, including, but not limited to:
 - 1. Structural precast accessories to be embedded in cast-in-place concrete:
 - a. Bearing plates.
 - b. Column anchor bolts.
 - 2. Structural precast accessories to be embedded in masonry:
 - a. Bearing plates.
- C. Install the following provided by others:
 - 1. Sleeves and imbedded items for plumbing, heating, or electrical distribution.
- D. Perform the following:
 - 1. Provide openings as indicated on Drawings.
- E. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 03 45 00 - Precast Architectural Concrete
 - 3. Section 04 20 00 - Unit Masonry Assemblies
 - 4. Section 05 12 00 - Structural Steel Framing
 - 5. Section 05 21 00 - Steel Joist Framing
 - 6. Section 05 50 00 - Metal Fabrications
 - 7. Section 07 92 00 - Joint Sealants
 - 8. Section 07 84 00 – Firestopping

1.2 REFERENCES

- A. ACI:
 - 1. 301 - Specifications for Structural Concrete for Buildings
 - 2. 318 - Building Code Requirements for Reinforced Concrete

- B. ANSI/AWS:
 - 1. D1.1 - Structural Welding Code - Steel
 - 2. D1.4 - Structural Welding Code - Reinforcing Steel
- C. ASTM:
 - 1. A36 - Structural Steel
 - 2. A82 - Cold Drawn Steel Wire for Concrete Reinforcement
 - 3. A123 - Hot Dip Galvanized Coatings on Steel Products
 - 4. A153 - Zinc-Coating Iron and Steel Hardware
 - 5. A185 - Wire Fabric for Concrete Reinforcement
 - 6. A276 - Stainless Steel Bars and Shapes
 - 7. A416 - Undercoat Seven-Wire Stress-Relieved Strand for Prestressed Concrete
 - 8. A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 9. A666 - Cold-Worked Austenitic Stainless Steel Sheets, Plates, Strips
 - 10. C33 - Concrete Aggregates
 - 11. C144 - Aggregate for Masonry Mortar
 - 12. C150 - Portland Cement
 - 13. C260 - Air Entraining Admixtures for Concrete
 - 14. C1107 - Packaged Dry Nonshrink Hydraulic Cement Grout
 - 15. F593 - Stainless Steel Bolts, Hex Caps, Screws, Studs
- D. CRSI - Manual of Standard Practice
- E. PCI:
 - 1. MNL 116 - Manual for Quality Control for Plants and Production of Precast Concrete Products
 - 2. MNL 120 - Design Handbook-Precast and Prestressed Concrete
 - 3. MNL 123 - Manual on Design of Connections for Precast Prestressed Concrete
 - 4. MNL 124 - PCI Design for Fire Resistance of Precast Prestressed Concrete

1.3 SYSTEM DESCRIPTION

- A. Critical Design Requirements for Architectural Precast Wall Panels:
 - 1. Both wythes (interior and exterior) of insulated sandwich panels must be pre-stressed.
 - 2. The exterior wythe must be a minimum of 2 inches.
 - 3. Openings through panels larger than 8 inches must be plant-formed and cast.
 - 4. Exposed panel faces, returns and edges must receive specified finish.
 - 5. Controlled surface cracking - for faces and members exposed to weather - shall be limited to 0.007 inch.
 - 6. Allowable tolerances: Panels must comply with the maximum allowable tolerances listed in the Guide Specifications of the Precast/Prestressed Concrete Institute (PCI), latest edition.
 - 7. Design Deviations:
 - a. Permitted only after E/A's written approval of manufacturer's proposed design supported by complete design calculations and drawings.
 - b. Design deviations shall provide an installation equivalent to the basic intent without incurring additional cost to Owner.

- B. Performance Requirements:
 - 1. Size components to withstand design loads in an unrestrained condition according to State Building Code or the following, whichever is greater:
 - a. Floor assembly superimposed load: 150 pounds per square foot.
 - b. Roof assembly superimposed load of 50 plus snow drift.
 - 2. Grout Keys: Capable of transmitting horizontal shear of 2,000 pounds per foot.
 - 3. Insulation: Total minimum R-Value of 15.

1.4 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, concrete design mix, handling, storage and installation instructions, and maintenance and cleaning recommendations.
- C. Delegated-Design Submittal: For plant-precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Shop Drawings: Include member locations, plans, elevations, dimensions, shapes and sections, sleeved openings, support conditions, openings and types of reinforcement, including special reinforcement. Detail fabrication and installation of precast structural concrete units.
 - 1. Indicate joints, reveals, and extent and location of each surface finish.
 - 2. Indicate separate face and backup mixture locations and thicknesses.
 - 3. Indicate welded connections by AWS standard symbols. Show size, length, and type of each weld.
 - 4. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
 - 5. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 - 6. Include and locate openings larger than 10 inches by 10 inches.
 - 7. Include all sleeves in beams.
 - 8. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
 - 9. Indicate relationship of precast structural concrete units to adjacent materials.
 - 10. Indicate estimated camber for precast floor slabs with concrete toppings.
 - 11. Indicate shim sizes and grouting sequence.
 - 12. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
- E. Samples:
 - 1. Selection Samples: Submit manufacturer's standard color and textures with Product Data and Shop Drawings.
 - 2. Color Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics. Include notification to E/A if selection is not within quoted price range.
 - 3. Components: Submit samples of anchors, fasteners, hardware, and other materials and components if requested by E/A.

- F. Quality Assurance/Control Submittals:
1. Test Reports: Written report of proposed mix for each type of concrete and/or other materials at least 15 days prior to start of precast unit production if requested by E/A.
 2. Certificates:
 - a. Certified design calculations: Prepared by structural engineer licensed in state where project is located.
 - b. Submit certificates of approval in compliance with Section 01 33 00 and conform to IBC code for state in which Project is located.
 - c. Provide AWS D1.1 certification for welders.
 3. Calculated fire-resistance analysis.
 4. Material Certificates:
 - a. Concrete materials.
 - b. Reinforcing materials and prestressing tendons.
 - c. Admixtures.
 - d. Bearing pads.
- G. Maintenance Manual: Provide to Owner, maintenance and warranty data in "Maintenance Manual" compliant with Division 1 Specifications.

1.5 QUALITY ASSURANCE

- A. Qualifications of Personnel/Firm:
1. Delegated-Design Professional Engineer: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
 2. Fabricator: Firm with 5 years successful experience in fabrication of precast concrete units similar to units required for project; with sufficient production capacity to produce required units without delay in work; producer member of PCI and satisfactory participant in its Plant Certification Program.
 3. Fabrication Plant: Plant engaged primarily in manufacturing of similar units.
 4. Supervision: 1 person present during execution of work, thoroughly trained with 5 years' experience in materials and methods required, to direct fabrication and installation.
 5. Welder: Certified by AWS D1.1.
- B. Codes and Standards: Comply with referenced standards unless otherwise indicated.
- C. Fire-Resistance Rated Precast Units:
1. Comply with IBC code for state in which Project is located.
 2. Conform with PCI MNL-124 to achieve required ratings.
- D. Testing: Perform following ASTM tests for each 150 cubic yards of concrete placed, minimum of weekly, and provide documentation of compliance:
1. Slump: C143
 2. Compressive Strength: C31, C192, C39
 3. Air Content: C231 or C173
 4. Unit Weight: C138
- E. Field Samples: Furnish sample of each type of finish to E/A for review prior to manufacture.

- F. Plant Review: If requested by E/A, review precast products at plant prior to shipment to job site.
- G. Field-Erected Mockups:
 - 1. Before installing structural precast concrete, erect mock-up for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution.
 - 2. Build mock-up to comply with the following requirements, using materials indicated for final unit of work.
 - a. Location: Locate mock-up on site in location and size indicated or, if not indicated, as directed by E/A.
 - b. Erect mock-up in presence of E/A after having provided 7 days notification of date and time when mockup is to be constructed.
 - c. Scope: Demonstrate the proposed range of aesthetic effects and workmanship.
 - d. Acceptance: Obtain E/A's acceptance of mock-up before start of final unit of work.
 - e. Maintenance: Retain and maintain mock-up during construction in undisturbed condition as a standard for judging completed unit of work.
 - 3. Accepted mock-up in undisturbed condition at time of Substantial Completion may become part of completed unit of work.
- H. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protection: Comply with manufacturer's recommendations for job-site storage and protection.
- B. Deliver precast structural concrete units to Site in such quantities and at such times to ensure continuity of installation.
- C. General Contractor is responsible for storing hollow core units in such a manner as to prevent plank saturation during construction. Any issues arising from free water present in the units is the responsibility of the General Contractor.
- D. Protect units from contact with soil or ground.
- E. Place stored units so that identification marks are discernible.
- F. Damaged Material: Replace damaged material prior to acceptance at no additional cost to Owner.
- G. Lift and support units only at designated lifting and supporting points as shown on Shop Drawings.
- H. Separate stacked members by battens across full width of each bearing point.
- I. Do not use upper member of stacked tier as storage area for shorter member or heavy equipment.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements: Heat surfaces to be grouted to above freezing prior to installation of grout; keep temperature above 40 degrees F for 48 hours after completion of grouting.
- B. Existing Conditions: Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.8 SEQUENCING

- A. Coordination with Other Trades: Coordinate with installation of other materials and erection of other structural systems, including items to be cast in pre-cast units.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Precast Concrete Units:
 - 1. Standard of Quality: Design is based on products of Wells Concrete Products Company, Wells, MN www.wellsconcrete.com
 - 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. County Materials, Eau Claire, WI www.countymaterials.com
 - b. Gage Bros. Concrete www.gagebrothers.com
 - c. Molin, Lino Lakes, MN www.molin.com
 - d. Fabcon (12" VersaCore+Green product) www.fabconprecast.com
 - e. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
- B. Metallic Grout:
 - 1. Acceptable manufacturers:
 - a. Masterflow 885, Master Builders, Inc., Sika
 - b. Vibra-Foil, Grace Construction Products
 - c. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
- C. Nonmetallic Grout:
 - 1. Acceptable manufacturers:
 - a. Crystex, L & M Construction Chemicals, Inc.
 - b. Masterflow 928, Master Builders, Inc., Sika
 - c. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

- A. Formwork:
 - 1. General Requirements: Provide forms and form facing materials of metal, plastic, wood, other acceptable material, non-reactive with concrete, which produces required finish surfaces.
 - 2. Construction: Accurate, mortar-tight, of sufficient strength to withstand pressures due to concrete placing operations, temperature changes, and when prestressed, pretensioning and detensioning operations; completed units of shapes, lines, dimensions indicated, within fabrication tolerances specified in PCI MNL 116.
 - 3. Design: Unless forms for plant manufactured prestressed concrete units are stripped prior to detensioning, design so stresses are not induced in precast units due to deformation of concrete under prestress or to movement during detensioning.
- B. Reinforcing Materials:
 - 1. Reinforcing Bars:
 - a. Deformed billet-steel: ASTM A615, Grade 60.
 - b. Deformed rail-steel: ASTM A616.

- c. Deformed axle-steel: ASTM A617.
 - d. Deformed low-alloy steel: ASTM A706.
 - 2. Steel Wire: Plain, cold-drawn, ASTM A82.
 - 3. Wire Fabric:
 - a. Welded Steel: ASTM A185.
 - b. Welded Deformed Steel: ASTM A497.
 - 4. Supports for Reinforcement:
 - a. Bolsters, chairs, spacers, other devices for spacing, supporting, fastening reinforcing.
 - b. Comply with CRSI recommendations.
 - c. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, support with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).
 - 5. In areas of high corrosion use only stainless steel accessories.
- C. Prestressing Tendons:
 - 1. Uncoated, 7-wire stress-relieved strand complying with ASTM A416.
 - 2. Either Grade 250 or Grade 270.
 - 3. At manufacturer's option, similar strand, but with size and ultimate strength increased approximately 15 percent, or strand with increased strength but fewer number of wires.
- D. Concrete Materials:
 - 1. Portland Cement: ASTM C150, Type I or Type III; one brand and type throughout unless otherwise acceptable to E/A.
 - 2. Aggregates: ASTM C33, and as specified, from single source for exposed concrete.
 - 3. Lightweight Aggregate: ASTM C330.
 - 4. Water: Drinkable, free from foreign materials in amounts harmful to concrete and embedded steel.
 - 5. Admixtures: Certified by manufacturer to be compatible with other required admixtures.
 - a. Air-entraining 6 percent, ASTM C260.
 - b. Water reducing, accelerating, high range water reducing admixtures: ASTM C494 Type A.
 - c. No other admixtures may be used without E/A's acceptance.
 - d. Salts: The use of calcium chloride, chloride ions or other salts is not permitted.
- E. Supplementary Cementitious Materials:
 - 1. Fly Ash: ASTM C618, Class C or F, with maximum loss on ignition of 3 percent.
 - 2. Metakaolin Admixture: ASTM C618, Class N.
 - 3. Silica Fume Admixture: ASTM C1240, with optional chemical and physical requirement.
 - 4. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
- F. Connection Materials:
 - 1. Steel Plates: Structural quality, hot-rolled carbon steel, ASTM A36.
 - 2. Wide Flange Shapes: ASTM A992.

3. Miscellaneous Steel Shapes: ASTM A36.
 4. Carbon-steel Headed Studs: ASTM A108, cold finished.
 5. Stainless Steel: ASTM A240, 302 or 304.
 6. Anchor Bolts: ASTM F1554, low-carbon steel regular hexagon nuts, carbon steel washers.
 7. High Strength Threaded Fasteners: Heavy hexagon structural bolts, and hardened washers complying with ASTM A325.
 8. Finish of Steel Unit: Exposed units galvanized per ASTM A153; others painted with rust-inhibitive primer.
- G. Bearing Pads (Any listed below are acceptable):
1. Elastomeric: Vulcanized, chloroprene elastomeric compound, molded to size or cut from molded sheet, 50 to 70 Shore A durometer.
 2. Laminated Fabric-rubber: Preformed, unused synthetic fibers, new, unvulcanized rubber, surface hardness 70 to 80 Shore A durometer.
 3. Random-oriented, Fiber-reinforced Elastomeric: Preformed, fibers set in elastomer, 70 to 90 Shore A durometer.
 4. Cotton-duck Fabric Reinforced Elastomeric: Preformed, horizontally layered fabric bonded to elastomer, 80 to 100 Shore A durometer.
 5. Frictionless: Tetrafluoroethylene (TFE), with glass fiber reinforcing as required for service load bearing stress.
 6. Tempered Hardboard: PS 58, smooth both sides.
 7. Plastic: Multimonomer plastic strips, non-leaching, no visible overall expansion under construction loads.
- H. Grout Materials:
1. Cement Grout: Portland cement, ASTM C150, Type I, and clean, natural sand, ASTM C144. Mix 1 part cement to 3 parts sand, by volume, with minimum water required for placement and hydration.
 2. Metallic Shrinkage-resistant Grout:
 - a. Premixed factory packaged ferrous aggregate grouting compound.
 - b. ASTM C1107, Grade B.
 3. Nonmetallic Shrinkage-resistant Grout:
 - a. Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing and water reducing agents.
 - b. ASTM C1107, Grade B.
- I. Insulation Materials:
1. Extruded Polyisocyanurate: R(minimum) = 7.0 per inch at 40 degrees F, 5.00 per inch at 75 degrees F (Aged Values).

2.3 PRECAST CONCRETE UNITS

- A. General Requirements:
1. Free of voids or honeycomb, with straight true edges and surfaces.
 2. Texture:
 - a. Floor members: Broomed or raked top finish for bonding with concrete floor topping.
 - b. Roof members: Smooth, float top finish.
 3. Reinforcement: Adequate to resist transporting and handling stresses.

4. Cast-in Weld Plates: Provide where required for anchorage or lateral bracing to structural steel and adjacent precast members, including cast-in weld plate to provide connection of flanges of adjoining members.
- B. Structural Framing Units: Plant precast prestressed concrete units produced under rigid factory-inspected process.
 1. Columns.
 2. Beams.
- C. Hollow Core Plank: Precast prestressed concrete units with open voids running full length of slabs.
 1. Provide headers of cast-in-place concrete or structural-steel shapes for openings larger than 1 slab width, according to hollow-core slab unit fabricator's written recommendations.
 2. Provide solid, monolithic precast slab units forming an integral part of hollow slab unit system. Design and fabricate to dimensions and details indicated for hollow slab units.
- D. Wall Panels:
 1. Plant fabricated, solid, precast prestressed concrete units produced under rigid factory-inspected process.
 2. Panel Types:
 - a. Insulated Flat Wall Panel.
 - b. Non-insulated Flat Wall Panel.
 3. Insulated Flat Wall Panel:
 - a. Overall Thickness: 12 inch thick, unless noted otherwise.
 - b. 3 inch exterior concrete wythe, unless noted otherwise.
 - c. 3 inch insulation, unless noted otherwise.
 - d. 6 inch interior concrete wythe, unless noted otherwise.
 4. Non-Insulated Flat Wall Panel:
 - a. Overall Thickness: 8 inch thick, unless noted otherwise.
 5. Cast-in weld plates: Where required for anchorage or lateral bracing to structural steel and adjacent precast members, including weld plate to connect flanges of adjoining members, vertical dove tail slots 24 inches on center where panels support brick veneer.
- E. Precast supplier shall provide infill pieces at joist pockets and other locations.

2.4 ACCESSORIES

- A. Joint Sealant: As recommended by precast concrete manufacturer for interior and exterior locations, or if no recommendation by manufacture, use multi-component polyurethane sealant, including backing rod. Joint Sealant by Sikaflex2cNS is an acceptable alternative for the precast joints.
- B. Hollow Core Plank Core End Plugs: Glass fiber insulation.
- C. Clips, hangers, other accessories required for installation and for support of subsequent construction or finishes.
- D. Key way voids shall be manufactured to fit by precast manufacturer.
- E. Other Materials: Materials not specifically described but required for complete, proper installation of structural precast concrete, subject to acceptance of E/A.

2.5 MIXES

- A. Prepare design mixtures for each type of precast concrete required.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C 1218/C 1218M.
- D. Normal-Weight Concrete Mixtures: Proportion full-depth mixture by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 116.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of
- I. materials, Project conditions, weather, test results, or other circumstances warrant.
- J. Release Strength for Prestressed Units: 3,500 psi minimum.
- K. Curing Compression Test Cylinders:
 - 1. Use same methods as for precast concrete work.
 - 2. Do not begin concrete production until E/A reviews mixes and evaluations.

2.6 FABRICATION

- A. Comply with manufacturing and testing procedures, quality control recommendations, dimensional tolerances of PCI MNL-116, and as specified for types of units required.
- B. Built-in Anchorages:
 - 1. Accurately position and secure to formwork.
 - 2. Locate where they do not affect position of main reinforcement or placing of concrete.
 - 3. Do not relocate bearing plates in units unless acceptable to E/A.
- C. Openings:
 - 1. Cast-in holes for openings larger than 8 inch diameter or 8 inch square according to final Shop Drawings.
 - 2. Other smaller holes may be field cut by trades requiring them, as acceptable to E/A.
- D. Form Preparation:
 - 1. Coat surfaces with bond-breaking compound before reinforcement is placed, with commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces requiring bond or adhesion.
 - 2. Comply with manufacturer's instructions.

- E. Installation of Reinforcement:
1. Preparation: Clean off loose rust and mill scale, earth, other materials which reduce or destroy bond with concrete.
 2. Displacement: Accurately position, support, secure reinforcement against displacement by formwork, construction, or concrete placement operations.
 3. Support: Metal chairs, runners, bolsters, spacers, and hangers, as required.
 4. Place to obtain at least minimum coverages for concrete protection.
 5. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations.
 6. Wire Ties: Set so ends are directed into concrete, not toward exposed concrete surfaces.
 7. Cut ends of strands not enclosed or covered flush and cover with high strength mortar, bonded to unit with epoxy resin bonding agent.
- F. Pretensioning:
1. Single strand tensioning method or multiple-strand tensioning method.
 2. Comply with PCI MNL-116 requirements.
- G. Concrete Placement:
1. Continuous operation to prevent formation of seams or planes of weakness in precast units, complying with requirements of ACI 304.
 2. Thoroughly consolidate placed concrete by internal and external vibration without dislocation or damage to reinforcement and built-in items.
- H. Identification:
1. Permanent markings to identify pick-up points and orientation in structure, complying with markings indicated on final Shop Drawings.
 2. Imprint date of casting on each precast unit on a surface which will not show in finished structure.
- I. Curing by Moisture Retention:
1. Form cure minimum 20 hours by moisture retention (without heat) method or accelerated heat curing with low-pressure live steam or radiant heat and moisture.
 2. Do not subject concrete to steam or hot air until after the concrete has attained its initial set. Take precautions to prevent moisture loss from concrete if using hot air for curing.
 3. Do not allow temperature of concrete to exceed 160 degrees F.
 4. Keep wet continuously for at least 6 days after being removed from the forms.
 5. Following curing period, allow the units to air dry for minimum 4 days before shipping to Site.
 6. Extend curing period if air temperature is below 50 degrees F.
- J. Detensioning:
1. Timing: Delay until concrete has attained at least 70 percent of design stress, as established by test cylinders.
 2. Heat-cured Concrete: Perform while concrete is still warm and moist, to avoid dimensional changes which may cause cracking or undesirable stresses in concrete.
 3. Pretensioned Tendons: Gradual release of tensioning jacks or by heat cutting tendons, using sequence and pattern to prevent shock or unbalanced loading.

2.7 FINISHES

- A. Formed Surfaces: For formed surfaces of precast concrete as indicated for each type of unit, and as follows:
 - 1. Standard Finish:
 - a. Normal plant run finish produced in forms that impart smooth finish to concrete.
 - b. Small surface holes caused by air bubbles, normal form joint marks, minor chips and spalls will be tolerated, but no major or unsightly imperfections, honeycomb, or structural defects will be permitted.
 - 2. Commercial Finish:
 - a. Exposed-to-view precast-prestressed elements.
 - b. Remove fins, large protrusions and fill large holes.
 - c. Rub or grind ragged edges.
 - d. Faces to be true, well-defined surfaces.
- B. Unformed Surfaces:
 - 1. Apply trowel finish to unformed surfaces unless otherwise indicated.
 - 2. Consolidate concrete; bring to proper level with straightedge, float, and trowel to smooth uniform finish.
 - 3. Surfaces for Toppings: Apply scratch finish to precast units that will receive concrete topping after installation.
 - 4. Following initial strike off, transversely scarify surface to provide ridges approximately 1/4 inch deep.
- C. Exposed Textures: Fabricate precast units and provide exposed surface finishes as follows to match E/A's control samples:
 - 1. Steel Smooth Form Surface: Make surface free of pockets, sand streaks, honeycomb; with uniform color and texture.
 - 2. Light Broom: After troweling, smooth broom lightly with fine broom drawn over surfaces in direction parallel with long dimension.
 - 3. Exposed Aggregate: Use chemical retarding agents applied to concrete forms with washing and brushing procedures after form removal.
 - 4. Formliners: Impart textured surface by form liners or inserts to provide surfaces free of pockets, streaks, and honeycombs, with uniform color and texture.
 - 5. Sandblasting: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
 - 6. Acid Etching: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
 - 7. Sand Embedment: Use selected stones placed in a sand bed in bottom of mold, with sand removed following curing.
 - 8. Honing or Polishing: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
 - 9. Refer to the Drawings for location and type of exposed textures.
- D. Exposure:
 - 1. Light Exposure: Only surface skin of cement and sand is removed, just sufficiently to expose the tips of the closest coarse aggregate.
 - 2. Medium Exposure: Removal of cement and sand to cause the coarse aggregate to visually appear approximately equal in area to the matrix.

3. Deep Exposure: Removal of cement and sand to allow the coarse aggregate to become major surface area.
 4. Refer to the Drawings for location and type of exposure.
- E. Color:
1. Natural gray for the hollow core floor planks.
 2. Wall panels with architectural features:
 - a. Pigments: As selected by from manufacturer's full range of color selections, and as indicated on the Drawings.

2.8 SOURCE QUALITY CONTROL

- A. Fabrication Tolerances: Conform to referenced standards.
- B. Tests, Inspections:
1. Testing: Unit dimensions smaller or greater than required, and outside specified tolerance limits are subject to additional testing as specified.
 2. Strength of Units: Strength of units will be considered potentially deficient if manufacturing processes fail to comply with any requirements which may affect strength, including following conditions:
 - a. Failure to meet compressive strength tests requirements.
 - b. Reinforcement, pretensioning and detensioning of tendons of prestressed concrete, not conforming to specified fabrication requirements.
 - c. Failure to cure, protect units against extremes in temperature as specified.
 - d. Precast units damaged during handling and erection.
 3. Suspected Non-compliance Testing: When there is evidence that strength of units does not meet specification requirements, the concrete testing service shall take cores drilled from hardened concrete for compressive strength determination, complying with ASTM C42 and as follows:
 - a. At least 3 representative cores from units of suspect strength, from locations directed by E/A.
 - b. Test cores in saturated surface dry condition per ACI 318 if concrete will be wet during use of completed structure.
 - c. Test cores in air-dry condition per ACI 318 if concrete will be dry during use of completed structure.
 - d. Strength of concrete for each series of cores will be considered satisfactory if average compressive strength is at least 85 percent of 28-day design compressive strength.
 - e. Test results are to be made in writing on same day tests are made, copies given to E/A, Contractor, and precast manufacturer. Include project name, number, date, manufacturer's name, concrete testing service name, identification letter, name, type of member or members represented by core tests, design compressive strength compression breaking strength and type of break (corrected for length-diameter ratio), direction of applied load to core with respect to horizontal plan of concrete as placed, and moisture condition of core at time of bearing.
 4. Patching: Where core test results are satisfactory and precast units are acceptable for use in work, fill core holes solid with patching mortar. Finish to match adjacent concrete surfaces.
 5. Defective Work: Replace with units that meet requirements of this section. Make corrections to other work affected by or resulting from corrections to precast concrete work at no cost to Owner.

- C. Verification of Performance:
 - 1. Owner may employ separate testing laboratory to evaluate manufacturer's quality control and testing methods.
 - 2. Allow access to materials storage areas, concrete production equipment, concrete placement and curing facilities.
 - 3. Cooperate, provide samples of materials and concrete mixes as requested.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that the structural precast concrete may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies:
 - 1. Immediately notify E/A.
 - 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 - 3. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.
- B. Surface Preparation, Field Welding and Cutting: Protect units from damage, provide non-combustible shield as required.

3.3 ERECTION

- A. Compliance: Comply with manufacturer's instructions, including product technical bulletin installation instructions and Shop Drawing details.
- B. Bearing Pads:
 - 1. Where indicated, as precast units are being erected.
 - 2. Set on level, uniform bearing surfaces.
 - 3. Maintain in correct position until precast units are placed.
- C. Powder-Actuated Fasteners: Do not use for surface attachment of accessory items in precast, prestressed unit unless otherwise accepted by precast manufacturer.
- D. Installation Tolerances: Do not exceed following tolerance limits:
 - 1. Variation from plumb: 1/4-inch in 20-foot run or story height, 1/2-inch total in 40-foot or longer run.
 - 2. Variation from level or elevations: 1/4-inch in 20-foot run; 1/2-inch in 40-foot run; total plus/minus 1/2 inch any location.
 - 3. Variation from position in plan: plus/minus 1/2-inch maximum any location.
 - 4. Offset in alignment of adjacent members any joint: 1/16-inch in 10-inch run: 1/4 inch maximum.
- E. Grouting Connections and Joints: After precast concrete units placed and secured, grout open spaces at connection and joints.
 - 1. Retain grout in place until sufficiently hard to support itself.
 - 2. Pack spaces with stiff grout material; tamp until voids completely filled.
 - 3. Finish smooth, plumb, level with adjacent concrete surfaces.

4. Keep grouted joints damp for not less than 24 hours after initial set.
 5. Promptly remove grout material from exposed surfaces before it hardens.
- F. Sealing Joints:
1. Seal exposed and non-exposed, exterior and interior joints. Use primer and backer rod as recommended by sealant manufacturer.
 2. Seal joints between roof and floor elements, between wall elements anywhere roof or floor and walls join.
- 3.4 FIELD QUALITY CONTROL
- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.
 - B. Field welds and connections using high-strength bolts will be subject to tests and inspections.
 - C. Testing agency to report tests results promptly in writing to contractor and E/A.
 - D. Additional testing and inspecting, at contractor's expense, will be performed to determine compliance of corrected work with specified requirements.
- 3.5 REPAIR/RESTORATION
- A. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance. Use materials, procedures recommended or furnished by manufacturer.
 - B. Damaged Metal Surface: Clean, apply coat of liquid galvanized repair compound to galvanized surfaces, compatible primer to painted surfaces.
 - C. Units Having Dimensions Smaller or Greater Than Required and Outside Specified Tolerance Limits: If appearance or function of structure is adversely affected, or if larger dimensions interfere with other construction, repair, or remove and replace as required to meet construction conditions.
- 3.6 ADJACENT PANEL ALIGNMENT
- A. Panels not in flush alignment with adjacent wall panels, and beyond allowable tolerance, must be replaced or, if possible, may be mechanically straightened and permanently fastened to remain at this intended alignment.
 - B. Fastener hardware for such corrections must be concealed and cast into the original panels to allow for such correction. See Drawings.
 - C. Weld Plates must provide full contact with each other to allow for full and thorough weld bead.
- 3.7 CLEANING
- A. Site:
 1. Do not allow accumulation of scraps, debris arising from work of this section.
 2. Maintain premises in neat, orderly condition.
 - B. System:
 1. Remove temporary covering and other provisions made to minimize soiling of other work.
 2. Promptly clean, repair surfaces stained, marred or otherwise damaged during work.
 3. Clean exposed surfaces of structural precast concrete using materials and methods recommended by manufacturer.
 4. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes.
 5. When work is completed, remove unused materials, containers, equipment, and debris.

END OF SECTION 03 41 00

END OF DIVISION 03 – CONCRETE

DIVISION 04 – MASONRY

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SECTION 04 22 00 – Concrete Unit Masonry

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. CMU wall masonry.
- B. Related Sections:
 - 1. Section 014100 – Special Inspections and Tests.
 - 2. Section 033000 – Cast-in-Place Concrete.
 - 3. Section 051200 – Structural Steel Framing.
 - 4. Section 055000 – Metal Fabrications.
 - 5. Section 081113 – Hollow Metal Doors and Frames.

1.2 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Burnished Concrete Masonry Unit
 - a. Color Selection
 - 1) For Initial Selection: Unit masonry sample box-sized samples showing the full range of colors and textures available for each different exposed masonry unit required.
 - 2) For Verification Purposes: Full-size units or full-face shells showing the full range of colors and textures expected in the completed project.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
 - a. Show elevations of reinforced walls.
- C. Informational Submittals:
 - 1. Qualification Data: For testing agency.
 - 2. Material Certificates: For each type and size of the following:
 - a. Masonry units.
 - 1) Include data on material properties, or material test reports substantiating compliance with requirements.

- 2) For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
- b. Cementitious materials. Include name of manufacturer, brand name, and type.
- c. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
- d. Grout mixes. Include description of type and proportions of ingredients.
- e. Reinforcing bars.
- f. Joint reinforcement.
- g. Anchors, ties, and metal accessories.
3. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - a. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
 - b. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
4. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.
5. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet (6 m) vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. CMU-1: Concrete Masonry Units: ASTM C 90 and as follows:
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
 - 2. Weight Classification: Normal weight.
 - 3. Provide Type I, moisture-controlled units.
 - 4. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 - 5. Exposed Faces: Manufacturer's natural color and burnished texture.
- C. Concrete Building Brick: ASTM C 55.
 - 1. Unit Compressive Strength: Match adjacent CMU.
 - 2. Density Classification: Normal weight.
 - 3. Size: As required to adjust dimensions in CMU construction.

2.5 STEEL-EMBEDDED CONCRETE MASONRY UNIT

- A. Steel-Embedded CMU: Manufactured CMU complying with ASTM C-90, with steel plate embedded in one or more faces.
 - 1. Steel Finish: 2 mil red oxide coating.
 - 2. Thickness: 0.1875 inch (3/16 inch).
- B. Embedded block steel plate shall pass the following:
 - 1. Static strength pullout test at 6,000 pounds minimum.
 - 2. Cyclical fatigue arm load test applied at load sequence 0 to 400 to 0 lbs. for 60,000 cycles, then 0 to 500 to 0 lbs. for 40,000 cycles.
 - 3. Ultimate load test of 2,600 lbs.

2.6 CONCRETE AND MASONRY LINTELS

- A. General: Provide one of the following:
- B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.
- C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 033000 "Cast-in-Place Concrete," and with reinforcing bars indicated.
- D. CMU Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.7 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
 - 1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.

- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Mortar Cement: ASTM C 1329/C 1329M.
- E. Aggregate for Mortar: ASTM C 144.
 - 1. For joints less than 1/4-inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
- F. Aggregate for Grout: ASTM C 404.
- G. Cold-Weather Admixture: Non-chloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- H. Water: Potable.

2.8 REINFORCEMENT

- A. Steel Reinforcing Bars, Uncoated: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. CMU Masonry Joint Reinforcement: ASTM A 951/A 951M, and as follows:
 - 1. Type: Ladder type with single pair of side rods.
 - 2. Exterior Walls: Hot dip galvanized.
 - 3. Interior Walls: Mill-galvanized, carbon steel.
 - 4. Wire Size for Side and Cross Rods:
 - a. 0.148-inch diameter for CMU Walls 8 inches nominal.
 - b. 0.187-inch diameter for CMU walls 12 inches nominal.
 - 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 - 6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

2.9 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
 - 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 - 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire.
 - 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized steel wire.

- D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.105-inch- thick steel sheet, galvanized after fabrication.
 - 2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- diameter, hot-dip galvanized steel wire.
- E. Partition Top Anchors: 0.105-inch- thick metal plate with a 3/8-inch- diameter metal rod 6 inches) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot dip galvanized after fabrication.
- F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
 - 1. Corrosion Protection: Hot dip galvanized to comply with ASTM A 153/A 153M.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).
- D. Masonry Cleaning Materials: Select and provide cleaning products and methods for removing mortar and grout stains, efflorescence, and other new construction stains from new masonry, without discoloring or damaging masonry surfaces.
 - 1. Acceptable Manufacturers: One of the following:
 - a. Diedrich Technologies, Inc.
 - b. ProSoCo, Inc.
 - c. EaCo Chem, Inc.
 - 2. Use product expressly approved for use by authorities having jurisdiction.
 - 3. Use product recommended by both masonry product and cleaning product manufacturers for cleaning types of masonry products indicated for this Project.
 - 4. Use methods that are the least aggressive that will effectively clean the wall of mortar smears, construction dirt, superficial efflorescence, and contaminants, to produce a uniform, clean appearance.
 - a. Do not use abrasive methods, unless otherwise indicated or approved in writing by Architect.
- E. Masonry Cell Insulation: INSUL-6C specified in Section 072100.

2.11 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, [Proportion] [Property] Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
 - 1. For masonry below grade or in contact with earth, use Type M.
 - 2. For reinforced masonry, use Type S.
 - 3. For exterior, above-grade, load bearing and non load-bearing walls and parapet walls; for interior load-bearing walls; for interior non load-bearing partitions; and for other applications where another type is not indicated, use Type N.
 - 4. For interior non load-bearing partitions, Type O may be used instead of Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 - 2. Proportion grout according to ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
 - 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
 - 4. Verify that substrates are free of substances that would impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

- A. Dimensions and Locations of Elements:
 - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
 - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.

3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4-inch in a story height or 1/2 inch total.
- B. Lines and Levels:
1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.
- C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build non load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
 - 2. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - a. Bed face shells in mortar; mortar to extend fully across bedding surface for the thickness of the face shell.
 - b. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
 - c. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.
 - d. Excessive mortar shall not extend into drainage cavities or into cores to be grouted.
- B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- E. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
 - 1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 - 1. Install plumb, straight, and of uniform width.
 - 2. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 - 3. Install preformed control-joint gaskets designed to fit standard sash block.
 - 4. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 - 5. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.
 - 6. Shear Key Locations: Install specified preformed control-joint gaskets designed to fit standard sash block.
 - 7. Fire-Rated Wall Locations: Specified ceramic-fiber felt.

3.9 LINTELS

- A. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 12.67 ft. .

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at contractor's expense.
 - 1. Refer to Section 014100 – Structural Testing and Special Inspections for requirements, and Structural Drawings.
- B. Inspections: Special inspections according to Level [B] [C] in TMS 402/ACI 530/ASCE 5.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- I. Prism Test: For each type of construction provided, according to ASTM C 1314 at 28 days.

3.12 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Masonry Cleaning: Clean masonry walls of mortar smears, construction dirt, superficial efflorescence, and contaminants, to produce a uniform, clean appearance.
 - 1. Protect surfaces and areas adjacent to masonry cleaning areas.
 - 2. Collect surface runoff of applied chemical products from areas of work; and prevent runoff from entering storm water inlets and landscaped areas, and as required by Authorities Having Jurisdiction.
 - 3. Apply cleaning agents and procedures initially on a sample panel in an inconspicuous location as required to assess cleaning effects prior to full application.
 - 4. Comply with masonry cleaning product manufacturers recommendations for cleaning types of masonry products and stains of this Project.
 - a. Thoroughly pre-wet surfaces.
 - b. Dilute acidic cleaning products according to masonry cleaning product manufacturer's recommendations for this Project.
 - c. Low Pressure Cleaning: Do not exceed 50 psi.

3.13 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in each dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
 - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 22 00

END OF DIVISION 04 – MASONRY

DIVISION 05 – METALS

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SECTION 05 12 00 – Structural Steel Framing

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section Includes:
 - 1. Structural steel framing.
 - 2. Structural thermal breaks for bolted structural steel connections.
- B. Related Sections:
 - 1. Section 014100 – Special Inspections and Tests.
 - 2. Section 033000 – Cast in Place Concrete.
 - 3. Section 042000 – Unit Masonry.
 - 4. Section 052100 – Steel Joist Framing.
 - 5. Section 053113 – Steel Floor Decking.
 - 6. Section 053123 – Steel Roof Decking.
 - 7. Section 055000 – Metal Fabrications.
 - 8. Section 078100 – Applied Fireproofing.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
 - 2. Welded built-up members with plates thicker than 2 inches.
 - 3. Column base plates thicker than 2 inches.
- C. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

2. Include embedment Drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 5. Indicate locations and dimensions of protected zones.
 6. Identify demand critical welds.
- C. Shop Drawings, Thermal Breaks:
1. Dimensions and locations of structural thermal break plates, structural thermal break washers, and bushings.
 2. Size and location of holes in structural thermal break plates.
 3. OD and ID for structural thermal break washers and bushings.
 4. Structural steel connection details, including bolt and washer sizes.
- D. Samples:
1. Structural Thermal Break Plates: Minimum 2 inches by 2 inches.
 2. Thermal break washers.
 3. Thermal break bushings.
- E. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Informational Submittals:
1. Welding Certificates.
 2. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
 3. Source quality-control reports.
 4. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Delegated-Design Professional Engineer: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
1. State of Licensure: Wisconsin
- B. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD; or, at contractor's option provide Source Quality Control specified in Art. 2.10.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Comply with applicable provisions of the following specifications and documents:
1. AISC 303 Code of Standard Practice for Steel Buildings and Bridges.
 2. AISC 341 and AISC 341s1.
 3. AISC 360.
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

- E. Coordination:
 - 1. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
 - 2. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.
 - F. Preinstallation Conference: Conduct conference at Project site.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
 - B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Quality Assurance Article, to design steel framing connections, using performance requirements and design criteria indicated.
- B. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC 360.
- C. Moment Connections: Indicated on Structural Drawings

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992; or ASTM A 572, Grade 50 (345).
- B. Channels, Angles, Plate and Bar: ASTM A 36.
- C. Corrosion-Resisting Structural Steel: ASTM A 588, Grade 50.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade C, structural tubing.
- E. Corrosion-Resisting, Cold-Formed Hollow Structural Sections: ASTM A 847, structural tubing.
- F. Steel Pipe: ASTM A 53, Type E or Type S, Grade B.
 - 1. Finish: Black.
- G. Steel Castings: ASTM A 216, Grade WCB with supplementary requirement S11.

- H. Steel Forgings: ASTM A 668.
- I. Welding Electrodes: E70XX, comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM F3125, Grade A325 or Grade A490, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Plain.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125 Grade F1852, Type 1, round head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Plain.
- C. Shear Connectors or Headed Concrete Anchors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- D. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A 563 heavy hex carbon steel.
 - 3. Plate Washers: ASTM A 36 carbon steel.
 - 4. Washers: ASTM F 436 hardened carbon steel.
 - 5. Finish: Plain
- E. Clevises and Turnbuckles: ASTM A 108, Grade 1035, cold-finished carbon steel.

2.4 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanizing Repair Paint: ASTM A 780.
- C. Bituminous Protection Coating: Carboline, Bitumastic 50

2.5 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 STRUCTURAL THERMAL BREAKS

- A. Structural Thermal Breaks: Manufactured, load-bearing, structural thermal break/insulation material that prevents thermal bridging between flanged, bolted, structural steel framing members at connections, while maintaining structural integrity of connections and reducing energy loss.
 - 1. Acceptable Product: Fabreeka–TIM.
 - 2. Thickness: 1/2 inch.
 - 3. Product Performance Characteristics:
 - a. Ultimate Mechanical Properties, Nominal:
 - 1) Tensile Strength, ASTM D 638: 11,000 psi.
 - 2) Flexural Strength, ASTM D 790: 25,000 psi.
 - 3) Compressive Strength, ASTM D 695: 38,900 psi.
 - 4) Compressive Modulus, ASTM D 695:
 - a) 1/2-Inch (12.7 mm) Thickness: 291,194 psi.
 - 5) Shear Strength, ASTM D 732: 15,000 psi.

- 6) Operating Temperature Range: Minus 20 degrees F to 250 degrees.
 - a) Loss in Ultimate Strength at 250 degrees F.
- 7) Flame Resistance, Nominal:
 - a) Oxygen Index, ASTM D 2863: 21.8 percent.
- 8) Thermal Properties, Nominal:
 - a) Coefficient of Thermal Expansion, ASTM D 696: 2.2 in/in/degree Cx10-5.
 - b) Thermal Conductivity, ASTM C 177: 1.8 BTU/hr/ft2/in/degree F (0.259 W/m* degree K).
 - c) Heat Flow Resistance, R-Value: 1/2-Inch Thickness: 0.28.
- 9) Density: 107.83 pcf.
- 10) Coefficient of Friction, (Fabreeka-TIM) to Steel:
 - a) Compression Load 5,000 psi: 0.27 μ s.
 - b) Compression Load 10,000 psi: 0.26 μ s.
- B. Provide manufacturer's thermal break washers and bushings as required for a complete installation.

2.7 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning" or SSPC-SP 1, "Solvent Cleaning".
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened or as indicated on Drawings.
- B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.9 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 3, "Power Tool Cleaning."
 - 2. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

2. Conduct tests according to requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors already tested.
- E. Prepare test and inspection reports.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by EOR.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 INSTALLATION OF THERMAL BREAKS

- A. Install structural thermal breaks according to Structural Engineer's instructions at locations indicated on the Drawings.
- B. Install sizes of structural thermal break plates, washers, and bushings as indicated on the Drawings.
- C. Install hardened USS Grade 8 flat washers on both sides of thermal break washers according to Structural Engineer's instructions.
 - 1. Steel Washer OD: Greater than or equal to thermal break washer OD.
- D. Install bushings into oversized holes in steel end plates to accept OD of bushings.
- E. Bolted Structural Steel Connections: Install bolted structural steel connections as specified in this Section.
 - 1. Bolt torque values are provided by Structural Engineer and are determined by required clamping force, proper tension of bolts, and long-term creep.

3.5 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds according to AWS D1.1.
 - a. In addition to visual inspection, test and inspect field welds according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E 165.
 - 2) Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E 164.
 - 4) Radiographic Inspection: ASTM E 94.

- C. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests according to requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.7 REPAIRS AND PROTECTION

- A. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 05 12 00

SECTION 05 21 00 – Steel Joist Framing

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. K-series steel joists.
 - 2. KCS-type K-series steel joists.
 - 3. K-series steel joist substitutes.
 - 4. LH- and DLH-series long-span steel joists.
 - 5. CJ-series & Ecospan composite steel joists.
 - 6. Joist girders.
 - 7. Joist accessories.
- B. Related Sections:
 - 1. Section 014100 – Special Inspections and Tests.
 - 2. Section 033000 – Cast-in-Place Concrete.
 - 3. Section 042000 – Unit Masonry.
 - 4. Section 051200 – Structural Steel Framing.
 - 5. Section 055000 - Miscellaneous Metal

1.2 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.3 SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
- B. Shop Drawings:
 - 1. Include layout, designation, number, type, location, and spacing of joists.
 - 2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
 - 3. Indicate locations and details of bearing plates to be embedded in other construction.
 - 4. Where bearing on cold form steel, indicate centroid of joist bearing and connection type and method.
 - 5. Shop drawings shall be submitted according the construction sequence.
 - 6. [Signed and sealed erection drawings may be required for complicated loading and erection sequencing]
- C. Informational Submittals:
 - 1. Qualification Data: For manufacturer and professional engineer.
 - 2. Welding certificates.
 - 3. Manufacturer certificates.
 - 4. Mill Certificates: For each type of bolt.

5. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.
6. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications[.]" and "Standard Specification for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice."
 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications[.]" and "Standard Specification for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.
- C. [Coordinate specialty coating required for fireproofing or unique corrosion environments]

1.6 SEQUENCING

- A. Deliver steel bearing plates to be built into cast-in-place concrete and/or masonry construction and as indicated in the structural drawings.
- B. [Special erection sequencing requirements to be noted on shop drawings submittal]

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
 1. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - a. Roof Joists: Vertical deflection of 1/240 of the span.
 - b. [Where required, adjust deflection criteria to meet architectural finish requirements]

2.2 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
 1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Camber joists according to SJI's "Specifications."
- E. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.3 PRIMERS

- A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
- B. Primer: Provide shop primer that complies with the fireproofing material recommendations.

2.4 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span.
 - 1. Evaluate, detail and furnish additional erection bridging as required for construction stability.
 - 2. Coordinate erection bridging requirements with GC and MEP within shop drawing submittal.
- B. Fabricate steel bearing plates from ASTM A 36 steel with integral anchorages of sizes and thicknesses indicated. Hot-dip zinc coat according to ASTM A 123.
- C. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.
 - 1. Finish: Plain, uncoated
- D. Welding Electrodes: Comply with AWS standards.
- E. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.
- F. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.
- C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications[,"]" and "Standard Specification for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice,]" joist manufacturer's written instructions, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.

3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - D. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: [Engage] a qualified testing agency to perform tests and inspections.
- B. Special Inspections: Owner's third-party special inspection agency shall provide special inspections coordinated by the contractor. Contractor is responsible for scheduling and complying with all steel inspections and associated inspection reports.
 1. Refer to Section 014000 Testing and Quality Control for requirements and Structural Drawings.
- C. Visually inspect field welds according to AWS D1.1/D1.1M.
 1. In addition to visual inspection, test field welds according to AWS D1.1 and the following procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709.
 - c. Ultrasonic Testing: ASTM E 164.
 - d. Radiographic Testing: ASTM E 94.
- D. Visually inspect bolted connections.
- E. Prepare test and inspection reports.

3.4 PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
 1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2 or power-tool cleaning according to SSPC-SP 3.
 2. Apply a compatible primer of same type as primer used on adjacent surfaces.

END OF SECTION 05 21 00

SECTION 05 31 23 – Steel Roof Decking

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Roof deck.
- B. Related Sections:
 - 1. Section 014100 – Special Inspections and Tests.
 - 2. Section 051200 – Structural Steel Framing.
 - 3. Section 055000 – Metal Fabrications.

1.2 SUBMITTALS

- A. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
- B. Research/Evaluation Reports: ICBO Approval Number for steel deck.
- C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
 - 2. Acoustical roof deck.

1.3 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- B. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- C. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class [1-90] windstorm ratings.
- D. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
 - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:
 - 1. Prime-Painted Steel Sheet: ASTM A 1008, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard
 - 2. Galvanized Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 33, G60 zinc coating.
 - 3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 - 4. Deck Profile: As indicated on drawings.
 - 5. Cellular Deck Profile: As indicated on drawings, with bottom plate.
 - 6. Profile Depth: As indicated on drawings.
 - 7. Design Uncoated-Steel Thickness: As indicated on drawings.
 - 8. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated on drawings.
 - 9. Span Condition: Triple span or more unless otherwise indicated on drawings.
 - 10. Side Laps: Overlapped.

2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, powder-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Sound Absorbing Material: Provide glass fiber in roll or pre-molded form for steel roof deck according to the manufacturer's standards. Provide a sample of acoustical material to be used.
- F. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- G. Galvanizing Repair Paint: ASTM A 780.
- H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Locate deck bundles to prevent overloading of supporting members.

- C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- H. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

- A. Mechanical Fasteners:
 - 1. Attach metal deck to supports with mechanical fasteners spaced as indicated on drawings.
 - 2. Install mechanical fasteners according to manufacturer's published instructions and recommendations.
 - 3. Pretest each different condition of attachment, such as different supporting member thickness, to determine proper installation prior to actual installation.
 - 4. Mechanically fasten side laps of decking together as indicated on drawings.
 - 5. Use self-tapping screws for both interlocking side laps and simple overlaps.
 - 6. Where structure thickness exceeds ½ inch diameter puddle welds with same spacing as mechanical fasteners.
- B. Welding:
 - 1. Weld deck to perimeter supports unless noted otherwise on drawings.
 - 2. Weld deck to interior supporting steel members as indicated on drawings.
 - 3. Weld side laps of decking together at center of spans or as indicated on the drawings.
 - a. Visible diameter: 5/8 inch minimum.
 - b. Arc seam or fillet weld: 1 inch long.
 - 4. Cover weld burn holes with metallic tape.
- C. Powder Driven Fasteners:
 - 1. Install according to manufacturer's published instructions and recommendations.
 - 2. Pretest each different condition of attachment with manufacturer's representative present, such as different supporting member thickness, to determine proper fastener types prior to actual installation.
 - 3. If during pretesting of attachment conditions fasteners system is failing, consult EOR as to what deck fastening alternatives are acceptable.
 - 4. Mechanically fasten side laps of decking together at center of spans or as indicated on drawings.

5. Use self-tapping screws for both interlocking side laps and simple overlaps.
 6. Where structure thickness exceeds manufacturers recommendations, weld deck to support with minimum effective 1/2 inch diameter puddle welds with same spacing as mechanical fasteners.
- D. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
1. End Joints: Lapped 2 inches minimum.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck according to quality-assurance inspection requirements of SDI QA/QC.
1. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on bottom surface of prime-painted deck immediately after installation and apply repair paint.
1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 23

SECTION 05 40 00 – Cold-Formed Metal Framing

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Exterior load bearing framing.
 - 2. Interior load-bearing framing.
 - 3. Exterior non-load-bearing framing.
- B. Related Sections:
 - 1. Section 05 12 00 - Structural Steel Framing
 - 2. Section 05 50 00 - Metal Fabrications
 - 3. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 4. Section 09 22 00 - Non-Structural Metal Framing
 - 5. Section 09 29 00 - Gypsum Board

1.2 REFERENCES

- A. AISI - Standards for Cold-Formed Steel Framing
- B. ASTM:
 - 1. A36 - Carbon Structural Steel
 - 2. A780 - Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - 3. A1003 - Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members
 - 4. B63 - Electrodeposited Coatings of Zinc on Iron and Steel
 - 5. C1513 - Steel Tapping Screws for Cold-Formed Steel Framing Connections
 - 6. C955 - Load-Bearing Steel Studs, Tracks, and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
 - 7. C1007 - Installation of Load Bearing Steel Studs and Related Accessories
 - 8. E119 - Fire Test of Building Construction and Materials
 - 9. E329 - Testing and Inspection
- C. SSMA - ICBO ER-4943P, Product Technical Information

1.3 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- C. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; fastening and anchorage details; reinforcing channels, opening and supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- D. Environmental Submittals:
 - 1. Recycled Content: Submit documentation certifying recycled (PI or PC) content, total cost of products, and total volume or weight of materials.
 - 2. Submit documentation on products that are manufactured within 500 miles of Site.

- E. Quality Assurance/Control Submittals:
 - 1. Structural analysis data: Signed by qualified professional engineer; include with Shop Drawings.
 - 2. Welding certificates.
 - 3. Product test reports.
 - 4. Research/evaluation reports.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: 10 years experience in the manufacture of cold-formed metal framing.
 - 2. Welders: Certified by AWS D1.1 and D1.3.
 - 3. Testing Agency: ASTM E329 and acceptable to authorities having jurisdiction.
 - 4. Professional Structural Engineer: Legally qualified to practice in jurisdiction where Project is located and experienced in providing engineering services of the kind required for Project.
- B. Regulatory Requirements:
 - 1. Comply with AISI and SSMA standards for cold-formed steel framing.
 - 2. Comply with ASTM E119 for fire-test-response characteristics indicated.
- C. Product Tests: Provide mill certificates or data indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing protected with a waterproof covering and ventilate to avoid condensation.

1.6 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Light-Gage Studs and Channel Tracks:
 - 1. Standard of Quality: Design is based on products of Dietrich Industries, Inc., Pittsburgh, PA www.clarkdietrich.com
 - 2. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - a. Manufacturer of comparable products submitted in compliance with Section 01 25 13.
- B. Slip Head Channel:
 - 1. Standard of Quality: Unless indicated otherwise, design is based on products of FireTrak Corporation, Kimball, MN www.firetrak.com

2. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - a. Dietrich Industries, Inc., Pittsburgh, PA www.clarkdietrich.com
 - b. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.2 MATERIALS

- A. Steel Sheet:
 1. Cold-formed galvanized.
 2. Meet ASTM A1003, Structural Grade A, Type H.
 3. Minimum G-60 protective coating.
 4. Comply with AISI and SSMA product requirements.
 5. 12-gage, with minimum yield of 50,000 psi.
 6. 16-gage, with minimum yield of 50,000 psi.
 7. 18-gage with minimum yield of 33,000 psi.
 8. 20-gage with minimum yield of 33,000 psi.
- B. Framing:
 1. Punched "C" section with stiffened flanges.
 2. Locate along centerline of webs of the members with a minimum center-to-center spacing of 24 inches.
 3. Minimum distance between end of member and near edge of web punch-out is 10 inches.
 4. Flange Width: See structural drawings, or if not shown, verify with Architect.
- C. Track:
 1. U-shaped, unpunched, straight flanges.
 2. Slotted deflection track, standard leg of 2-1/2 inches, vertical slot of 1-1/2 inches in leg.
 3. Exterior Framing Double deflection deep leg track.
- D. Slip Head Channel: UL approved, fire rated system where required, with enough depth to allow for deflection of non-load-bearing walls.
- E. U-channel:
 1. 2 inches.
 2. Manufacturer's standard length.
 3. Minimum Thickness: 16 gage.
- F. Bridging/spacer bar:
 1. Minimum Thickness: 16 gage.
 2. 1-1/4 by 1/1-4 by 50 inches long, pre-notched at 16 by 24 inch centers.
- G. Header:
 1. Standard C Shapes: One piece, of web depths indicated; stiffened flanges, punched, minimum 14 gage.
 2. Product: HDS by Dietrich Metal Framing or approved equal.
- H. Fasteners and Accessories:
 1. Provide sizes and types specifically recommended by stud manufacturer for purposes required.

- I. Backing Plate:
 - 1. Heavy-duty, flexible fire-retardant wood backing for handrails, shelves, sinks, and other wall fixtures.
 - 2. Product: Danback by Dietrich Metal Framing.
 - J. Other materials not specifically described, but required for complete and proper installation of light-gage framing to be new, first quality of respective kinds, subject to approval of Architect.
- 2.3 FABRICATION
- A. Fabricate framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI and SSMA specifications and standards, manufacturer's written instructions, and requirements of this section.
 - B. Maximum allowable tolerance variation is 1/8 inch in 10 feet.
 - C. Cut framing members by sawing or shearing; do not torch cut.
 - D. Fasten members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying is not permitted.
 - E. Welding:
 - 1. Permitted on 18 gage or heavier material only.
 - 2. Comply with AWS D1.3 requirements and procedures for welding.
 - 3. Touch up welds with zinc-rich paint in compliance with ASTM A780.
 - F. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that installation may proceed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies:
 - 1. Immediately notify Architect.
 - 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 - 3. Commencement of installation signifies acceptance of surface conditions.

3.2 INSTALLATION OF TRACK

- A. Accurately align, fasten light-gage track to supporting structure using 1/8-inch diameter powder driven anchors spaced at 16 inches on center.
- B. At track butt joints, securely butt weld members together.

3.3 INSTALLATION OF STUDS

- A. Cutting Framing:
 - 1. Cut accurately, squarely so as to be completely and squarely seated in track with stud web and flange abutting track web.
 - 2. Cut with radial arm saws, power hacksaws, chop saws, or power handsaws equipped with reinforced abrasive blade.

- B. Erection of Framing:
 - 1. Accurately plumb, align, hold firmly into position until members can be permanently fastened.
 - 2. Positive mechanical attachments are required at all load bearing wall assemblies.
 - 3. Anchor to tracks, bridging, and other members.
 - 4. Install jack studs or cripples, kickers, braces below window sills, above window and door heads, at free standing stair rails, elsewhere to furnish support; securely attach to supporting members.
 - 5. Install slip connectors at deck edge to all curtainwall studs which bypass intermediate floor or roof structure.
- C. Attaching Miscellaneous Steel: Accurately position veneer shelf angles, steel plates, clips as shown on Drawings and anchor to light-gage framing with full penetration fillet welds on both sides of framing members.
- D. Bridging: Install continuous cold rolled channel bridging in manner to prevent stud rotation.
 - 1. In walls up to 10 feet high, install 1 row of bridging at the mid-point of studs.
 - 2. Space bridging rows 5 feet on center maximum at walls over 10 feet in height.
 - 3. Install row of bridging or strapping to secure studs within 12 inches of all slip head channels.
- E. Insulation: Provide insulation equal to that specified in Section 07 21 00 in spaces of doubled header members which will not be accessible when building insulation is installed.

3.4 FIELD QUALITY CONTROL

- A. Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Remove and replace work where test results indicate it does not comply with specified requirements.
- D. Additional testing and inspecting, at contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer, to ensure cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 05 50 00 – Metal Fabrications

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Steel ladders (may include safety cage – see Drawings).
 - 2. Pan-filled stairs.
 - 3. Steel tube and pipe railings and handrails.
 - 4. Steel framed stairs.
 - 5. Floor plate.
 - 6. Grating.
 - 7. Trench grate.
 - 8. Inspection Bays:
 - a. Aluminum diamond plate pit covers.
 - b. Movable Inspection Pit bridges.
 - c. Rub-rail assembly.
 - d. Removable aluminum planks.
 - e. Overhead Door Control Station.
 - 9. Miscellaneous framing and supports:
 - a. Overhead door track support framing.
 - b. Video equipment support framing.
 - 10. Metal fabrication accessories including, but not limited to:
 - a. Rough hardware.
 - b. Grout and anchoring cement.
- B. Furnish the following for other sections to install including, but not limited to:
 - 1. Nosings.
 - 2. Loose bearing and leveling plates.
 - 3. Loose lintels.
 - 4. Shelf and relieving angles.
 - 5. Structural steel overhead door frames.
 - 6. Pipe bollards (with yellow polyethylene covers).
 - 7. Metal fabrication accessories including, but not limited to:
 - a. Rough hardware.
- C. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 03 41 00 - Plant-Precast Structural Concrete
 - 3. Section 04 20 00 - Unit Masonry Assemblies
 - 4. Section 05 12 00 - Structural Steel Framing
 - 5. Section 07 92 00 - Joint Sealants
 - 6. Section 08 36 13 - Sectional Steel Overhead Doors
 - 7. Section 10 60 00 - Safety Netting

1.2 REFERENCES

A. Building Codes:

1. Wisconsin Commercial Building Code
2. International Building Code

B. AASHTO H20 - Loading Conditions for Gratings

C. ASTM:

1. A27 - Steel Carbon Castings, General Applications
2. A36 - Carbon Structural Steel
3. A47 - Ferritic Malleable Iron Castings
4. A48 - Gray Iron Castings
5. A53 - Pipe, Steel, Black, Hot Dipped, Zinc Coated, Welded, Seamless
6. A123 - Zinc Coatings on Iron and Steel Products
7. A153 - Zinc Coatings on Iron and Steel Hardware
8. A167 - Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet, and Strips
9. A500 - Cold-Formed, Welded and Seamless Carbon Steel Structural Tubing
10. A501 - Hot-Formed, Welded and Seamless Carbon Steel Structural Tubing
11. A510 - Wire Rods and Coarse Round Wire, Carbon Steel
12. A513 - Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
13. A536 - Ductile Iron Castings
14. A569 - Tables, Mess, Marine, Steel
15. A653 - Steel Sheet, Galvanized or Galvannealed by Hot Dip Process
16. A780 - Repair of Damaged Galvanized Coatings
17. A786 - Hot Rolled Carbon, Low Alloy, High Strength Low Alloy, and Alloy Steel Floor
18. A992 - Structural Steel Shapes
19. A1008 - Steel Sheet, Cold Rolled, Carbon, Structural High Strength, Low Alloy
20. E119 - Test Method for Fire Tests of Building Construction and Methods
21. E894 - Test for Anchorage of Permanent Metal Railing Systems and Rails for Buildings
22. E935 - Performance of Permanent Metal Railing Systems and Rails for Buildings
23. E985 - Permanent Metal Railing Systems and Rails for Buildings
24. G90 - Standard for Performing Outdoor Weathering of Nonmetallic Materials Using Sun

D. AWS:

1. D1.1 - Structural Welding Code - Steel
2. D1.3 - Structural Welding Code - Sheet Metal
3. D1.2 - Structural Welding Code - Aluminum

E. NAAMM:

1. Metal Finishes Manual
2. MBG 532 - Heavy-Duty Metal Bar Grating Manual

- F. SSPC:
 - 1. SP6 - Commercial Blast Cleaning
 - 2. SP3 - Power Tool Cleaning
 - 3. PA1 - Paint Application Specification No. 1

1.3 DEFINITIONS

- A. Metal Fabrications: Items made from iron and steel shapes, plates, bars, strips, tubes, pipes, castings not part of structural steel or other metal systems specified elsewhere.

1.4 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Handrails and Railing Systems: Design, engineer, fabricate, and install handrails and railing systems to comply with requirements of ASTM E985 for structural performance based on testing performed according to ASTM E894 and E935.
 - 2. Thermal Movement: Allow for thermal movement for exterior assemblies resulting from maximum 150 degree change in ambient temperature in design, fabrication, installation to prevent buckling, opening up of joints, over stressing of welds and fasteners.
 - 3. Base design calculations on actual surface temperatures of metals due to solar heat gain and nighttime sky heat loss.
- B. Performance Requirements: Design, engineer, fabricate, and install the following metal fabrications to withstand the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections.
 - 1. Apply each load to produce the maximum stress in each respective component of each metal fabrication.
 - 2. Top Rail of Guardrail Systems:
 - a. Uniform load of 50 pounds per linear foot, applied nonconcurrently, vertically downward or horizontally.
 - b. Concentrated and uniform loads above need not be assumed to act concurrently.
 - 3. Handrails Not Serving as Top Rails:
 - a. Uniform load of 50 pounds per linear foot applied nonconcurrently, vertically downward or horizontally.
 - b. Concentrated and uniform loads above need not be assumed to act concurrently.
 - 4. Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 pounds applied to one square foot at any point in the system including panels, intermediate rails balusters, or other elements composing the infill area.
 - 5. Treads of Steel Stairs: Capable of withstanding a uniform load of 100 pounds per square foot or a concentrated load of 300 pounds on a area of 4 square inches located in the center of the tread, whichever produces the greater stress.
 - 6. Platforms of Steel Stairs: Capable of withstanding a uniform load of 100 feet per pound per square foot.

1.5 SUBMITTALS

- A. Product Data: Data for products used, including paint products and grout.
- B. Shop Drawings:
 - 1. Detail fabrication, erection of each metal fabrication indicated. Include plans, elevations, sections, details of metal fabrications, their connections. Show anchorage and accessory items.

2. Provide templates for anchors, bolts specified for installation under other sections.
- C. Samples:
 1. Two sets, representative of materials, finished products as requested by E/A.
- D. Calculations:
 1. Where indicated to comply with certain design loadings, include structural computations, material properties, other information needed for structural analysis, signed and sealed by qualified professional engineer, registered in the state where project located, responsible for their preparation.
- E. Welder Certificates: Signed by contractor certifying that welders comply with specified requirements.
- F. Qualification Data: For firms and persons specified, to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

1.6 QUALITY ASSURANCE

- A. Qualifications:
 1. Fabricator: Firm experienced in successfully producing metal fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.
 2. Installer: Arrange for installation of metal fabrications specified in this section by same firm that fabricated them.
 3. Welding Processes and Welding Operators:
 - a. Qualify according to AWS D1.1 "Structural Welding Code - Steel," D1.3 "Structural Welding Code - Sheet Steel," and D1.2 "Structural Welding Code - Aluminum."
 - b. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.7 SITE CONDITIONS

- A. Field Measurements:
 1. Check actual locations of walls, other construction to which metal fabrications must fit, by accurate field measurements before fabrication.
 2. Show recorded measurements on final Shop Drawings.
 3. Coordinate fabrication schedule with construction progress to avoid delay of Work.
 4. Where field measurements cannot be made without delaying Work, guarantee dimensions, proceed with fabrication without field measurements.
 5. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

1.8 SEQUENCING AND SCHEDULING

- A. Handrails:
 1. Mount only on completed walls.
 2. Do not support temporarily by any means not satisfying structural performance requirements.
 3. Mount only on gypsum board assemblies reinforced to receive anchors, where location of concealed anchor plates are clearly marked.

- B. Gratings:
 - 1. Coordinate installation of anchorages for gratings, grating frames, and supports.
 - 2. Furnish setting drawings, templates, and directions for installing anchors that are to be embedded in concrete or masonry.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Aluminum Plank:
 - 1. Standard of Quality: Unless otherwise indicated, design is based on products of McNichols, Tampa, FL www.mcnichols.com
 - 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Direct Metals, Pleasant Prairie, WI www.directmetals.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
- B. Grout and Anchoring Cement:
 - 1. Approved Manufacturers: One of the following or approved in advance by E/A.
 - 2. Non-shrink Metallic Grouts:
 - a. Metox RM by ChemMasters Corporation www.chemmasters.net
 - b. Hi-Flow Metallic Grout by Euclid Chemical Company www.euclidchemical.com
 - c. MasterFlow 885 by Sika USA, www.usa.sika.com
 - 3. Non-shrink Nonmetallic Grouts:
 - a. Precision Non-Shrink Construction Grout by www.sakrete.com
 - b. Hi-Flow Grout by Euclid Chemical Company www.euclidchemical.com
 - c. Kemset by ChemMasters Corporation www.chemmasters.net
 - d. Crystex by L & M Construction Chemicals, Inc www.laticrete.com
 - e. Masterflow 713 by Sika USA, www.usa.sika.com
 - f. Masterflow 100 by Sika USA, www.usa.sika.com
 - 4. Erosion-Resistant Anchoring Cement:
 - a. "Super Por-Rok"; CGM Building Products www.cgmbuildingproducts.com
 - b. Quikrete www.quikrete.com
 - c. Approved equal
 - 5. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 FERROUS METALS

- A. Metal Fabrications Exposed to View:
 - 1. Provide materials selected for surface flatness, smoothness, and freedom from surface blemishes.
 - 2. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.
- B. Wide flange shapes and structural tees cut from: ASTM A992.
- C. Steel Shapes, Plates, and Bars: ASTM A36.

- D. Rolled Steel Floor Plates: ASTM A786.
- E. Wire Rod for Grating Cross Bars: ASTM A510.
- F. Gray Iron Castings: ASTM A48, Class 30.
- G. Malleable Iron Castings: ASTM A47, grade as recommended by fabricator for type of use indicated.
- H. Ductile Cast Iron Castings: ASTM A536, grade 65-45-12.
- I. Steel Tubing: Cold-formed, ASTM A500; or hot-rolled, ASTM A501. For exterior installations and where indicated, provide tubing with hot-dip galvanized coating per ASTM A53.
- J. Structural Steel Sheet: Hot-rolled, ASTM E936; or cold-rolled ASTM 1008, Class 1; grade required for design loading.
- K. Galvanized Structural Steel Sheet: ASTM A653, grade required for design loading. Coating designation indicated; if not indicated, G90.
- L. Wide Flange Shapes & Tees: ASTM A992.
- M. Steel Pipe:
 - 1. ASTM A53; Type, Grade B, as required for design loading.
 - 2. Black finish unless galvanizing is indicated.
 - 3. Galvanized finish for exterior installations and where indicated.
 - 4. Standard weight (Schedule 40) unless otherwise indicated.
- N. All other steel shapes, plates and bars: ASTM A36.
- O. Brackets, Flanges, and Anchors: Cast or formed metal of same type material, finish as supported rails, unless otherwise indicated.
- P. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A47, or cast steel, ASTM A27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM 153.
- Q. Stainless Steel: ASTM A167 W/No. 2B Mill Finish.

2.3 FINISHES

- A. Steel and Iron Finishes:
 - 1. Galvanizing: Apply zinc-coating by the hot-dip process, complying with:
 - a. ASTM A153 for galvanizing iron and steel hardware.
 - b. ASTM A123 for galvanizing fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, forged shapes, plates, bars, and strips 0.0299 inch thick and heavier.
 - c. ASTM A386 for assembled steel products.
- B. Preparation for Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finish or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated.

2.4 FABRICATION, GENERAL

- A. Forming:
 - 1. Form from materials of size, thickness, shapes indicated, complying with performance requirements indicated.
 - 2. Work to dimensions indicated or noted on Shop Drawings.
 - 3. Form exposed work true to line, level, with accurate angles and surfaces and straight sharp edges.

- B. Cutting and Shaping:
 - 1. Shear, punch metals cleanly, accurately. Remove burrs.
 - 2. Ease exposed edges to radius of approximately 1/32 inch unless otherwise indicated.
 - 3. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
 - 4. Remove sharp or rough areas on exposed traffic surfaces.
- C. Welding:
 - 1. Comply with AWS recommendations.
 - 2. Use materials, methods to minimize distortion, develop strength and corrosion resistance of base metals.
 - 3. Fuse without undercut or overlap.
 - 4. Remove welding flux immediately.
 - 5. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Joints:
 - 1. Form exposed connections with hairline joints flush, smooth, using concealed fasteners wherever possible.
 - 2. Use exposed fasteners of type indicated or, if not indicated, Phillips flathead (countersunk) screws or bolts.
 - 3. Locate joints where least conspicuous.
- E. Anchorage:
 - 1. Provide for type indicated; coordinate with supporting structure.
 - 2. Fabricate, space anchoring devices to provide adequate support for intended use.
- F. Joints: Fabricate joints exposed to weather in manner to exclude water, or provide weep holes where water may accumulate.
- G. Shop Assembly:
 - 1. Preassemble in shop to greatest extent possible.
 - 2. Disassemble only as necessary for shipping, handling limitations.
 - 3. Use connections that maintain structural value of joined pieces.
 - 4. Clearly mark for reassembly and coordinated installation.
 - 5. Cut, reinforce, drill, tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.
- H. Finishes:
 - 1. Comply with referenced NAAMM manual.
 - 2. Finish metal fabrications after assembly.

2.5 STEEL LADDERS

- A. Fabricate ladders for the locations shown, with dimensions, spacings, details and anchorages as indicated. Comply with requirements of ANSI A14.3.
- B. Siderails: Continuous steel flat bars, 1/2 inch by 2-1/2 inches, with eased edges, spaced 18 inches apart, unless shown otherwise on the plans.

- C. Bar Rungs:
 - 1. Round steel bars, 3/4 inch diameter.
 - 2. Space as shown on Drawings, or if not shown, evenly spaced (12 inches on center maximum).
 - 3. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.
 - 4. Provide non-slip surface on top of each rung, either by coating the rung with aluminum oxide granules set in epoxy resin adhesive, or by using a type of manufactured rung that is filled with aluminum oxide grout.
- D. Support:
 - 1. Support each ladder at top and bottom and at intermediate points spaced not more than 5 feet on center by means of welded or bolted steel brackets.
 - 2. Size brackets to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 7 inches.
 - 3. Extend side rails 42 inches above top rung, and return rails to wall or structure unless other secure handholds are provided.
 - 4. If the adjacent structure does not extend above the top rung, gooseneck the extended rails back to the structure to provide secure ladder access.
- E. Galvanizing: Galvanize ladders and cages, including, brackets and fasteners, in the following locations:
 - 1. Exterior locations unless otherwise indicated.

2.6 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area.
- B. Drill plates to receive anchor bolts and for grouting as required.
- C. Galvanize after fabrication unless indicated otherwise.

2.7 LOOSE STEEL LINTELS

- A. Fabrication:
 - 1. Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.
 - 2. Weld adjoining members together to form a single unit where indicated.
- B. Sizing:
 - 1. Size loose lintels for equal bearing of 1 inch per foot of clear span but not less than 8 inches bearing at each side of openings, unless otherwise indicated.
 - 2. Galvanize loose steel lintels located in exterior walls unless indicated otherwise.

2.8 SHELF AND RELIEVING ANGLES

- A. Fabrication:
 - 1. Fabricate from steel angles of sizes indicated, for attachment to concrete framing.
 - 2. Provide slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and not more than 24 inches on center, unless otherwise indicated.
- B. Shelf Angles:
 - 1. Galvanize shelf angles to be installed on exterior concrete framing.
 - 2. Furnish wedge-type concrete inserts, complete with fasteners, for attachment of shelf angles to cast-in-place concrete.

- C. Furnish wedge-type concrete inserts, complete with fasteners, for attachment of shelf angles to cast-in-place concrete.
- 2.9 RUB-RAIL ASSEMBLY
- A. Provide shop fabricated steel angle and tube section "rub rail" as indicated on the Drawings.
- 2.10 REMOVABLE ALUMINUM PLANKS AT INSPECTION PITS
- A. Removable Aluminum Planks:
 - 1. Alloy 5052-H32
 - 2. 0.1250 inch thick (8 gauge), 6-Hole, 2" Channel Depth.
 - 3. Slip-Resistant Surface with holes sheared through both ends of plank parallel to width of plank.
 - 4. 35% open area.
 - 5. Size: As indicated on the Drawings.
 - 6. Product: McNichols Perf-O-Grip M712201212.
- 2.11 MOVABLE INSPECTION PIT BRIDGES
- A. Provide shop fabricated pit bridges at Inspection Bay as indicated on the Drawings.
 - B. Aluminum Planks:
 - 1. Alloy 5052-H32
 - 2. 0.1250 inch thick (8 gauge), 6-Hole, 2" Channel Depth.
 - 3. Slip-Resistant Surface with holes sheared through both ends of plank parallel to width of plank.
 - 4. 35% open area.
 - 5. Size: As indicated on the Drawings.
 - 6. Product: McNichols Perf-O-Grip M712201212.
- 2.12 MISCELLANEOUS FRAMING
- A. Overhead Door Track Supports: Fabricate rigid support of steel shapes of size required to rigidly brace overhead door track during all phases of operation.
 - B. Toilet Partition Supports:
 - 1. Beams: Continuous steel shapes of size required to limit deflection to L/360 between hangers, but use not less than C 8 by 11.5 channels or another shape with equivalent structural properties.
 - 2. Hangers:
 - a. Steel rods, 1/2 inch in diameter, spaced not more than 36 inches on center.
 - b. Thread rods to receive anchor and stop nuts.
 - c. Fit hangers with wedge shape washers for full bearing on sloping flanges of support beam.
 - 3. Braces and Angles: Steel angles of size required for rigid support of beam and for secure anchorage.
 - C. Galvanize miscellaneous framing and supports in the following locations:
 - 1. Exterior locations where indicated on the Drawings.
 - 2. Interior locations where indicated on the Drawings.

2.13 STRUCTURAL STEEL DOOR FRAMES FOR OVERHEAD DOORS

- A. Fabrication: Fabricate from structural shapes and bars of size and to dimensions indicated, fully welded together, with 5/8 inch by 1 1/2 inch steel bar stops, unless otherwise indicated. Plug weld built-up members; continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10 inches on center. Reinforce frames, drill and tap as required to accept finish hardware.
- B. Anchorage: Provide steel strap anchors for securing door frames into adjoining concrete or masonry, using 1/8 inch by 2 inch straps of length required for minimum 8 inch embedment, unless otherwise indicated. Weld to frame jambs no more than 12 inches from both bottom and head of frame and space anchors not more than 30 inches apart.
- C. Galvanize frames and anchors at exterior locations unless otherwise indicated.

2.14 TRENCH GRATES

- A. Standard Heavy Duty: Comply with AASHTO H-20 loading conditions.
- B. Coordinate with Section 03 30 00 for drainage structure.

2.15 STEEL TUBE AND PIPE RAILINGS AND HANDRAILS

- A. Fabricate pipe railings and handrails to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacings, and anchorage, but not less than that required to support structural loads.
- B. Interconnections: Interconnect railing and handrail members by butt welding or welding with internal connectors, at fabricator's option, unless otherwise indicated. At tee and cross intersections, notch ends of intersecting members to fit contour of pipe to which end is joined and weld all around.
- C. Form changes in direction of railing members as follows:
 - 1. By radius bends of radius indicated.
 - 2. By mitering at elbow bends.
 - 3. By any method indicated above, applicable to change of direction involved.
- D. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
- E. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.
- F. Ends: Close exposed ends of pipe by welding 3/16 inch thick steel plate in place or by use of prefabricated fittings, except where clearance of end of pipe and adjoining wall surface is 1/4 inch or less.
- G. Toe Boards:
 - 1. Where indicated, provide toe boards at railings around openings and at the edge of open-sided floors and platforms.
 - 2. Fabricate to dimensions and details indicated, or if not indicated, use 4 inches high by 1/4" inches steel plate welded to, and centered between, each railing post.
- H. Brackets, Flanges, Fittings, and Anchors:
 - 1. Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of railings and handrails to other work.
 - 2. Furnish inserts and other anchorage devices for connecting railings and handrails to concrete or masonry work.
- I. For railing posts set in concrete fabricate sleeves from steel pipe not less than 6 inches long and with an inside diameter not less than 1/2 inch greater than the outside diameter of post, with steel plate closure welded to bottom of sleeve.

- J. Removable Railings:
 - 1. For removable railing posts, fabricate slip-fit sockets from steel pipe whose inside diameter is sized for a close fit with posts and to limit deflection of post without lateral load, measured at top, to not more than 1/12 of post height.
 - 2. Provide socket covers designed and fabricated to resist accidental dislodgment.
- K. Fillers:
 - 1. Provide steel sheet or plate fillers of thickness and size indicated or required to support structural loads of handrails where needed to transfer wall bracket loads through wall finishes to structural supports.
 - 2. Size fillers to suit wall finish thicknesses. Size fillers to produce adequate bearing to prevent bracket rotation and over stressing of substrate.
- L. Fittings: For interior steel railings formed from steel pipe with black finish, provide nongalvanized ferrous metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
- M. For interior steel railings and handrails formed from steel pipe with galvanized finish, galvanize fittings, brackets, fasteners, sleeves, and other ferrous components.

2.16 STEEL FRAMED STAIRS

- A. General:
 - 1. Construct stair to conform to sizes and arrangements indicated.
 - 2. Join pieces together by welding, unless otherwise indicated.
 - 3. Provide complete stair assemblies, including metal framing, hangers, columns, railings, newels, balusters, struts, clips, brackets, bearing plates, and other components necessary for the support of stairs and platforms, and as required to anchor and contain the stairs on the supporting structure.
- B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM "Metal Stair Manual" for class of stair designated, except where more stringent requirements are indicated:
 - 1. Commercial class, unless otherwise indicated.
 - 2. Architectural class where indicated.
- C. Stair Framing:
 - 1. Fabricate stringers of structural steel channels, or plates, or a combination thereof, as indicated.
 - 2. Provide closures for exposed ends of stringers.
 - 3. Construct platforms of structural steel channel headers and miscellaneous framing members as indicated.
 - 4. Bolt or weld headers to strings, newels, and framing members to strings and headers.
 - 5. Fabricate and join so that bolts, if used, do not appear on finish surfaces.
- D. Metal Pan Risers, Subtreads, and Subplatforms:
 - 1. Shape metal pans for risers and subtreads to conform to configuration shown.
 - 2. Provide thicknesses of structural steel sheet for metal pans indicated, but not less than that required, supporting total design loading.
- E. Metal Pans: Form metal pans of uncoated cold-rolled steel sheet, unless otherwise indicated.
- F. Fabrication: Directly weld risers and subtreads to stringers; locate welds on side of metal pans to be concealed by concrete fill.

- G. Subplatforms:
1. Provide subplatforms of configuration and construction indicated; if not indicated, of same metal as risers and subtreads, in thicknesses required to support design loading.
 2. Attach subplatform to platform framing members with welds.
- H. Smooth Soffit Construction: Construct subplatforms with smooth soffits at locations indicated on Drawings.
- I. Steel Floor Plate Treads:
1. Provide raised pattern steel floor plate in pattern indicated or, if not indicated, as selected from manufacturer's standard patterns.
 2. Form treads of 1/4-inch thick raised pattern steel floor plate with integral nosing and back edge stiffener.
 3. Weld steel supporting brackets to stringers and treads to brackets.
 4. Fabricate platforms of raised pattern steel floor plate of thickness indicated.
 5. Provide nosing matching that on treads at all landings.
 6. Secure to platform framing members with welds.
- J. Grating
1. Provide patterns, spacing and bar sizes indicated; fabricate to comply with NAAMM "Metal Bar Grating Manual."
 2. Shop prime paint unless indicated otherwise.
 3. Secure treads to stringers with bolts.
 4. Fabricate grating platforms, with nosing matching that on grating treads.
 5. Provide toe plates at open-sided edges of grating platform.
 6. Secure grating to platform frame with welds.
- K. Stair Railings and Handrails: Comply with applicable requirements specified elsewhere in this section for steel tube and pipe railings and handrails.

2.17 PIPE BOLLARD

- A. Fabricate pier set bollards from:
1. Schedule 80 steel pipe, galvanized.
 2. 6-inch I.D. black pipe.
 3. Length: 7'0".
 4. Yellow polyethylene bollard cover with red reflective tape; cut to length.
- B. Manufacturer
1. Standard of Quality: Unless otherwise indicated, design is based on products by Post Guard, Farmington Hills, MI www.postguard.com
 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers are:
 - a. Innoplast, Garfield Heights, OH www.innoplast.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.18 GROUT AND ANCHORING CEMENT

- A. Rough Hardware:
1. Bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, other miscellaneous steel and iron shapes required for framing and supporting woodwork, anchoring or securing woodwork to concrete or other structures.

2. Fabricate to sizes, shapes, dimensions required.
 3. Malleable-iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.
- B. Non-shrink Metallic Grout: Premixed, factory-packaged, (int. ferrous aggregate grout complying with CE CRD-C 621, only) specifically recommended by manufacturer for heavy duty loading applications of type specified in this section.
- C. Non-shrink Nonmetallic Grout: Premixed, factory-packaged, (non-staining, noncorrosive, nongaseous grout complying stain) with CE CRD-C 621. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.
- D. Erosion-Resistant Anchoring Cement:
1. Factory-prepackaged, non-shrink, non-staining, hydraulic expansion cement formulation for mixing with potable water at Site to create pourable anchoring, patching, and grouting compound.
 2. Provide formulation that is resistant to erosion from water exposure without need for protection by a sealer or waterproof coating and is recommended for exterior use by manufacturer.

2.19 FINISHES

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
1. Refer to Section 09 91 50.
- B. Finish metal fabrications after assembly.
- C. Steel and Iron Finishes:
1. Galvanizing: For those items indicated for galvanizing, apply zinc-coating by the hot-dip process in compliance with the following requirements:
 - a. ASTM A153 for galvanizing iron and steel hardware.
 - b. ASTM A123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch thick and heavier.
 - c. Use process for galvanizing that will prepare item for painting
 2. Primer Application:
 - a. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finish or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated.
 - b. Comply with requirements of SSPC PA1 "Paint Application Specification No. 1" for shop painting.
- D. Surfaces to Receive Fireproofing: In addition to above, shop paint only with materials that are approved by the fireproofing manufacturer in compliance with UL or FM assemblies.
- E. Galvanizing Repair Paint: High zinc dust content; dry film containing at least 94 percent zinc dust by weight; comply with DOD-P-21035 or SSPC-Paint-20.
- F. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint-12 except containing no asbestos fibers.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.

- B. Verification of Conditions: Verify that Metal Fabrications may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Coordination:
 - 1. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.
 - 2. Coordinate delivery of such items to Site.
- B. Utilize templates and other systems required to ensure accurate placement of items that will be embedded in concrete and masonry.
- C. Sleeves: Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

3.3 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Temporary Bracing: Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- E. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

3.4 SETTING LOOSE PLATES

- A. Clean concrete and masonry bearing surfaces of any bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
- B. Setting: Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.

1. Use metallic non-shrink grout in concealed locations where not exposed to moisture.
2. Use nonmetallic non-shrink grout in exposed locations, unless otherwise indicated.
3. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

- A. Anchor supports securely to, and rigidly brace from, overhead building structure.
- B. Expansion Joints: Provide expansion joints at locations indicated, or if not indicated, at intervals not exceeding 40 feet. Provide slip joint with internal sleeve extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6 inches of posts.

3.6 INSTALLATION OF BOLLARDS

- A. Anchor bollards in concrete.
 1. After bollards have been inserted into concrete, fill annular space in bollard with non-shrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's directions.
 2. Wrap bollard with bond breaker prior to installation of paving or slabs.

3.7 INSTALLATION OF PREFABRICATED BUILDING COLUMNS

- A. Install prefabricated building columns to comply with AISC "Code of Standard Practice for Steel Building Construction," AISC "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," and requirements of the testing and inspecting agency that apply to the fire resistance rating indicated.

3.8 TOLERANCES

- A. Install in required position and within following tolerances:
 1. Maximum variation from plumb: 1/4 inch.
 2. Maximum offset from true alignment: 1/4 inch.

3.9 ADJUSTING AND CLEANING

- A. Touch-Up Painting: Cleaning touch-up painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Section 09 91 50.
- B. Galvanizing: For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A780.
- C. Collect offcuts and scrap and place in designated areas for recycling.

END OF SECTION 05 50 00

END OF DIVISION 05 - METALS

DIVISION 06 – WOODS, PLASTICS, AND COMPOSITES

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Section	Title
06 10 53	Miscellaneous Rough Carpentry
06 40 23	Interior Architectural Woodwork
06 61 00	Cast Polymer Fabrications
END OF INDEX	

SECTION 06 10 53 – Miscellaneous Rough Carpentry

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Dimension lumber framing.
 - 2. Wood furring, grounds, nailers, roof and wall blocking, sleepers, and cap at any back wall details.
 - 3. Sheathing.
 - 4. Interior wood trim (not identified in Section 06 40 23).
 - 5. Carpentry accessories.
- B. Related Sections:
 - 1. Section 06 40 23 - Interior Architectural Woodwork
 - 2. Section 07 41 13 - Metal Roofing and Wall Panels
 - 3. Section 07 54 00 - Thermoplastic Membrane Roofing
 - 4. Section 07 62 00 - Sheet Metal Flashing and Trim
 - 5. Section 07 72 00 - Roof Accessories
 - 6. Section 07 92 00 - Joint Sealants

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASME:
 - 1. B18.6.1
 - 2. B18.2.1
- B. ASTM:
 - 1. A153 - Zinc-Coating (Hot-Dip) of Iron and Steel Hardware
 - 2. A307 - Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

3. A563 - Carbon and Alloy Steel Nuts
 4. A653 - Galvanized Steel Sheet
 5. A666 - Annealed or Cold-Worked Austenitic Stainless Steel Sheet
 6. B633 - Electrodeposited Coatings of Zinc on Iron and Steel
 7. C954 - Steel Drill Screws for Application of Gypsum Panel Products to Steel Studs
 8. D3498 - Adhesives for Field Gluing Plywood to Lumber Framing
 9. E488 - Strength of Fasteners in Concrete and Masonry
 10. F593 - Carbon and Alloy Steel Externally Threaded Metric Fasteners
 11. F594 - Stainless Steel Nuts
 12. F1667 - Driven Fasteners
 - C. AWWA U1 - Preservative Treatment by Pressure Process
 - D. APA The Engineered Wood Association Form E30 - APA Design/Construction Guide
 - E. Council of American Building Officials (CABO) NER-272 - Pneumatic or Mechanically Driven Staples, Nails, P-Nails and Allied Fasteners for Use in All Types of Building Construction
 - F. U.S. Department of Commerce (DOC), National Institute of Standards and Technology:
 1. PS1 - U.S. Product Standard for Construction and Industrial Plywood
 2. PS2 - Performance Standard for Wood-Based Structural-Use Panels
 3. PS20 - American Softwood Lumber Standard
 - G. Western Wood Products Association - Grading rules
- 1.4 DEFINITIONS
- A. Dimension Lumber: Surface nominal thickness of 2 to 4 inches and nominal width of 2 inches and wider.
- 1.5 SUBMITTALS
- A. Refer to the Division 1 Specifications.
 - B. Product Data: Submit for each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 1. Wood Treatment Data: Provide chemical treatment manufacturer's instructions for handling, storing, installation, finishing.
 - C. Quality Assurance/Control Submittals:
 1. Test Reports: Reports indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with performance requirements indicated.
 2. Certifications:
 - a. Preservative-treated wood products: For each type include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, compliance with applicable standards, and instructions for handling, storing, installing, and finishing treated materials.
 - b. Waterborne-treated products: Include certification that moisture content of treated materials was reduced to levels indicated before shipment to Site.
 - c. Fire-retardant-treated wood products: Include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener-holding capacities of treated materials.

- d. For wood members treated with FRT chemicals, NDS for Wood Construction Section 2.3.4 requires submittal of design values, including connections, from the company providing the treatment and redrying service.
- e. Submit organic chemical formulation, third party inspected, ICBO and NER report, EPA registered as a preservative, with a builder's warranty.

1.6 QUALITY ASSURANCE

A. Qualifications:

- 1. Manufacturer: 5 years experience in the manufacture of wood chemical treatment, with 6 projects of similar size, scope and type of which 3 have been in successful use for 3 years or longer.
- 2. Contractor: 3 years experience in carpentry with 6 projects of similar size.
- 3. Personnel: For actual installation, use personnel skilled in work required.

B. Preinstallation Meetings: Conduct conference at Site to comply with requirements of the Division 1 Specifications.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

B. Protection:

- 1. Keep materials under cover and dry.
- 2. Protect from weather and contact with damp or wet surfaces.
- 3. Stack lumber, plywood, and other panels, providing for air circulation within and around stacks and under temporary coverings.
- 4. For lumber and plywood pressure- treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

1.8 PROJECT CONDITIONS

A. Existing Conditions: Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. FSC Certified Wood Products: Subject to compliance with specified requirements, acceptable manufacturers and products are:

- 1. Certified Wood Products, Minnetonka and Maple Lake, MN
www.certifiedwoodproducts.net
- 2. Weyerhaeuser, Seattle, WA www.weyerhaeuser.com
- 3. Other FSC providers: www.fscus.org/certified_companies
- 4. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

A. Lumber, General:

- 1. Lumber Standards: Comply with DOC PS 20, and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

2. Grade Stamps:
 - a. Factory mark each piece with grade stamp of inspection agency.
 - b. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece.
 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 4. Provide dressed lumber, S4S, unless otherwise indicated.
 5. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38 mm actual) thickness or less, unless otherwise indicated, and lumber items not specified to receive wood preservative treatment.
 6. Interior particleboard or fiberboard products shall contain no urea formaldehyde.
- B. Wood-preservative-treated Materials:
1. Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWP A U1.
 2. Lumber not in contact with ground and protected from liquid water may be treated with inorganic boron (SBX).
 3. Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.
 4. Use chemicals acceptable to authorities having jurisdiction and containing no chromium or arsenic.
 5. For exposed items indicated to receive stained finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
 6. Pressure treat aboveground items with waterborne preservatives to a minimum retention of 0.25 pound per cubic foot. After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively.
 7. Treat indicated items and the following:
 - a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - b. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - c. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - d. Wood framing members less than 18 inches above grade.
 - e. Wood floor plates installed over concrete slabs on grade.
 8. Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to a minimum retention of 0.40 pound per cubic foot.
- C. Fire-retardant-treated Materials:
1. Comply with applicable requirements of AWP A UCFA (interior, not in contact with ground) and UCFA (exterior, not in contact with ground or foundations).
 2. Treatment Types:
 - a. Use treatment that does not promote corrosion of metal fasteners.
 - b. Use Exterior type for exterior locations and where indicated.
 - c. Use Interior Type A, High Temperature (HT) for enclosed roof framing, framing in attic spaces, and where indicated.
 - d. Use Interior Type A on other applications unless otherwise indicated.

3. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Mark end or back of pieces indicated to be stained or natural finish.
 4. Treat all miscellaneous carpentry, unless otherwise indicated, and the following:
 - a. Framing for raised platforms.
 - b. Concealed blocking, roof construction.
 - c. Plywood backing panels.
 5. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.
- D. Dimension Lumber:
1. Provide dimension lumber of grades indicated according to the ALSC National Grading Rule (NGR) provisions of the inspection agency indicated.
 2. Interior Partitions: Provide framing of the following grade and species:
 - a. Grade: 3, Construction, or Stud.
 - b. Species:
 - 1) Hem-fir north.
 - 2) Spruce-pine-fir north.
 - 3) Western woods.
 3. Other Framing: Provide the following:
 - a. Grade: 2, Construction, or Stud.
 - b. Species:
 - 1) Douglas fir-larch.
 - 2) Hem-fir north.
 - 3) Spruce-pine-fir north.
 - 4) Southern pine.
- E. Boards:
1. Concealed Boards:
 - a. Moisture content: 19 percent maximum.
 - b. Species and grade:
 - 1) Hem-fir, Standard or No. 3 Common.
 - 2) Spruce-pine-fir, Standard or No. 3 Common.
 - 3) Western woods, Standard or No. 3 Common.
- F. Miscellaneous Lumber:
1. Provide lumber for support or attachment of other construction, including:
 - a. Blocking.
 - b. Nailers.
 - c. Rooftop equipment bases and support curbs.
 - d. Cants.
 - e. Furring.
 - f. Grounds.
 - g. Utility shelving.

2. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
 3. Grade:
 - a. For dimension lumber sizes, provide Grade 3 or Standard.
 - b. For board-size lumber, provide Grade 3, Common, or Standard.
 4. Species:
 - a. Douglas fir-larch.
 - b. Hem-fir north.
 - c. Spruce-pine-fir north.
 - d. Southern pine.
 5. Select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
 6. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.
- G. Interior Wood Trim:
1. Softwood Trim:
 - a. Kiln-dried finished (surfaced) material without finger jointing.
 - b. Texture: Smooth.
 - c. Species:
 - 1) Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine.
 - 2) Western red cedar.
 - 3) Douglas fir.
 2. Hardwood Trim:
 - a. Lumber for transparent finish (stained or clear): Solid lumber.
 - b. Lumber for painted finish: Finger jointed or solid lumber.
 - c. Texture: Surfaced (smooth).
 - d. Species and cut:
 - 1) Rift-sawn, clear, kiln-dried red oak selected for compatible grain and color.
- H. Wood-based Structural-use Panels:
1. Structural-Use Panel Standards: Provide either all-veneer, mat-formed, or composite panels complying with DOC PS 2, "Performance Standard for Wood-Based Structural-Use Panels," unless otherwise indicated.
 2. Provide plywood panels complying with DOC PS 1, "U.S. Product Standard for Construction and Industrial Plywood," where plywood is indicated.
 3. Trademark: Factory mark structural-use panels with APA trademark evidencing compliance with grade requirements
 4. Span Ratings: Provide panels with span ratings required to meet "Code Plus" provisions of APA Form E30, "APA Design/Construction Guide: Residential & Commercial."
 5. Miscellaneous Concealed Panels: APA-rated sheathing, Exposure 1, span rating to suit framing in each location.
 6. Miscellaneous Exposed Plywood: A-C Exterior, thickness as indicated on Drawings, but not less than 1/2 inch thick.

7. Plywood Backing Panels:
 - a. For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with grade, C-D Plugged Exposure 1, in thickness indicated on Drawings. If not indicated, thickness to be not less than 3/4".
 - b. For mounting cabinets, grab bars, large format televisions / monitors, provide fire-retardant-treated plywood panels, or fan-fold panels, such as Pyro-Guard Backing Board. Panels to be 1" thick minimum.
 - c. Provide fire-retardant-treated plywood panels, or fan-fold panels, such as Pyro-Guard Backing Board in locations indicated on the Drawings. Panels to be 1" thick minimum. Install panels with the center of the panel at 5'-6" A.F.F.

I. Fasteners:

1. Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
2. Miscellaneous carpentry exposed to weather, in ground contact, or in area of high relative humidity: Provide fasteners with hot-dip zinc coating per ASTM A153 or of 304 stainless steel.
3. Nails, Wire, Brads, and Staples: ASTM F1667.
4. Power-Driven Fasteners: CABO NER-272.
5. Wood Screws: ASME B18.6.1.
6. Cold-Formed Metal Framing Screws: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
7. Lag Bolts: ASME B18.2.1.
8. Bolts: Steel bolts complying with ASTM A307, Grade A, with ASTM A563 hex nuts and, where indicated, flat washers.
9. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete, determined by testing per ASTM E488.
 - a. Carbon-steel, zinc plated to comply with ASTM B633.
 - b. Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 3, grade A1 or A4.

J. Metal Framing Anchors:

1. Provide galvanized steel framing anchors of structural capacity, type, and size indicated and acceptable to authorities having jurisdiction.
2. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653, G60 (Z180) coating designation; structural, commercial, or lock-forming quality, as standard with manufacturer for type of anchor indicated.
3. 304 Stainless Steel Sheet: ASTM A666.

K. Accessories:

1. Adhesives for gluing furring and sleepers to concrete or masonry.
 - a. Comply with ASTM D3498.
 - b. Approved for use indicated by adhesive manufacturer.
 - c. VOC content of 70 g/L or less.
2. Other Materials: Materials not specifically described but required for complete, proper installation of miscellaneous carpentry, subject to acceptance of E/A.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that miscellaneous carpentry may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies:
 - 1. Immediately notify E/A in writing.
 - 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 - 3. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protect installed work and materials of other trades.
- B. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- C. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.

3.3 INSTALLATION

- A. Installation, General:
 - 1. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
 - 2. Fit carpentry to other construction; scribe and cope as required for accurate fit.
 - 3. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
 - 4. Do not splice structural members between supports, unless otherwise indicated.
 - 5. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.
 - 6. Countersink nail heads on exposed carpentry work and fill holes with wood filler.
 - 7. Use fasteners of appropriate type and length, complying with Table 2304.9.1 "Fastening Schedule" in IBC. Predrill members when necessary to avoid splitting wood.
- B. Fire Blocking: Provide in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Concealed spaces behind combustible cornices and exterior trim at not more than 20 feet on center.

- C. Wood Grounds, Nailers, Blocking, and Sleepers:
 - 1. Install where shown and where required for screeding or attaching other work.
 - 2. Form to shapes indicated and cut as required for true line and level of attached work.
 - 3. Coordinate locations with other work involved.
 - 4. Attach to substrates to support applied loading.
 - 5. Recess bolts and nuts flush with surfaces, unless otherwise indicated.
 - 6. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1 1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.
 - 7. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- D. Wood Furring:
 - 1. Install plumb and level with closure strips at edges and openings.
 - 2. Shim with wood as required for tolerance of finish work.
 - 3. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal size furring at 24 inches on center.
 - 4. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal size furring vertically at 16 inches on center.
- E. Installation of Structural-use Panels:
 - 1. Comply with applicable recommendations contained in APA Form No. E30, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.
 - 2. Comply with "Code Plus" provisions of above-referenced guide.
- F. Wood Trim Installation:
 - 1. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available.
 - 2. Stagger joints in adjacent and related standing and running trim.
 - 3. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint.
 - 4. Use scarf joints for end-to-end joints.
 - 5. Match color and grain pattern across joints.
 - 6. Install trim after gypsum board joint finishing operations are completed.
 - 7. Drill pilot holes in hardwood before fastening to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads and fill holes.
 - 8. Install to tolerance of 1/8 inch in 96 inches for level and plumb.
 - 9. Install adjoining finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.

3.4 ADJUSTING

- A. Replace damaged materials with new materials complying with specified requirements.

3.5 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from work of this Section. Maintain premises in neat, orderly condition.

- B. System:
1. Remove temporary covering and other provisions made to minimize soiling of other work.
 2. Promptly clean, repair surfaces stained, marred or otherwise damaged during Work.
 3. When Work is completed, remove unused materials, containers, equipment, and debris.
- 3.6 PROTECTION
- A. Protect wood treated with inorganic boron (SBX) from weather. If it becomes wet, apply EPA-registered borate treatment by spraying.
 - B. Protect rough carpentry from weather. If it becomes wet, apply EPA-registered borate treatment by spraying.
 - C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer to ensure work is without damage or deterioration at time of Substantial Completion.

END OF SECTION 06 10 53

SECTION 06 40 23 – Interior Architectural Woodwork

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Standing and running wood trim.
 - 2. Architectural woodwork accessories including, but not limited to:
 - a. Fasteners and anchors.
 - b. Joint sealant.
- B. Related Sections:
 - 1. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 2. Section 07 92 00 - Joint Sealants
 - 3. Section 08 14 00 - Wood Doors
 - 4. Section 08 71 00 - Door Hardware
 - 5. Section 08 80 00 - Glazing
 - 6. Section 09 91 00 - Painting
 - 7. Section 10 11 00 - Visual Display Surfaces
 - 8. Section 12 30 00 - Manufactured Casework

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ANSI:
 - 1. A208 - Particleboard
- B. ASTM:
 - 1. A167 - Stainless and Heat Resistant Chromium Nickel Steel Plate, Sheet, Strip
 - 2. A276 - Stainless Steel Bars and Shapes
 - 3. D1037 - Evaluating Properties of Wood-Based Fiber and Particle Panel Materials
 - 4. D3201 - Hydroscopic Properties of Fire Retardant Wood and Wood Based Products
- C. AWI - Quality Standards of the Architectural Woodwork Industry
- D. NEMA LD3

1.4 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.
- B. HCS: Horizontal, Through-Color Standard
- C. HGF: Horizontal Fire Rated
- D. HGP: Horizontal, General Purpose, Postforming

- E. HGS: Horizontal, General Purpose, Standard
- F. LGP: Laboratory, General Purpose, Postforming
- G. VGP: Vertical, General Purpose, Postforming
- H. VGS: Vertical, General Purpose, Standard
- I. VOC: Volatile Organic Compound

1.5 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations for each product, process specified.
- C. Provide product data indicating percentages by value of rapidly renewable interior architectural woodwork products and total cost of all interior architectural woodwork materials.
- D. Samples:
 - 1. Color Samples: Submit manufacturer's standard color samples with Product Data and Shop Drawings for each product specified.
 - 2. Lumber with or for transparent finish; 6 inches by 3/4 inch by 18 inches, for each species, cut, finished on one side and one edge.
 - 3. Veneer leaves representative of, selected from flitches to be used for transparent finished woodwork.
 - 4. Wood veneer faced panel products, with or for transparent finish, finished, 8 inch by 10 inch, for each species, cut.
- E. Shop Drawings:
 - 1. Show system fabrication, installation drawings.
 - 2. Show location of each item, dimensioned plans and elevations, large-scale (full size) details, attachment devices, and other components.
 - 3. Locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other sections.
 - 4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
- F. Quality Assurance/Control Submittals:
 - 1. Certificates:
 - a. Fire-retardant treatment: Include treating plant certification that fire retardant treated materials comply with requirements.
 - b. Quality: Submit woodwork manufacturer's (fabricator's) certification, stating that fabricated woodwork complies with quality grades, other requirements indicated.
 - c. Submit certification from an independent certification organization accredited by the Forest Stewardship Council certifying that wood comes from an independently certified, well-managed forestry source.
 - d. Chain of custody: Submit Forest Stewardship Council certification numbers and copies of invoices bearing these numbers as documentation that lumber was properly segregated from other materials while in storage and production.

1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide architectural woodwork units made of components of standard construction furnished by one manufacturer as coordinated and sequence-matched assemblies.
- B. Qualifications:
 - 1. Manufacturer: 10 years experience in the manufacture of architectural woodwork.
 - 2. Contractor: 10 years experience in the installation of architectural woodwork.
 - 3. Personnel: For actual installation of architectural woodwork, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of Work.
- C. Regulatory Requirements:
 - 1. Fire-Test-Response Characteristics: Comply with UL, ITS, or other testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
- E. Field Samples: If requested, furnish sample of each type of architectural woodwork to E/A for review prior to manufacture/ installation. E/A will forward approved sample to the Site for installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas.
- B. Store only in areas where environmental conditions comply with requirements specified in "Project Conditions" article.

1.8 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Woodwork Manufacturer:
 - a. Establish optimum moisture content, required temperature, and humidity condition.
 - b. Advise installer regarding temperature, humidity requirements for woodwork installation and storage areas.
 - 2. Installer:
 - a. Do not install until required temperature, relative humidity have been stabilized and will be maintained in installation areas.
 - b. Maintain temperature, humidity in installation area as required to maintain moisture content of installed woodwork within 1.0 percent tolerance of optimum moisture content, from date of installation through remainder of construction period.
- B. Existing Conditions:
 - 1. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work.
 - 2. Field-verify dimensions and assume full responsibility for their accuracy.
 - 3. Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other sections to ensure that interior architectural woodwork can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule to fabricator of architectural woodwork. Coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. General:
 - 1. Provide materials that comply with requirements of referenced quality standard for each type of wood trim and quality grade specified, unless noted otherwise, from FSC-Certified Wood Suppliers.
 - 2. Provide materials from FSC-Certified Fabricators.
 - 3. Provide materials as indicated on the Drawings.
- B. Standing and Running Trim:
 - 1. Comply with the “Architectural Woodwork Standards” for grades of wood trim indicated for construction, finishes, installation, and other requirements.
 - 2. Unless noted otherwise on Drawings, trim shall be fabricated in standard profiles.
 - 3. Comply with following requirements for finish type:
 - a. Transparent finish:
 - 1) Grade: Premium.
 - 2) Species: Clear Maple, plain sawn.
 - 3) Stained to match wood door finish.
 - 4) Refer to Drawings for stain color.
 - b. Opaque Finish:
 - 1) Grade: Custom.
 - 2) Species: Any closed grain hardwood listed in referenced woodworking standards.
 - 3) Refer to Drawings for color.
- C. Fire-Retardant-Treated Lumber and Plywood:
 - 1. Pressure impregnated with fire-retardant chemicals. Comply with following requirements:
 - a. Use chemicals of type, for applications indicated which do not bleed-through or otherwise adversely affect finishes.
 - b. Do not use colorant in solution to distinguish treated lumber from untreated lumber.
 - c. Use low hygroscopic type halogen, sulfate-free solution intended for interior applications not exposed to relative humidities in excess of 95 percent; with treated material having equilibrium moisture content of not over 28 percent per ASTM D3201 at 92 plus 2 percent relative humidity.
 - 2. Marking: Identify treated lumber with separable paper classification marking of inspecting, testing agency acceptable to authorities having jurisdiction.
 - 3. Milling: Mill lumber after treatment, within limits set for wood removal which does not affect listed fire performance characteristics, using woodworking plant certified by testing, inspecting agency.

4. Kiln-dry after treatment to levels required for non-fire-retardant treated woodwork materials. Maintain moisture content required by kiln drying, before and after treatment.
- D. Woodwork Substrates:
1. Fire-Rated: Particleboard meeting Underwriter's Laboratories, Inc., Standard Tests for surface burning characteristics of burning materials (UL 723) and ASTM E119.
- E. Architectural Woodwork Accessories:
1. Fasteners and Anchors:
 - a. Nails and screws:
 - 1) Countersunk, concealed fasteners and blind nailing.
 - 2) Use fine finishing nails or finishing screws.
 - b. Anchors:
 - 1) Material, type, size, finish required by each substrate for secure anchorage.
 - 2) Non-ferrous metal or hot-dip galvanized anchors and inserts for exterior installations, elsewhere as required for corrosion-resistance.
 - 3) Toothed steel or lead expansion bolt devices for drilled-in-place anchors.
 - 4) Furnish inserts, anchors, as required, to be set into concrete or masonry work for subsequent woodwork anchorage.
 2. Joint Sealant: 1-part polyurethane.
- 2.2 FABRICATION
- A. General:
1. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber at time of fabrication and for relative humidity conditions in installation areas.
 2. Fabrication:
 - a. Fabricate to dimensions, profiles, details indicated with openings, mortises precut, where possible, to receive hardware, other items and work.
 - b. Ease edges to 1/16 inch radius for edges of solid wood members less than 1 inch nominal thickness, 1/8 inch radius for edges of rails, similar members over 1 inch nominal thickness.
 3. Assembly:
 - a. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Site to maximum extent possible.
 - b. Disassemble components only as necessary for shipment and installation.
 - c. Where necessary for fitting at site, provide ample allowance for scribing, trimming, fitting.
 4. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements, verify dimensions, Shop Drawing details as required for accurate fit.

- B. Standing and Running Trim:
 - 1. Rout or groove backs of flat trim members, kerf backs of other wide flat members, except for members with ends exposed in finished work.
 - 2. Assemble, trim railings in plant except where limitations of access to place of installation require field assembly.
- 2.3 SOURCE QUALITY CONTROL
- A. Standing and Running Trim: Comply with AWI Section 300.
- 2.4 FINISH
- A. Wood Shop Finishes:
 - 1. Grade:
 - a. Provide finishes of same grades as items to be finished.
 - b. Transparent finish: Premium grade with stain with satin sheen.
 - 2. Shop finish transparent-finished interior architectural woodwork at fabrication shop. Refer to the Division 1 Specifications for finishing opaque-finished architectural woodwork.
 - 3. Drawings indicate items that are required to be shop finished. Refer to the Division 1 Specifications for finishing architectural woodwork not indicated to be shop finished.
 - 4. Shop Priming: Shop apply the prime coat including backpriming, if any, for items specified to be field finished. Refer to the Division 1 Specifications for material and application requirements.
 - B. Preparation for Finishing:
 - 1. Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 2. Whenever plastic laminate or finished surface is discontinued due to cutting, routing, or other means, seal edges of coreboard materials and wood surfaces to prevent off-gassing during use.
 - C. Backpriming:
 - 1. Apply 1 coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork.
 - 2. Apply 2 coats to back of paneling and to end-grain surfaces.
 - 3. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.
 - D. Woodwork Accessories:
 - 1. Joint Sealant: Color to be selected by E/A from full range of standard and exotic colors.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that Architectural Woodwork may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.

- C. Discrepancies:
 - 1. Immediately notify E/A.
 - 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 - 3. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Environmental Conditions:
 - 1. Verify that prevailing temperature, humidity conditions are within acceptable range prior to beginning installation.
 - 2. Proceed only when work which may be detrimental to woodwork is complete and all involved parties agree that acceptable environmental conditions can be maintained for duration of project.

3.3 INSTALLATION

- A. General Requirements:
 - 1. Install plumb, level, true, straight, with no distortions.
 - 2. Shim as required using concealed shims. Install to tolerance of 1/8 inch in 8 feet for plumb and level, with no variations in flushness of adjoining surfaces.
 - 3. Scribe, cut to fit adjoining work.
 - 4. Refinish cut surfaces or repair damaged finish at cuts.
- B. Pressure Treated Wood: Handle, store, install in compliance with recommendations of chemical treatment manufacturer, including those for adhesives, where required for installation.
- C. Anchoring:
 - 1. Anchor woodwork to anchors or blocking built-in or directly attached to substrates.
 - 2. Secure to grounds, stripping, blocking with countersunk, concealed fasteners, blind nailing as required for complete installation.
 - 3. Except where prefinished matching fasteners heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork.
 - 4. Match final finish where transparent finish is indicated.
- D. Standing and Running Trim:
 - 1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
 - 2. Stagger joints in adjacent and related members.
 - 3. Cope at returns, miter at corners, and comply with referenced Quality Standards for joinery.

3.4 ADJUSTMENT

- A. Damaged and Defective Woodwork:
 - 1. Repair where possible to eliminate defects functionally and visually.
 - 2. Where not possible to repair, replace woodwork.
 - 3. Adjust joinery for uniform appearance.

3.5 CLEANING

- A. Woodwork:
 - 1. Clean exposed and semi-exposed surfaces.
 - 2. Touch-up shop-applied finishes to restore damaged or soiled areas.

3.6 WASTE MANAGEMENT

- A. Separate wood waste according to Section 01 74 20 Construction Waste Management.
- B. Separate the following categories for salvage or reuse on site:
 - 1. Sheet materials larger than 2 square feet.
 - 2. Solid wood trim longer than 16 inches.
 - 3. Multiple offcuts of any size larger than 12 inches.
- C. Recycle:
 - 1. Clean, unpainted engineered wood products.
 - 2. Clean, unpainted dimensional lumber.
- D. Separate for disposal and place in designated areas for hazardous materials: Treated, stained, painted, or contaminated wood.

3.7 PROTECTION

- A. Provide final protection, maintain conditions, in manner acceptable to fabricator and installer, to ensure architectural woodwork is without damage or deterioration at time of substantial completion.

END OF SECTION 06 40 23

SECTION 06 61 00 – Cast Polymer Fabrications

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Cast polymer fabrications (Quartz) for:
 - a. Countertops.
 - b. Vanity tops.
 - c. Windowsills.
 - d. Backsplashes.
- B. The following is not included in this section:
 - 1. Plumbing Fixtures.
- C. Related Sections:
 - 1. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 2. Section 08 43 13 - Aluminum Framed Storefront
 - 3. Section 08 90 00 - Louvers and Vents
 - 4. Section 09 22 00 - Non-Structural Metal Framing
 - 5. Section 09 29 00 - Gypsum Board
 - 6. Section 09 91 00 - Painting
 - 7. Section 12 30 00 - Manufactured Casework
 - 8. Division 22 – Plumbing

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. C97 - Moisture Absorption.
 - 2. C99 - Modulus of Rupture.
 - 3. C170 - Compressive Strength.
 - 4. C501 - Abrasion Resistance.
 - 5. C482 - Bond Strength.
 - 6. C484 - Thermal Shock.
 - 7. C531 - Coefficient of Thermal Expansion.
 - 8. C648 - Breaking Strength of Tile.
 - 9. C1026 - Resistance to Freeze-Thaw Cycling.
 - 10. E84 - Surface Burning Characteristics.
 - 11. E662 - Smoke Density.
 - 12. 650-04 - Chemical Resistance.

- B. ANSI:
 - 1. Z124.6 - Stain Resistance.
 - 2. A137.1 - Wet/Dry Dynamic Coefficient of Friction.

1.4 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings:
 - 1. Submit Shop Drawings showing countertop layout, windowsill locations, dimensions, required locations of support and blocking member, edge profiles, cutouts, and attachments.
 - 2. Indicate details of anchorage.
- D. Samples:
 - 1. Initial Color Selection: Submit manufacturer's full range of color samples for each type of finish with Product Data and Shop Drawings. Color selections **MUST** be from manufacturer's full range of colors, including ALL exotic colors.
 - 2. Color Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics. Include notification to E/A if selection is not within quoted price range.
 - 3. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components if requested by E/A.
- E. Maintenance Manual: Provide to Owner, maintenance and warranty data in "Maintenance Manual" at maintenance demonstration at Substantial Completion.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide materials made of components with uniform texture and color or blend, furnished by one manufacturer unless indicated otherwise.
- B. Qualifications:
 - 1. Manufacturer: 15 years' experience in the manufacture of quartz design and production.
 - 2. Fabricator/Installer: manufacturer approved, with 5 years experience in the installation of quartz surfaces.
- C. Preinstallation Meetings: Conduct pre-installation meeting to clarify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Observe manufacturer's recommendations and handle fabrications in a manner to prevent breakage. Brace parts if necessary. Transport in the near vertical position with finished face toward finished face. Do not allow finished surfaces to rub during shipping and handling.
- B. Storage and Protection:
 - 1. Store in racks in near vertical position.
 - 2. Store inside away from direct exposure to sunlight.
- C. Remove damaged materials from jobsite.

1.7 PROJECT CONDITIONS

A. Existing Conditions:

1. Drawings do not purport to show actual field dimensions but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.8 WARRANTY

A. Full Lifetime Warranty.

1. Fully transferable, non-prorated warranty.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Cast Polymer Fabrications (Quartz)

1. Standard of Quality for design of Cast Polymer (Quartz) is based on Cambria, Le Sueur, MN www.cambriausa.com
2. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - a. Caesarstone, Charlotte, NC www.caesarstoneus.com
 - b. LX Hausys, Atlanta, GA www.lxhausys.com/us
 - c. Silestone by Cosentino, Coral Gables, FL www.silestoneusa.com
 - d. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.2 MATERIALS

- A. Homogeneous mixture containing quartz with additions of high performance polyester resin, pigments, and special effects, that is resistant to stains and heat.
- B. Construction:
 1. Quartz, binder, and pigment.
- C. Thickness: 3 cm.
- D. Identification: Material shall be labeled with manufacturer's identifying mark.
- E. Performance:
 1. Moisture Absorption: 0.02%
 2. Compressive Strength: 24,750 PSI.
 3. Abrasion Resistance: 223.
 4. Surface Burning Characteristics: Class A/1 Rating
- F. Color: To be selected from manufacturer's full color range.
- G. Finish: Unless noted otherwise on Drawings, fabrications to have manufacturer's standard gloss finish.
- H. Exposed Edges and Corners:
 1. Unless noted otherwise on Drawings, fabrications to have an eased edge profile.
- I. Backsplash: Unless noted otherwise on Drawings, provide square splash with flat top.

2.3 ACCESSORIES

A. Mounting Adhesive:

1. 50-year 100% silicone or epoxy adhesive.
2. Type as recommended by manufacturer.

- B. Quartz Surface Adhesive:
 - 1. Provide epoxy or acrylic adhesive of a type recommended by manufacturer for application and conditions of use.
 - 2. Adhesive which will be visible in finished work shall be tinted to match quartz surface.
- C. Joint Sealant:
 - 1. Clear sealant of type recommended by manufacturer for application and use.
 - 2. Provide anti-bacterial sealant in toilet and shower areas, and food preparation areas.
 - 3. Acceptable manufacturers:
 - a. Dow Corning.
 - b. GE Sealants.
- D. Solvent: Denatured alcohol for cleaning to assure adhesion of adhesives and sealants.
- E. Cleaning Agents: Mild soap and water.

2.4 FABRICATION

- A. Inspection of Materials:
 - 1. Inspect materials for imperfections prior to fabrication.
 - 2. Variations in distribution of aggregate and color that occur in quartz products are within manufacturer's tolerance and do not constitute defective product.
 - 3. Removal of the protective plastic film is required.
- B. Layout:
 - 1. Layout surface to minimize joints. Joint width should not be larger than 1/32".
 - 2. Work with manufacturer's approved fabricator who utilizes digital images for seam coordination, product flow, and bookmatch material.
- C. Countertops:
 - 1. Provide continuous tops as indicated on the Drawings.
 - 2. Coordinate sink size, number, and locations with plumbing.
 - 3. Notify E/A regarding any discrepancies.
- D. Window Stools:
 - 1. Provide as indicated on the Drawings.
 - 2. Trim hidden edges as required with power saw and masonry blades.
 - 3. Polish cut edges to match cast surfaces.
 - 4. Hold cutting of exposed surfaces to minimum.
 - 5. Anchor material in place using adhesives specifically recommended by manufacturer of solid surfacing material.
- E. Backsplashes:
 - 1. Provide as indicated on the Drawings.
 - 2. Anchor material in place using adhesives specifically recommended by manufacturer of solid surfacing material.
- F. Tools: Cut and polish with water-fed powered tools.
- G. Cutouts:
 - 1. Cutouts shall have a minimum of ¼" (6.35mm) radius.
 - 2. Where edges of cutouts will be exposed in finished work, polish edges.

- H. Laminations: Laminate layers of cast polymer surfacing as required to create built-up edges following procedures recommended by the manufacturer.
- I. Mitered Edge: Miter cast polymer surfacing material as required following procedures recommended by the manufacturer.

PART 3 – EXECUTION

3.1 PRE-INSTALLATION EXAMINATION.

- A. Site Verification:
 - 1. Verify dimensions by field measurements prior to installation.
 - 2. Verify that substrates supporting quartz surfaces are plumb, level, and flat to within 1/8 inch in 10 feet and that all necessary supports and blocking are in place.
 - 3. Support structure shall be secured to adjoining units, back wall, and/or flooring.
- B. Inspection of quartz surfacing:
 - 1. Inspect materials for imperfections prior to installation.

3.2 PREPARATION

- A. Prepare Surface:
 - 1. Clean quartz surfacing according to manufacturer's instructions prior to installation.
- B. Protection of quartz surfacing:
 - 1. Protect finished surfaces from damage.
 - 2. Apply protection where necessary.
 - 3. Take necessary precautions to prevent dirt, grit, dust, and debris from other trades from contacting the surface by covering the top and exposed edge profiles after installation is completed.

3.3 INSTALLATION

- A. Install materials according to manufacturer's procedures and approved shop drawings.
- B. Preliminary Installation:
 - 1. Position materials to verify the correct size and orientation (bookmatch material).
 - 2. If size adjustments, or additional fabrication is necessary, use water-fed tools. Protect jobsite and surface from dust and water. Perform work away from installation site if possible.
 - 3. Allow gaps for expansion of not less than 1/8" (1.5mm) per 10 feet when installed between walls or other fixed structures.
- C. Permanent Installation:
 - 1. After verification of fit and finish, clean substrate; remove loose and foreign matter which may interfere with adhesion. Clean quartz surfacing backside and joints per manufacturer's instructions.
 - 2. Horizontal surface: Apply continuous bead of 100% silicone at the intersection point of the cast polymer fabrication and the substrate or cabinet. This bead will be continuous throughout the entire perimeter.
 - 3. Vertical surface: Apply continuous bead of mounting adhesive around the perimeter of the vertical piece(s). In addition, apply 1/4" mounting adhesive bead every 8" on vertical center.
 - 4. Install cast polymer fabrication plumb, level, square, and all on the same plane.
 - 5. Align adjacent pieces in same plane.

- D. Joints:
 - 1. Joints between adjacent pieces of quartz surfacing:
 - a. Joints shall be flush, tight fitting, level, and clean.
 - b. Securely join adjacent pieces with adhesive per manufacturer's instructions.
 - c. Fill joints level to polished surface.
 - d. Secure adjacent quartz surfacing with pneumatic vacuum clamps until adhesive hardens.
 - 2. Joints between quartz surfacing and adjacent materials:
 - a. Seal joints with 50-year 100% silicone sealant.

3.4 REPAIR

- A. Perform any finish work necessary and replace any damaged material.

3.5 CLEANING

- A. Remove all masking, all excessive adhesive, and all excess sealants.
- B. Thoroughly clean all exposed surfaces per manufacturer's instructions to remove all debris.

3.6 PROTECTION

- A. Protect installed fabrications with non-staining sheet coverings.

END OF SECTION 06 61 00

END OF DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

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07 53 23	EPDM Membrane Roofing
07 62 00	Sheet Metal Flashing and Trim
07 71 23	Gutters and Downspouts
07 72 00	Roof Accessories
07 84 00	Firestopping
07 92 00	Joint Sealants
END OF INDEX	

SECTION 07 13 00 – Sheet Waterproofing

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Modified bituminous sheet membrane, self-adhering.
 - 2. Surface conditioner.
 - 3. Protection board:
 - a. Bituthene asphaltic hardboard.
 - b. Extruded polystyrene “fanboard.”
 - c. Extruded polystyrene foundation insulation.
 - 4. Prefabricated drainage composite.
 - 5. Sheet membrane waterproofing accessories including, but not limited to:
 - a. Primer.
 - b. Liquid membrane.
 - c. Mastic.
 - d. Protection board adhesive.
 - e. Petroleum resistant tape.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 03 41 00 - Plant-Precast Structural Concrete
 - 3. Section 04 20 00 - Unit Masonry Assemblies

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCE STANDARDS

- A. ASTM:
 - 1. C578 - Rigid Cellular Polystyrene Thermal Insulation
 - 2. D412 - Vulcanized Rubber Thermoplastic Elastomer
 - 3. D570 - Water Absorption of Plastics
 - 4. D1621 - Compressive Properties of Rigid Cellular Plastics
 - 5. D1970 - Self-Adhering Polymer Modified Bituminous Sheet Materials
 - 6. D5385 - Hydrostatic Pressure Resistance of Waterproofing Membranes
 - 7. E96 - Water Vapor Transmission of Materials
 - 8. E154 - Water Vapor Retarders Used in Contact With Earth

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's Product Data, including installation instructions, use limitations, and certification of material indicating VOC content.
- B. Samples: 3 weeks minimum prior to delivery, submit samples of the following for approval:
 - 1. Sheet membrane.
 - 2. Protection board.
- C. Shop Drawings: Detail to show fabrication, anchorage and interface of Work with work of adjacent trades.
- D. Manufacturer's Warranty: 5 years from installation date on material (3 copies).

1.5 QUALITY ASSURANCE

- A. Manufacturer: 5 years production of self-adhesive sheet membrane waterproofing.
- B. Installer: Applicator with 5 years experience in this type of work; currently certified by manufacturer.
- C. Manufacturer's Representative: Make arrangements to have manufacturer's trained representative on site periodically during membrane waterproofing work to review installation procedures, after which, representative is to make report to E/A.
- D. Materials: Single source supplier for each type of primary material. Verify compatibility.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Deliver materials to Site in manufacturer's unopened containers with labels intact and legible at time of use.
 - 2. Sequence deliveries to avoid delays but minimize on-site storage.
- B. Storage and Protection:
 - 1. Store and handle in strict accordance with manufacturer's instruction.
 - 2. Protect materials before, during and after installation. Protect installed work and materials of other trades from damage by this trade.

3. Immediately repair or replace damages as necessary to acceptance of E/A, and at no additional cost to Owner.

1.7 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Sheet Membrane Waterproofing System:
 1. Standard of Quality: Design is based on products of Grace Construction Products, Cambridge, MA www.gcpat.com
 - a. Bituthene System 3000
 2. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable products and manufacturers are:
 - a. CCW Mira-Dri by Carlisle Corp, Supula, OK www.carlisle-ccw.com
 - b. Polyguard 650 by Polyguard Products, Ennis TX www.polyguard.com
 - c. SealTight Mel-Rol by W.R. Meadows, Elgin, IL www.wrmeadows.com
 - d. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.2 MATERIALS

- A. Modified Bituminous Sheet Membrane:
 1. 60-mil thick, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated to a 4-mil-thick polyethylene film with release liner on adhesive side and formulated for application with primer or surface conditioner.
 2. Physical Properties:
 - a. Tensile strength: 250 psi minimum, ASTM D412, Die C, modified.
 - b. Ultimate elongation: 300 percent minimum, ASTM D412, Die C, modified.
 - c. Low-temperature flexibility: Pass at minus 20 degrees F, ASTM D1970.
 - d. Puncture resistance: 40 pound/foot minimum, ASTM E154.
 - e. Hydrostatic-head resistance: 150 feet minimum, ASTM D5385.
 - f. Water absorption: 0.15 percent weight-gain maximum after 48 hour immersion at 70 degrees F, ASTM D570.
 - g. Vapor permeance: 0.05 perms, ASTM E96, Water Method.
- B. Surface Conditioner:
 1. Water based latex surface treatment, which is formulated to bind site dust and concrete efflorescence, providing a suitable surface for the waterproofing membrane.
 2. Product: Bituthene System 3000 Surface Conditioner.
- C. Protection Board:
 1. 1/8 inch Bituthene Asphaltic Hardboard by Grace Construction Products, Cambridge, MA www.gcpat.com
 2. "Fanboard:" High density extruded polystyrene plastic form sandwiched between two facers of plastic film:

- a. Thickness 1/4 inch.
 - b. Core Material: Black, high impact polystyrene.
 - 1) Light duty, impermeable polystyrene sheet.
 - 2) Compression: 11,000 psf.
 - 3) Foundation drainage rate: 9 gal/min/ft2
 - c. Fabric Material: Black, non-woven filter fabric.
 - 1) Flow: 150 gal/min/ft2
 - 2) Puncture: 65 lbs.
 - d. Product: ArmorDrain Drainage Mats, by Mar-Flex, Carlisle, OH
www.mar-flex.com or equal accepted in advance by E/A.
- D. Prefabricated Drainage Composite:
 - 1. Earth Contact:
 - a. Drainage composite consisting of dimpled, high-impact polystyrene core which is adhered to a needle-punched non-woven filter fabric at the front of the core, and a film at the back of the core.
 - b. Product: Hydroduct 2 by Grace Construction Products, Cambridge, MA
www.gcpat.com
- E. Miscellaneous Materials:
 - 1. Primer: Low VOC content rubber based formulated to provide permanent adhesion of the waterproofing membrane.
 - 2. Liquid Membrane: Two component, elastomeric, cold-applied, trowel grade material for use as:
 - a. Fillet material at inside corners.
 - b. Reinforcement material at inside corners.
 - c. Flashing material around drains, protrusions, curbs, and parapets.
 - d. Sealing material at terminations.
 - e. Repair materials for defects on concrete surfaces.
 - 3. Mastic: Rubberized asphalt-based materials with excellent adhesion to structural concrete, masonry, and wood, designed to seal terminations.
 - 4. Protection Board Adhesive: Adhesive acceptable to both the Sheet membrane waterproofing manufacturer and the protection board manufacturer.
 - 5. Petroleum Resistant Tape: "3M" tape No. 853 or equal.
 - 6. Accessories, specified or acceptable to manufacturer of sheet membrane waterproofing, needed for a complete job.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examination of Conditions: Verify that work may be performed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- B. Work of Other Trades: Prior to commencing Work, carefully inspect and verify that work is complete to point where this installation may properly commence. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to installer.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved.

3.2 PREPARATION OF SUBSTRATES

- A. Refer to manufacturer's recommendation for preparation of substrates.
- B. Surfaces shall be structurally sound and free of voids, spalled areas, loose aggregates and sharp protrusions.
- C. Remove contaminates such as grease, oil, and wax from exposed surfaces. Remove dust, dirt, loose stone and debris.
- D. Use repair materials and methods that are acceptable to manufacturer of sheet membrane waterproofing.
- E. Related Materials: Treat joints and install flashings as recommended by waterproofing manufacturer.

3.3 INSTALLATION

- A. Refer to manufacturer's literature for recommendations on installation for waterproofing and related materials.
- B. Apply surface conditioner at dilution and rate recommended by manufacturer. Re-coat areas not waterproofed if contaminated by dust. Mask and protect adjoining exposed finish surfaces from excessive application of surface conditioner.
- C. Delay application of membrane until surface conditioner is completely dry.
- D. Install upside-down 6-inch strip of bituthene membrane over each precast concrete joint.
- E. Seal daily terminations with troweled bead of mastic.
- F. Apply protection board and related materials according to manufacturer's recommendations.

3.4 CLEANING AND PROTECTION

- A. Remove masking materials after installation.
- B. Clean stains on materials that would be exposed in the completed Work.
- C. Protect completed membrane waterproofing from subsequent construction activities as recommended by manufacturer.

END OF SECTION 07 13 00

SECTION 07 21 00 – Thermal Insulation

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Batt insulation.
 - a. Thermal.
 - b. Acoustical.
 - 2. Rigid insulation (including below grade insulation).
 - 3. Spray foam sealant.
 - 4. Vapor retarder.
 - 5. Accessories including, but not limited to:
 - a. Tape.
 - b. Insulation support pins.
 - c. Insulation standoff.
- B. The following is not included in this section:
 - 1. Cavity wall insulation (Section 04 20 00).
 - 2. Roofing insulation (Section 07 53 23).
- C. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 04 20 00 - Unit Masonry Assemblies
 - 3. Section 05 31 00 - Steel Decking
 - 4. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 5. Section 07 26 00 - Vapor Retarder
 - 6. Section 07 41 13 - Metal Roofing and Wall Panels
 - 7. Section 07 53 23 - EPDM Membrane Roofing
 - 8. Section 07 84 00 - Firestopping
 - 9. Section 09 29 00 - Gypsum Board

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. C236 - Measuring Steady-State Thermal Transmission of Fenestration Systems
 - 2. C272 - Water Absorption
 - 3. C518 - Thermal Transmission
 - 4. C578 - Rigid Cellular Polystyrene
 - 5. C665 - Standard for Mineral-Fiber Blanket Thermal Insulation

6. C739 - Cellulosic Fiber Loose-Fill Thermal Insulation
7. C764 - Mineral Fiber Loose-Fill Thermal Insulation
8. C1104 - Water Vapor Sorption of Unfaced Mineral Fiber Insulation
9. C1304 - Odor Emission of Thermal Insulation Materials
10. C1338 - Fungi Resistance of Insulation Materials and Facings
11. D882 - Tensile Properties of Thin Plastic Sheeting
12. D1621 - Compressive Properties
13. D1709 - Impact Resistance of Plastic Film
14. D2126 - Dimensional Stability
15. E84 - Surface Burning Characteristics of Building Materials
16. E96 - Water Vapor Transmission of Materials
17. E119 - Fire Tests of Building Construction and Materials
18. E136 - Behavior of Materials in a Vertical Tube Furnace
19. E970 - Critical Radiant Flux of Exposed Attic Floor Insulation
20. E1643 - Standard for Installation of Water Vapor Retarders Under Concrete
21. E1745 - Standard for Plastic Water Vapor Retarders Under Concrete

1.4 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Plenum Rating: Provide insulation where indicated in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.
2. Mold Growth and Humidity Test Results: Insulation showing no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with *Chaetomium globosum* on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

1.5 SUBMITTALS

A. Refer to Section 01 33 00.

B. Product Data:

1. Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
2. Include binders, additive, and expanding agent.

C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections details of components, joint locations and configurations within system and between system and adjoining system.

D. Certificates:

1. Manufacturer: That vermiculate insulation does not contain asbestos.

1.6 QUALITY ASSURANCE

A. Single Source Responsibility: Provide building insulation system made of components of standard construction furnished by one manufacturer as coordinated assemblies.

- B. Qualifications:
 - 1. Manufacturer: 5 years' experience in the manufacture of building insulation.
 - 2. Contractor: 3 years' experience in the installation of building insulation.
 - 3. Personnel: For actual installation of building insulation, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Regulatory Requirements:
 - 1. Use aged and settled values for thermal resistance factors (R-values), tested according to ASTM C518 at 75 degrees F and 50 percent relative humidity for at least 6 months.
 - 2. Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products by test method indicated below:
 - a. Surface-Burning Characteristics: ASTM E84.
 - b. Fire-Resistance Ratings: ASTM E119.
 - c. Combustion Characteristics: ASTM E136.
- D. Field Samples: If requested, furnish sample of each type of building insulation to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources.
- B. Store inside and in a dry location.
- C. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Plastic Insulation:
 - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times.
 - 3. Do not deliver to Site before installation time.
 - 4. Complete installation and concealment as rapidly as possible in each area of construction.

1.8 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Batt/Blanket Insulation:
 - 1. Fiberglass:
 - a. Standard of Quality: Design is based on products of Owens-Corning Fiberglass, Toledo, OH; www.owenscorning.com

- b. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - 1) CertainTeed, Valley Forge, PA www.certainteed.com
 - 2) Johns Manville www.jm.com
 - 3) Manufacturer of comparable products submitted in compliance with Section 01 25 13.
- B. Rigid Board Insulation:
 - 1. Extruded Polystyrene:
 - a. Standard of Quality: Design is based on products of Owens Corning, Toledo, OH www.owenscorning.com
 - b. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - 1) Dow Chemical Company, Midland, MI www.dow.com
 - 2) Johns Manville www.jm.com
 - 3) Kingspan, DeLand, FL www.kingspan.com
 - 4) Manufacturer of comparable products submitted in compliance with Section 01 25 13.
 - 2. Polyisocyanurate:
 - a. Dow Chemical Company, Midland, MI www.dow.com
 - b. GAF Materials Corporation, Wayne, NJ www.gaf.com
 - c. Johns Manville Roofing systems Group, Denver, CO www.jm.com
 - d. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.
 - 3. Fiberboard:
 - a. Standard of Quality: Design is based on products of Homasote Company, West Trenton, NJ www.homasote.com
 - b. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - 1) Owens-Corning, www.owenscorning.com
 - 2) Thermafiber, www.owenscorning.com
 - 3) Manufacturer of comparable products submitted in compliance with Section 01 25 13.
- C. Spray Foam Adhesive/Sealant:
 - 1. Standard of Quality: Design is based on PL300 Foam Board Adhesive by Loctite, Inc., Westlake, CT www.loctiteproducts.com
 - 2. Other acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. CF Crack and Joint Foam by Hilti, Tulsa, OK www.us.hilti.com
 - b. Great Stuff, Dupont, Wilmington, DE www.dupont.com
 - c. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
- D. Vapor Retarder:
 - 1. Standard of Quality: Design is based on products of Raven Industries, Sioux Falls, SD www.viaflex.com

2. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - a. Fortifiber Building Systems Group, Reno, NV www.henry.com
 - b. Reef Industries, Houston, TX www.reefindustries.com
 - c. W.R. Meadows, Elgin, IL www.wrmeadows.com
 - d. Manufacturer of comparable products submitted in compliance with Section 01 25 13.
- E. Tape:
1. Standard of Quality: Design is based on No. 8086 Contractor Sheathing Tape by 3M, St. Paul, MN
 2. Other acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Sheathing Tape 1585CW-2 by VentureTape, Rockland, MA www.venturetape.com
 - b. Manufacturer of comparable products submitted in compliance with Section 01 25 13.
- F. Insulation Support Pins:
1. Standard of Quality: Design is based on Insulation Hangers by Gemco, Danville, IL www.gemcoinsulation.com
 2. Other acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. TruFast, Bryan, OH www.trufastwalls.com
 - b. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.2 MATERIALS

- A. Batt Insulation:
1. Glass Fiber Batts:
 - a. Formaldehyde-free.
 - b. Combustion characteristics: Passes ASTM E136.
 - c. Critical radiant flux: ASTM E970, greater than 0.11 btu/square foot s.
 - d. Water vapor sorption: ASTM C1104, 5 percent or less.
 - e. Odor emission: Passes ASTM C13047.
 - f. Corrosiveness: Passes ASTM C665.
 - g. Fungi resistance: Passes ASTM C1338.
 - h. Recycled content: Certified by Scientific Certification Systems to contain minimum of 20 percent post-consumer and 5 percent pre-consumer recycled glass product.
 - i. Thickness: As recommended by manufacturer unless stated differently on Drawings.
 - j. Sound attenuating:
 - 1) STC of 49 when used with wall type indicated.
 - 2) Polyethylene-wrapped OR Unfaced batt.
 - 3) Product poly wrapped: Johns Manville Comfort Therm.
 - 4) Product unfaced: Sound-Shield Free.

- k. Bi-component glass fiber: 2-part, irregularly twisted, glass fiber, not containing binders.
- B. Rigid Board Insulation:
 - 1. Use preformed units to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths. Thicknesses as shown on the Drawings.
 - 2. Extruded Polystyrene Board Insulation:
 - a. Rigid, cellular thermal insulation with closed-cells and integral high density skin, formed by expansion of polystyrene base resin in extrusion process.
 - b. 5-year aged R-values (ASTM C518) 5.4 and 5 per inch at 40 and 5 degrees F respectively.
 - c. Dimensional stability (ASTM D2126) of 1.0 percent.
 - d. Water absorption (ASTM C272) of 0.15 percent (maximum).
 - e. Below grade insulation:
 - 1) Product: Foamular 250.
 - 2) Type: IV.
 - 3) Minimum density: 1.6 pounds per cubic foot unless otherwise indicated.
 - 4) Compressive resistance: 25 pounds per square inch.
 - f. Above grade insulation:
 - 1) Product: Foamular 150.
 - 2) Type: X.
 - 3) Minimum density: 1.35 pounds per cubic foot unless otherwise indicated.
 - 4) Compressive resistance (ASTM D1621): 15 pounds per square inch.
 - 3. Polyisocyanurate Insulation:
 - a. Meet ASTM C1289.
 - b. Maximum 4 foot by 4 foot boards.
 - c. All packages to have RIC/TIMA label.
 - d. Type 1: Class 1, aluminum foil on both surfaces.
 - e. Type II: Felt or glass fiber mat on both surfaces.
 - f. Type III (Composite): Perlite on one side and felt or glass fiber mat on other.
 - g. Type IV (Composite): Cellulose fiber insulation board on one side and felt or glass fiber mat on other.
 - h. Type V (Composite): OSB on one side and felt or glass fiber mat on other.
 - i. Minimum 2 layers.
- C. Vapor Retarders:
 - 1. Nominal 6 mil (minimum), continuous, clear polyethylene film (walls, ceilings).
 - 2. Laminated high density polyethylene sheet (below slabs).
 - a. Meet ASTM E1745, Class C.

- b. Performance requirements:
 - 1) 1-inch tensile strength: ASTM D882, minimum 7350 psi.
 - 2) Puncture resistance: ASTM D1709, minimum 1.91 pounds.
 - 3) Perm rating: ASTM E96, minimum 0.045.
 - c. Provide accessories where required.
 - d. Product: Rufco 300 by Raven Industries.
 - D. Accessories: All other materials not specifically described but required for complete and proper installation of building insulation subject to acceptance of engineer including, but not limited to:
 - 1. Soffit Vent Chute: Preformed polystyrene.
 - 2. Adhesive:
 - a. Product approved by insulation manufacturer.
 - b. Low VOC.
 - 3. Spray Foam Sealant: Non-shrink closed cell expanding urethane.
 - 4. Tape:
 - a. 2 inches wide.
 - b. Self-adhesive vapor retarder tape.
 - c. Flame spread index of 25 or less, smoke developed index of 50 or less.
 - 5. Insulation Supports:
 - a. Corrugated cardboard for overhead installations, 65 percent recycled content, foil facing.
 - b. Netting for blown-in insulation in wall and ceiling cavities.
 - c. Adhesively attached or peel and stick spindle-type anchors:
 - 1) Perforated plate welded to projecting spindle.
 - 2) Plate galvanized carbon steel.
 - 3) Spindle copper-coated, low carbon steel, fully annealed, 12 gage tip. Length to suit depth of insulation.
 - d. Self-locking washer:
 - 1) 12 gage, Stainless steel.
 - 2) Beveled to prevent cutting into insulation.
 - 3) Thickness: 0.016.
 - 4) Diameter: 1-1/2 inch by 1 1/2 inch OR 2 1/2 inch by 2 1/2 inch.
 - e. Insulation standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 2 inches between face of insulation and substrate to which anchor is attached.
 - f. Anchor adhesive: To bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.
 - g. Metal or wire strapping.

2.3 ENVIRONMENTAL CONSIDERATIONS

- A. Chemical Composition:
 - 1. Rigid board insulation shall not contain chlorofluorocarbons (CFCs).
 - 2. Insulation shall not contain formaldehyde.

- B. Seal insulation products containing loose fiber or chemicals that offgas, from office spaces.
- C. Protect ducts and HVAC system from loose insulation particulates.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades:
 - 1. Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
 - 2. Verify substrates are properly prepared and clean.
- B. Verification of Conditions: Verify that building insulation may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies:
 - 1. Immediately notify engineer.
 - 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 - 3. Commencement of installation signifies acceptance of surface conditions.

3.2 INSTALLATION

- A. General:
 - 1. Install according to manufacturer's instructions.
 - 2. Where taped joints are specified, completely seal joints between adjacent vapor retarders and between vapor retarders and adjacent construction.
 - 3. Install sound control insulation in manner to achieve and maintain the sound ratings specified.
 - 4. Water-piping coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
 - 5. Install insulation that is undamaged, dry, and unsoiled, and that has not been left exposed at any time to ice and snow.
 - 6. Minimize the generation of offcuts and waste. Reuse insulation scraps to maximum extent feasible.
- B. Batts/Blankets:
 - 1. Install snug fitting to completely fill cavities, without voids.
 - 2. Fill voids around windows, door frames, and miscellaneous exterior openings.
 - 3. Fit to exterior side of electrical devices and pipes.
 - 4. Fasten to vertical surfaces using 9/16 inch staples.
 - 5. Do not compress to fit.
- C. Rigid Board Insulation:
 - 1. Install in a clean, dry condition.
 - 2. Attach with adhesive specifically recommended for such use.
 - 3. Use expanding foam sealant between insulation panels.
 - 4. Fill holes and openings.

- D. Vapor Barrier: Comply with ASTM E1643.
1. Walls:
 - a. Apply full height continuous vapor barrier over warm side face of studs.
 - b. Temporarily attach to ceiling deck with tape or other suitable material until interior covering is applied.
 - c. Where necessary to lap vapor barrier, lap minimum 2 stud spaces and tape.
 2. Ceiling:
 - a. Underside of ceiling framing:
 - 1) Apply continuous vapor barrier with minimum number of lap joints over warm side face of framing.
 - 2) Temporarily attach to ceiling framing with tape or other suitable material until interior covering is applied.
 - 3) Where necessary to lap vapor barrier, lap minimum 2 stud spaces and tape.
 - b. Insulation above deck:
 - 1) Apply continuous vapor retarder with minimum number of laps on roof deck prior to installation of insulation.
 - 2) Where necessary to lap vapor retarder, lap minimum of 6 inches and tape.
 3. Under Concrete Slabs:
 - a. Install vapor retarder under concrete slabs on grades.
 - b. Where necessary to lap vapor retarder, lap minimum of 6 inches and tape.
 4. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.
 5. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor retarder tape or another layer of vapor retarder.
- E. Insulation Anchors:
1. Adhesive glued anchors:
 - a. Prepare surface according to manufacturer's directions.
 - b. Surface to be clean and dry, free of oil, grease, frost, or any foreign matter.
 - c. Allow to set 24 to 72 hours before impaling insulation.
 2. Peel and Stick Anchors: Prepare surface according to manufacturer's directions.
 3. Screw Anchors: Screw in place with manufacturer's recommended screws.
 4. Place 12 to 16 inches apart.
 5. Self Locking Washer: Place at end of spindle and press down to appropriate position.
 6. Safety Washers and Dome Caps: Push onto spindle until the spindle contacts the top of the dome. Cover tip of spindle to reduce potential risk of injury.
 7. Spindle can be left sticking out, bent over, or clipped off.
- F. Acoustical Insulation: Install where indicated in sound rated assemblies, maintaining acoustical rating of assembly.

- G. Other Insulation: Apply as indicated on Drawings or required by construction in such a manner to provide continuous barrier to movement of heat and air.

3.3 PROTECTION

- A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.4 INSPECTION AND TESTING

- A. Inspect insulation for proper installation.
- B. Correct defects such as voids, gaps, or insulation compressed behind pipes.

3.5 CLEANING

- A. Clean construction area of all scrap insulation at the end of each working day.

END OF SECTION 07 21 00

SECTION 07 41 13 – Metal Roofing and Wall Panels

PART 1 – GENERAL

1.1 SUMMARY

A. Provide:

1. Steel roofing and wall panels:
 - a. (Structural) standing seam roofing.
 - b. (Architectural) standing seam roofing.
 - c. Batten roofing.
 - d. Concealed fastener siding panels:
 - 1) Rectangular modular flat wall panel.
 - e. Exposed fastener siding panels:
 - 1) Deep “V” rib siding.
 - 2) Ribbed siding.
 - f. Fabricated plate.
2. Flashings and trim.
3. Water barrier membrane.
4. Miscellaneous accessories including, but not limited to:
 - a. Felt underlayment.
 - b. Gaskets.
 - c. Panel clips.
 - d. Fasteners.
 - e. Joint sealers for metal roof and wall panels.
 - f. Red rosin paper.
 - g. Roof Tie-Off Devices.

B. Related Sections:

1. Section 06 10 53 - Miscellaneous Rough Carpentry
2. Section 07 21 00 - Thermal Insulation
3. Section 07 41 14 - Snow Guards
4. Section 07 46 17 - Metal Soffit and Fascia Systems
5. Section 07 62 00 - Sheet Metal Flashing and Trim
6. Section 07 71 23 - Gutters and Downspouts
7. Section 07 92 00 - Joint Sealants

1.2 FEDERAL BIDDING REQUIREMENTS

A. Buy America:

1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.

B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

A. ASTM:

1. A653 - Galvanized Steel Sheet by Hot Dip Process
2. B209 - Aluminum Alloy Sheet
3. C209 - Cellulostic Fiber Insulation Board
4. D226 - Asphalt Saturated Organic Felt
5. D523 - Specular Gloss Coatings
6. D1970 - Self-Adhering Polymer Modified Bituminous Sheet Materials
7. E119 - Methods for Fire Tests of Building Construction and Materials
8. E136 - Combustion Characteristics
9. E331 - Standard Test Method for Water Penetration
10. E1592 - Structural Performance
11. E1646 - Water Penetration
12. E1680 - Air Leakage

B. NAAMM - "Metal Finishes Manual for Architectural and Metal Products"

1.4 SUBMITTALS

A. Refer to Section 01 33 00.

B. Product Data: Manufacturer's current product specifications, standard details, certified product test results, installation instructions, general recommendations, as applicable to materials and finishes for each component and for total system of preformed panels.

C. Samples:

1. Manufacturer's standard color samples.
2. Three weeks (minimum) prior to fabrication/delivery, 2 copies, 12 inches square, of each exposed finish material, including joint.

D. Shop Drawings:

1. Small-scale layouts of panels on walls and columns, large-scale details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim flashings, closures, special details including side laps and end laps if any.
2. Distinguish between factory and field assembly work.
3. Coordination Drawings of roof or wall plans for metal panels, coordinating penetrations and roof-mounted or wall-mounted items.

E. Test Reports: Submit test reports prepared by Underwriters Laboratories, Inc. (UL) indicating wind uplift rating of proposed roof system.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility: Provide materials made of components with uniform texture and color or blend, furnished by one manufacturer unless indicated otherwise.

B. Qualifications:

1. Manufacturer: 10 years experience in the manufacture of metal roof and wall panels.
2. Contractor: 5 years experience in the installation of metal roof and wall panels.
3. Testing and Inspection Agency: ASTM E119, acceptable to authorities having jurisdiction.

C. Regulatory Requirements:

1. Fire-Resistance Ratings:
 - a. Combustion characteristics: ASTM E136.
 - b. Comply with UL "Fire Resistance Directory".
 - c. Identify panels with markings of testing and inspecting agency.
 - d. Surface-burning characteristics:
 - 1) Flame Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 450 or less.
 2. Meet IBC code requirements adopted by state in which project is located.
 3. Low sloped roofs:
 - a. Design to resist uplift pressure calculated according to ANSI/SPRI ES 1.
 - b. Contractor and roofing manufacturer are responsible for ensuring metal roof meets wind uplift requirements per applicable codes and manufacturer's weathertightness warranty.
 - c. All costs associated with any engineering to meet this requirement shall be included in the contractor's bid.
 4. Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for the following:
 - a. Metal panels:
 - 1) Air infiltration - ASTM E1680.
 - 2) Water penetration - ASTM E1646.
 - 3) Wind-uplift resistance - UL 580.
 - 4) Structural performance - ASTM E1592.
 - b. Insulation and water barrier membranes:
 - 1) Thermal resistance.
 - 2) Fire-test-response characteristics.
 - 3) Water-vapor transmission.
 - 4) Water absorption - ASTM C209.
- D. Preinstallation Meetings: Installer and manufacturer's technical rep shall meet with E/A prior to the start of installation.
- E. Manufacturer's Observation:
1. Manufacturer's representative shall visit site while panels are being installed to observe methods.
 2. Manufacturer's representative shall submit log of visit, including instructions given to the installer, to the engineer's office within one week of visit.

1.6 PERFORMANCE REQUIREMENTS

- A. No water penetration of the panel assembly shall be permitted when tested at 20 psf pressure for 15 minutes according to ASTM Test Procedure E331.
- B. Deflection shall be limited to L/240 for positive loading.
 1. The panels shall withstand a 250 lb. concentrated load applied to a four square inch area at the center of the panel at mid-span between supports without panel deformation, rib buckling or panel side lap separation that will adversely affect the weather tightness of the system.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect metal panels from damage (including rust) during shipment, storage and construction.
- B. Stack on platforms or pallets, covered with suitable weather-tight and ventilated covering. Ensure dryness.

1.8 PROJECT CONDITIONS

- A. Existing Conditions:
 - 1. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.
 - 2. Allow for trimming panel units where final dimensions cannot be established prior to fabrication.

1.9 COORDINATION

- A. Coordinate metal panel assemblies with adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Manufacturer:
 - 1. Provide manufacturer's standard 20-year warranty for finish.
 - 2. Provide manufacturer's full system No Dollar Limit (NDL) written warranty signed by installer and manufacturer for 20-year period from date of substantial completion of building, covering repairs required to maintain roof and flashings in watertight conditions.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Roofing and Wall Panels: Standard of Quality: Design is based on Snap-Clad by PAC-CLAD Peterson Aluminum, Elk Grove, IL www.pac-clad.com
- B. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Elevate, Nashville, TN www.holcimelevate.com
 - b. ATAS International, Allentown, PA www.atas.com
 - c. Manufacturer of comparable products submitted in compliance with Section 01 25 13.
- C. Water Barrier Membrane: Standard of Quality: Design is based on PAC-CLAD HT, by PAC-CLAD Peterson Aluminum, Elk Grove, IL www.pac-clad.com
 - 1. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. CertainTeed, Valley Forge, PA, www.certainteed.com
 - b. Deck Guard by Polyguard Products, Ennis, TX www.polyguard.com
 - c. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.2 MATERIALS

- A. Steel for Painting/Coating:
 - 1. Thickness: 24 gauge.
 - 2. G90 hot-dip zinc coated steel sheet compliant with ASTM A653, Grade A except where higher strength required by manufacturer for performance.

B. Water Barrier Membrane:

1. ASTM D1970.
2. 36-inch-wide, 0.004-inch thick.
3. Cold-applied, self-adhering membrane.
4. High-strength polyethylene film coated on one side with a thick layer of adhesive-consistency rubberized asphalt.
5. Membrane to be able to withstand temperature of 200 degrees F without adhesive degradation.
6. Provide complete with manufacturer's recommended primer.
7. Product: PAC HT (WIP300) by Pac-Clad.

2.3 FABRICATION

A. General:

1. Fabricate panels to sizes on Drawings.
2. Form siding panels with preformed corners fully welded and ground smooth.
3. Fabricate and finish panels, accessories, at factory to greatest extent possible by manufacturer's standard procedures and processes, as required to fulfill indicated performance requirements which have been demonstrated by factory testing.
4. All radius work to be factory rolled.
5. Form panels to specified dimensions with tolerances to accommodate thermal expansion and contraction between panels and structural members.
6. Fabricate panel joints with captive gaskets or separator strips, which provide tight seal and prevent metal-to-metal contact in manner to minimize noise from movements within panel system.
7. Condensation: Fabricate panels for control of condensation, including vapor inclusion of seals and provisions for breathing, venting, weeping, and draining.
8. Comply with indicated profiles and dimensional requirements, and structural requirements.
9. Individual panels shall be removable for replacement of damaged material without disturbing adjacent panels.

B. Panels:

1. (Structural) Standing Seam Roofing:
 - a. Steel.
 - b. UL-90 rating.
 - c. 18-inch-wide center to center panel with 2-inch rib designed and warranted for low sloped roof, as indicated on Drawings.
 - d. Crimped.
 - e. Product: Tite-Loc by Pac-Clad.
 - f. Color: As indicated on the Drawings.
2. (Architectural) Standing Seam Roofing:
 - a. Steel.
 - b. UL-90 rating.
 - c. 18-inch-wide center to center panel with 2" rib height.
 - d. Product: Tite-Loc by Pac-Clad.
 - e. Color: As indicated on the Drawings.

3. Siding Panels:
 - a. 0.040 aluminum.
 - b. 36-inch wide by 12-inch tall, rectangular panel.
 - c. Horizontal panel orientation.
 - d. Product: Versa-Lok VSL 123 by ATAS International.
 - e. Color: As indicated on the Drawings.
4. Flashing and Trim:
 - a. J channel and all closure trim indicated or required for complete system.
 - b. Materials shall be of same material, gauge, finish, and color as the panels.
 - c. Locations as shown on Drawings or otherwise required to make building watertight.
5. Accessories: Including but not limited to:
 - a. Felt underlayment: 36-inch-wide unperforated 30-pound asphalt-saturated inorganic felt, ASTM D6757.
 - b. Gaskets: As provided by metal panel manufacturer.
 - c. Panel clips:
 - 1) As recommended by the panel manufacturer.
 - 2) 16 gauge minimum.
 - 3) Full recessed to prevent sharp edges coming into contact with roof materials.
 - 4) Allow for expansion and contraction of panel through expected temperature range.
 - d. Fasteners:
 - 1) Screw type.
 - 2) As recommended by panel manufacturer.
 - 3) Stainless steel.
 - 4) Separate washers with hot bonded neoprene faces and pop rivets set in wet sealant.
 - e. Closure Strips: Shop fabricated, prefinished, 24 gauge galvanized steel drip edge and soffit channels as indicated on the Drawings. Color to match metal panels.
 - f. Prefabricated Vent Pipe Flashing System:
 - 1) Vent pipe flashing shall consist of a stepped profile EPDM pipe boot, designed for multiple pipe diameters, attached to an aluminum flanged base plate.
 - 2) Aluminum base plate to be shop painted Kynar 500 coating. Color to match metal roof panels.
 - g. Joint sealers: As recommended by panel manufacturer or, if not specified, see Section 07 92 00.
 - h. Slip sheet: Red rosin paper, minimum 5 pounds per 100 square feet.
 - i. Roof Tie-Off Devices: Two Way Standing Seam Roof Clamp.
 - 1) Manufacturer: Preferred Safety Products, Denver, CO, www.preferredsafety.com

- 2) Reusable, all steel construction with zinc electroplate finish.
- 3) Provide three (3) clamp units to Owner at project completion.

2.4 METAL FINISHES

A. General Requirements:

1. Provide colors or color matches as indicated or, if not otherwise indicated, as selected by engineer from manufacturer's standard colors.
2. Apply coatings either before or after forming and fabricating panels, as required by coating process and for maximum coating performance capability.
3. Protect coating promptly after application and cure, by application of strippable film or removable adhesive cover. Retain until installation has been completed.
4. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products."

B. Paint:

1. Fluoropolymer Coating: Full-strength 70 percent Kynar 500 coating baked-on for 15 minutes at 450 degrees F in dry film thickness of 1.0 mil, 30 percent reflective gloss (ASTM D523), over minimum 0.2 mil baked-on modified epoxy primer.
2. Siliconized Polyester Finish:
 - a. Total dry film thickness:
 - 1) Exterior: 1 mil.
 - 2) Interior: 0.5 mil.

C. Color: Refer to Drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that metal panels may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies:
 1. Immediately notify engineer in writing.
 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 3. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protect installed work and materials of other trades.
- B. Apply bituminous coating or other permanent separation materials on concealed panel surfaces where panels would otherwise be in direct contact with substrate materials which are incompatible or could result in corrosion or deterioration of either material or finishes.

3.3 INSTALLATION

- A. Water Barrier Membrane: Lay one layer horizontally over entire roof and wall; lapping according to manufacturer's written instructions.
- B. Roofing and Wall Panels:
 1. Comply with panel fabricator's and material manufacturers' instructions for installation, as applicable to project conditions and supporting substrates.
 2. Field cutting by torch is not permitted.

3. Anchor panels and other components of work securely in place, with provisions for thermal/structural movement.
 - a. Install panels with recommended fasteners.
 - b. Separate dissimilar metals with bituminous paint, PVC shims, or separation tape/membrane wherever 2 dissimilar metals come in contact.
 - C. Fabricated Plate Panel:
 1. Attach panels with intermittent, staggered clip angles.
 2. Install with nominal 1/2-inch joints.
 3. Seal joints.
 - D. Accessories
 1. Snow Guards.
 2. Joint Sealers:
 - a. Install gaskets, joint fillers, sealants where indicated and where required for weatherproof performance of panel systems.
 - b. Provide types of gaskets, sealants/fillers indicated or, if not otherwise indicated, types recommended by panel manufacturer.
 3. Rooftop Equipment Crickets: Provide panel manufacturer's standard cricket to flash rooftop equipment and provide positive drainage.
- 3.4 WATER TIGHTNESS INSPECTIONS
- A. Prior to project close-out, complete inspection of all work under this section to verify that installation of panels, trim, flashings, and accessories comply with the manufacturer's requirements for weather tightness warranty.
 - B. Test all roof penetration flashings for water tightness and repair installations where necessary.
- 3.5 FIELD QUALITY CONTROL
- A. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4 inch in 20 feet on level/plumb/slope and location/line as indicated, within 1/8 inch offset of adjoining faces and of alignment of matching profiles.
 - B. Owner may engage a qualified independent testing and inspecting agency to perform inspections and prepare reports.
 - C. Engage a factory-authorized service representative to inspect completed metal panel installation, including accessories, and provide written report.
 - D. Remove and replace metal panels that inspections indicate do not comply with specified requirements.
 - E. Additional inspections, at contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 3.6 CLEANING AND PROTECTION
- A. Replace panels, other components of work that have been damaged or have deteriorated beyond successful repair by means of finish touch-up or similar minor repair procedures.
 - B. Cleaning:
 1. Remove temporary protective coverings and strippable films, if any, as each panel is installed.
 2. Upon completion of panel installation, clean finished surfaces as recommended by panel manufacturer.
 3. Maintain clean condition during construction.

- C. Protection: Maintain conditions in a manner acceptable to manufacturer to ensure work is without damage or deterioration at time of Substantial Completion.

END OF SECTION 07 41 13

SECTION 07 41 14 – Metal Roof Snow Guards

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Snow retention system that clamps directly to the metal roofing panels without penetrating the roofing system.
 - 2. Accessories including, but not limited to:
 - a. Clamps/Brackets.
 - b. Snow and ice clips.
 - c. Bars.
 - d. Fasteners.
 - e. End Caps.
- B. Related Sections:
 - 1. Section 07 41 13 - Metal Roofing and Wall Panels
 - 2. Section 07 62 00 - Sheet Metal Flashing and Trim
 - 3. Section 07 92 00 - Joint Sealants

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Manufacturer's current product specifications, standard details, certified product test results, installation instructions, general recommendations, as applicable to materials and finishes for each component and for total system of preformed panels.
- C. Samples:
 - 1. Manufacturer's standard color samples.
 - 2. Standard detail drawings.
 - 3. Installation instructions.
- D. Maintenance Manual: Provide to Owner, maintenance and warranty data in "Maintenance Manual" at maintenance demonstration at Substantial Completion.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide materials made of components with uniform texture and color or blend, furnished by one manufacturer unless indicated otherwise.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of snow retention systems.
 - 2. Contractor: 5 years experience in the installation of metal roofing and snow retention systems.
 - 3. Testing and Inspection Agency: ASTM E119, acceptable to authorities having jurisdiction.

- C. Preinstallation Meetings: Installer and manufacturer's technical rep shall meet with E/A prior to the start of installation.
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - A. Inspect material upon delivery and order replacements for any missing or defective items. Keep material dry, covered and off the ground until installed.
- 1.6 PROJECT CONDITIONS
 - A. Existing Conditions:
 - 1. Drawings do not purport to show actual field dimensions but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.
 - 2. Allow for trimming panel units where final dimensions cannot be established prior to fabrication.
- 1.7 WARRANTY
 - A. Snow retention systems shall include free limited lifetime warranty on parts and finish for all systems following manufacturer's spacing/ installation recommendations.

PART 2 – PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Attachment system to provide attachment to standing seam metal roofs:
 - 1. With only minor dimpling of panel seams.
 - 2. Without penetrations through roof seams or panels.
 - 3. Without the use of sealers or adhesives.
 - 4. Without voiding roof warranty.
- B. Performance Requirements: Provide snow guards to withstand exposure to the weather and environmental elements, and resist design forces without failure due to defective manufacture.
 - 1. Loading: Design snow guard system to resist minimum in-service snow loads shown on the Drawings.
 - 2. Factor of safety: Utilize a factor of safety ≥ 2 to determine allowable loads from ultimate tested clamp tensile load values.
 - 3. Source Limitation: Provide snow guard system as designed and tested by the manufacturer as a complete system. Install components by the same manufacturer.

2.2 MANUFACTURERS

- A. Snow Retention System
 - 1. Standard of Quality: Design is based on ColorGard Snow Retention System by S-5! Metal Roof Innovations, Colorado Springs, CO www.s-5.com
 - 2. Other Acceptable manufacturers, subject to compliance with specified requirements, are:
 - a. Ace Clamp by PMC Industries, Plainville, CT www.aceclamp.com
 - b. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.3 MATERIALS:

- A. Clamps:
 - 1. Manufactured from 6061-T6 aluminum extrusions conforming to ASTM B221 or aluminum castings conforming to ASTM B85 and to AA Aluminum Standards and Data.

2. Set screws: 300 Series stainless steel, 18-8 alloy, 3/8 inch diameter, with round nose point.
 3. Attachment bolts: 300 Series stainless steel, 18-8 alloy, 8 mm or 10 mm diameter, hex flange bolt.
- B. Brackets
1. Manufactured from 6061-T6 or 6005-T5 alloy and temper aluminum extrusions conforming to ASTM B221 and AA Aluminum Standards and Data or cast aluminum.
 2. Screws for attachment of brackets to roof per manufacturer's recommendations.
- C. Cross Members:
1. Manufactured from 6061-T6 or 6005-T5 alloy and temper aluminum extrusions conforming to ASTM B221 and AA Aluminum Standards and Data.
 2. Receptacle in face to receive color-matched metal strips.
 3. Provide splice connectors ensuring alignment and structural continuity at end joints.
- D. Color Strips: Same material and finish as roof panels; obtained from roof panel manufacturer.
- E. Snow and Ice Clips: 1. Aluminum, with rubber foot, minimum 3 inches wide.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions:
1. Verify that snow guards may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
 2. Prior to beginning installation, verify that:
 - a. Panel seaming is complete.
 - b. Panel attachment is sufficient to withstand loads applied by snow guard system.
 - c. Installation will not impede roof drainage.
 - d. Roof attachment is sufficient to withstand loads applied by snow guard system.
- C. Discrepancies: Immediately notify E/A in writing. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protect installed work and materials of other trades.
- B. Clean areas to receive attachments. Remove loose and foreign matter that could interfere with installation or performance.

3.3 INSTALLATION:

- A. Comply with architectural drawings for location and with Manufacturer's instructions for assembly, installation and erection.
- B. Coordinate with the installation of the metal roofing system to assure the proper fastening of the metal roof to the substructure.

C. Clamps should be spaced as recommended by the manufacturer.

D. Refer to manufacturer's installation instructions.

3.4 REPAIR/RESTORATION

A. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance. Use materials, procedures recommended or furnished by manufacturer.

3.5 ADJUSTING

A. Replace damaged materials with new materials complying with specified requirements.

3.6 CLEANING

A. Site: Do not allow accumulation of scraps, debris arising from work of this section. Maintain premises in neat, orderly condition.

B. System:

1. Remove temporary covering and other provisions made to minimize soiling of other work.
2. Promptly clean surfaces not to receive snow guard system; repair surfaces stained, marred or otherwise damaged during work.
3. Clean exposed surfaces of snow guard systems using materials and methods recommended by manufacturer.
4. When work is completed, remove unused materials, containers, equipment, and debris.

3.7 DEMONSTRATION

A. Maintenance Instructions: Manufacturer's representative to schedule and attend meeting with Owner's representatives to explain:

1. Maintenance and Care Instructions.
2. Recommended Maintenance Program.
3. Warranty Requirements.

3.8 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer to ensure work is without damage or deterioration at time of Substantial Completion.

END OF SECTION 07 41 14

SECTION 07 46 17 – Metal Soffit and Fascia Systems

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Soffit panels:
 - a. Non-perforated.
 - 2. Fascia.
 - 3. Accessories including, but not limited to:
 - a. Trim, closure pieces, and caps.
 - b. Sealants and gaskets.
 - c. Contact cement.
 - d. Touch-up paint.
 - e. Fasteners.
- B. Related Sections:
 - 1. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 2. Section 07 41 13 - Metal Roofing and Wall Panels
 - 3. Section 07 62 00 - Sheet Metal Flashing and Trim
 - 4. Section 07 71 23 - Gutters and Downspouts
 - 5. Section 07 92 00 - Joint Sealants

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate

1.4 SUBMITTALS

- A. Refer to Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance and cleaning recommendations.
- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections, details of components, joint locations and configurations within system and between system and adjoining system.
- D. Samples:
 - 1. Initial Color Selection: Submit manufacturer's standard color samples for each type of finish with Product Data and Shop Drawings.
 - 2. Color Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics. Include notification to E/A if selection is not within quoted price range.

3. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components if requested by E/A.
- E. Maintenance Manual: Provide to Owner, maintenance and warranty data in "Maintenance Manual" at maintenance demonstration at Substantial Completion.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide metal soffit and fascia systems units made of components of standard construction furnished by 1 manufacturer as coordinated assemblies.
- B. Qualifications:
 1. Manufacturer: 5 years experience in the manufacture of metal soffit and fascia systems, with 6 projects of similar size, scope and type of which 3 have been in successful use for 3 years or longer.
 2. Contractor: 3 years experience in the installation of metal soffit and fascia systems.
 3. Personnel: For actual installation of metal soffit and fascia systems, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Certifications: Provide to E/A, certification of installer from the of metal soffit and fascia systems.
- D. Field Samples: If requested, furnish sample of each type of metal soffit and fascia systems to the E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.
- E. Field-Erected Mockups:
 1. Before installing metal soffit and fascia systems, erect mock-up for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mock-up to comply with the following requirements, using materials indicated for final unit of work.
 2. Location: Locate mock-up on site in location and size indicated or, if not indicated, as directed by E/A.
 3. Erect mock-up in presence of E/A after having provided 7 days notification of date and time when mockup is to be constructed.
 4. Scope: Demonstrate the proposed range of aesthetic effects and workmanship.
 5. Acceptance: Obtain E/A's acceptance of mock-up before start of final unit of work.
 6. Maintenance: Retain and maintain mock-up during construction in undisturbed condition as a standard for judging completed unit of work.
 7. Accepted mock-up in undisturbed condition at time of Substantial Completion may become part of completed unit of work.
- F. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.6 WARRANTY

- A. One year on physical properties of metal, and 40 years on finish color.

1.7 MAINTENANCE

- A. Extra Materials: Provide for maintenance purposes, two units of each type, size, color, pattern of metal soffit and fascia systems installed – 10'-0" sticks of fascia and/or lengths of longest soffit panels. Furnish from same production run as materials installed. Package and mark to identify building and material type and color. Deliver and store where directed by Owner.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Standard of Quality: Design is based on PAC-CLAD by Peterson Aluminum, Elk Grove, IL www.pac-clad.com
- B. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - 1. Una-Clad by Elevate, Nashville, TN www.holcimelevate.com
 - 2. ATAS International, Allentown, PA www.atas.com
 - 3. Manufacturer of comparable products submitted in compliance with Division 1 requirements

2.2 MATERIALS

- A. Sheet Stock: ASTM B209; 3005-H19 grade aluminum sheet.
- B. Accessories:
 - 1. Sealants and Gaskets: Manufacturer's standard type suitable for use with installation of metal fascia and soffit; non-shrinking and non-sagging for exterior applications.
 - 2. Contact Cement: Waterproof, all-weather type, cured resilient without final set.
 - 3. Touch-up Paint: As recommended by manufacturer.
 - 4. Fasteners: Manufacturer's standard type to suit application.
 - 5. Other Materials: Other materials not specifically described but required for complete, proper installation of metal soffit and fascia systems, subject to acceptance of E/A.

2.3 FABRICATION

- A. Soffit Panels:
 - 1. Provide factory-formed panels designed to be field-assembled by lapping and interconnecting side edges of adjacent panels and mechanically attach to panel through supports, using concealed fasteners in side laps.
 - 2. Minimum 0.032 inch sheet stock; 12 inch wide panels.
 - 3. Factory-apply sealant within interlocking joint.
 - 4. Fabricate in lengths as long as possible.
 - 5. Product: PAC-750 Soffit -Solid.
 - 6. Color as selected by E/A.
- B. Fascias, Trim, Closure Pieces, Caps, In fills: Reference Section 07 62 00 Sheet Metal Flashing and Trim.
- C. Anchorage and Support Members: Minimum 0.014 inch thick aluminum girts.
- D. Fabrication of component profiles on site not permitted.

2.4 FINISH

- A. Exposed Surfaces of Soffit System: Color selected by Architect and Owner from manufacturer's full range of finishes and colors.
- B. Sealants and Gaskets: Color as selected by Architect from manufacturer's standard colors.
- C. Fasteners: Finish to match metal fascia and soffit.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that metal soffit and fascia systems may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A in writing. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.
- B. Surface Preparation: Protect fascia and soffit surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.

3.3 INSTALLATION

- A. Install as indicated on Drawings, or if not indicated, perpendicular to support framing.
- B. Install metal fascia, soffit, and related components according to manufacturer's instructions.
- C. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.
- D. Remove site cuttings from finish surfaces.
- E. Permanently fasten fascia and soffit system to structure; align, level, and plumb within specified tolerances.

3.4 CONSTRUCTION

- A. Site Tolerances:
 - 1. Maximum offset from true alignment between adjacent members butting or in-line: 1/8 inch.
 - 2. Maximum variation from plane or location indicated on Drawings: 1/4 inch.

3.5 REPAIR/RESTORATION

- A. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance. Use materials, procedures recommended or furnished by manufacturer.

3.6 ADJUSTING

- A. Replace damaged materials with new materials complying with specified requirements.

3.7 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from work of this section. Maintain premises in neat, orderly condition.
- B. System:
 - 1. Remove temporary covering and other provisions made to minimize soiling of other work.
 - 2. Promptly clean surfaces not to receive metal soffit and fascia systems; repair surfaces stained, marred or otherwise damaged during work.
 - 3. Clean exposed surfaces of metal soffit and fascia systems using materials and methods recommended by manufacturer.
 - 4. When work is completed, remove unused materials, containers, equipment, and debris.

3.8 DEMONSTRATION

- A. Maintenance Instructions: Manufacturer's representative to schedule and attend meeting with Owner's representatives to explain:
 - 1. Maintenance and Care Instructions.
 - 2. Recommended Maintenance Program.
 - 3. Warranty Requirements.

3.9 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer to ensure work is without damage or deterioration at time of Substantial Completion.

END OF SECTION 07 46 17

SECTION 07 46 33 – PVC Siding

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Capped PVC Board Cladding and Accessories
- B. Related Sections:
 - 1. Section 03 41 00 - Plant-Precast Structural Concrete
 - 2. Section 05 50 00 - Metal Fabrications
 - 3. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 4. Section 07 62 00 - Sheet Metal Flashing and Trim

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, test results, and maintenance recommendations.
- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections details of components, joint locations and configurations within system and between system and adjoining system.
- D. Samples:
 - 1. Initial Color Selection: Submit manufacturer's standard color samples for each type of finish with Product Data and Shop Drawings.
 - 2. Color Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics. Include notification to E/A if selection is not within specified price range.
 - 3. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components if requested by E/A.
- E. Maintenance Manual: Provide to Owner maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide PVC siding made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of PVC siding.
 - 2. Contractor: 3 years experience in the installation of PVC siding.
 - 3. Personnel: For actual installation, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of Work.

- C. Field Samples: If requested, furnish sample of each type of product to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.
- D. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.
- E. Mock-Up: Arrange for the construction of a mock-up of the products specified in this section. Example must include one cladding section for each type specified, including the selected color and finish. Owner and E/A will verify acceptance of products and workmanship.
 - 1. Accepted mockups may be incorporated into the work.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials and products according to the manufacturer's instructions and recommendations and industry standards.
- B. Store all materials in the manufacturer's original packaging until ready for installation. Protect all products from damage or exposure to adverse weather conditions.
 - 1. Store products in shaded or cool location.

1.6 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.
- B. Prior to fabrication, verify that dimensions are consistent with those found in the construction drawings. Where discrepancies exist, confirm the proper dimensions with the Architect before proceeding with work.
- C. Schedule work around the ambient conditions required by the manufacturer. Do not perform work outside manufacturer's recommended limits for environmental conditions.

1.7 WARRANTY

- A. Warranty on Cladding Material: Manufacturer agrees to replace or refund the purchase price of nonconforming capped PVC boards that fail within the specified warranty period.
 - 1. Failure Methods: Splitting, cupping, splintering, blistering, peeling, flaking, cracking, rotting or structural damage from termites or fungal decay.
 - 2. Commercial Warranty Period: 30 years from date of purchase.
- B. Special Warranty on Cladding Finishes: Manufacturer agrees to replace or refund the purchase price of nonconforming capped PVC boards that show evidence of deterioration of factory-applied color beyond specified limit within the specified warranty period.
 - 1. Color Fade: Not to exceed 5 Delta E (CIE) units.
 - 2. Commercial Warranty Period: 30 years from date of purchase.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. PVC siding:
 - 1. Standard of Quality: Unless otherwise indicated, design is based on products of TimberTech, an Azek Building Products Brand, Chicago, IL www.azek.com
 - 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. PlyGem, Cary, NC www.plygem.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 PERFORMANCE REQUIREMENTS

- A. Physical Performance: Provide cladding boards according to ASTM D7254 and ASTM D3679, and ICC-ES AC227.
 - 1. Heat Shrinkage: Less than 0.2% linear shrinkage when tested according to ASTM D1042.
 - 2. Impact Resistance: Pass; when tested at 265/220 (in·lb) mean failure energy according to ASTM D4226.
 - 3. Surface Distortion: No effect at 120°F or at maximum developed temp of 165°F when tested according to ASTM D3679 Section 6.12.
 - 4. Coefficient of Thermal Expansion: Maximum 2.72×10^{-5} in/in/°F; when tested according to ASTM D696.
- B. Surface-Burning Characteristics: Meet the following values when tested according to ASTM E84:
 - 1. Class A Flame-Spread Index: 0 to 25.
- C. Ignition Resistance: Cellular PVC core boards pass NFPA 268.
- D. Environmental Performance:
 - 1. Water Absorption: No observed water droplets when tested according to ASTM D570 and AATCC 127.
 - 2. UV Resistance: Pass at least 2000 hours of Xenon-Arc exposure when tested according to ASTM D2565 Cycle 1.
 - 3. Fungus Decay Resistance: Pass; when tested according to ASTM D2017. Boards do not contain cellulosic material.
 - 4. Termite Resistance: Pass; when tested according to ASTM D3345. Boards do not contain cellulosic material.
 - 5. Moisture Effect: Not prone to absorption, no adjustments when tested according to ASTM D7032.
 - 6. Freeze Thaw Resistance: Less than 10% effect, no adjustments when tested according to ASTM D7032.
- E. Recycled Content: Greater than 45% combined pre-consumer (post-industrial) and post-consumer by weight.

2.3 PRODUCTS

- A. Capped PVC Boards: Cellular PVC core boards with PVC-based capping material and complying with ASTM D3679.
 - 1. Physical Characteristics:
 - a. Edge: Square; .0125-inch corner fillet radius.
 - b. Thickness: 1 inch.
 - c. Width: As indicated on the Drawings.
 - d. Length: As indicated on the Drawings.
 - e. Color: As indicated on the Drawings.
- B. Other Materials: Other materials not specifically described but required for complete, proper installation of PVC siding, subject to acceptance of E/A.

2.4 ACCESSORIES

- A. Fasteners: Provide fasteners as recommended by manufacturer.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that product may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.
- B. Comply with manufacturer's printed installation instructions, clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

- A. General Requirements:
 - 1. Install plumb, true, square in neat, rigid, substantial manner.
 - 2. Install according to manufacturer's current installation instructions, industry recognized best practices, all code bodies having jurisdiction, and approved shop drawings.
 - a. Do not install damaged products.
 - b. Refer to manufacturer's published technical data for expansion and contraction due to changes in temperature.
- B. Securely attach PVC siding to substrate. Fastener size, number, spacing, and minimum dimensions from board edges and ends according to manufacturer's recommendations.

3.4 ADJUSTING AND CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from Work of this Section. Maintain premises in neat, orderly condition.
- B. Clean and remove all stains, grime, or other soils using manufacturer's recommended methods. Only use materials and methods approved by the manufacturer for use on the finishes specified.
- C. Protect installed products until completion of work specified in this section.

END OF SECTION 07 46 33

SECTION 07 53 23 – EPDM MEMBRANE ROOFING

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide thermoset, elastomeric, vulcanized EPDM membrane roofing system, including:
 - 1. Vapor barrier membrane.
 - 2. Roofing insulation:
 - a. Polyisocyanurate.
 - 3. Cover Board.
 - 4. Membrane:
 - a. Attachment: Fully adhered.
 - 5. Single-ply membrane roofing accessories including, but not limited to:
 - a. Membrane Walkway.
 - b. Precast splash blocks.
 - c. Pipe seals.
 - d. Fasteners.
 - e. Adhesives, tapes, and sealants.
 - f. Flashing.
- B. Installation of material furnished by other sections including, but not limited to:
 - 1. Roof drains - Refer to Plumbing Specifications
- C. The following is not included in this section:
 - 1. Roof hatches.
 - 2. Manufactured curbs for mechanical equipment (refer to Mechanical Specifications).
- D. Related Sections:
 - 1. Section 05 31 00 - Steel Decking
 - 2. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 3. Section 07 62 00 - Sheet Metal Flashing and Trim
 - 4. Section 07 72 00 - Roof Accessories
 - 5. Section 07 92 00 - Joint Sealants
- E. Alternates: Refer to Section 01 23 00.

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. C36 - Gypsum Wallboard
 - 2. C208 - Cellulostic (Wood) Fiber Insulation Board
 - 3. C552 - Cellular Glass Thermal Insulation

4. C553 - Mineral Fiber Blanket Thermal Insulation
5. C578 - Foamed Plastic Insulations
6. C665 - Mineral Fiber Blanket Thermal Insulation
7. C728 - Perlite Thermal Insulation Board
8. C1177 - Glass Mat Gypsum Substrate
9. D41 - Specification for Asphalt Primer
10. D312 - Specification for Asphalt Used in Roofing
11. D412 - Vulcanized Rubber and Thermoplastic Elastomers
12. D471 - Test for Effect of Liquids on Rubber
13. D573 - Internal Reflection Spectroscopy
14. D624 - Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
15. D750 - Test for Rubber Deterioration
16. D751 - Coated Fabrics
17. D1148 - Ultraviolet Degradation of Rubber
18. D1149 - Rubber Deterioration - Surface Ozone Cracking
19. D1204 - Stretching at Elevated Temperatures
20. D1289 - Faced Rigid Cellular Polyiso Thermal Insulating Board
21. D1970 - Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Roofing Underlayment
22. D2137 - Brittleness Point of Plastics and Elastomerics
23. D4263 - Test for Moisture in Concrete - Plastic Sheet Method
24. D6134 - Vulcanized Rubber Sheets Used in Waterproofing System
25. E96 - Water Vapor Transmission of Materials

B. Factory Mutual:

1. Class IA-90 Rating
2. FM 4450 and 4470 - Membrane Roofing System Approval Guide
3. FM Loss Prevention Data Sheet 1-49
4. Meet Factory Mutual designation for hail resistance: SH

C. UL - Class A Fire Rating.

1.4 DEFINITIONS

- A. EPDM: Ethylene, propylene diene monomer

1.5 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Provide installed roofing membrane and base flashings that remain watertight and resist exposure to weather without failure.
2. Provide roofing materials that are compatible with one another under conditions of service and application required, as approved by roofing manufacturer.
3. Low sloped roofs: Design to resist uplift pressure calculated according to ANSI/SPRI ES 1.

4. Meet IBC code requirements adopted by state in which project is located.
5. Provide roofing membrane, base flashings, and component materials that comply with requirements in FMG 4450 and FMG 4470 as part of a membrane roofing system, and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.

1.6 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Product Data, including specifications, handling, storage and installation instructions, maintenance recommendations, and copy of the warranty.
- C. Shop Drawings showing system fabrication, installation drawings, including roof insulation plans indicating layout, slope and average R value, details of components, within system and between system and adjoining system.
- D. Samples: Manufacturer's standard components, including water barrier membrane, roof insulation, membrane, membrane flashings, securement devices, and membrane walkway pads or rolls.
- E. Quality Assurance/Control Submittals:
 1. Manufacturer's representative's written observation reports.
 2. Certificates: Membrane manufacturer's current written acceptance of installer to E/A in duplicate before starting roofing work.

1.7 QUALITY ASSURANCE

- A. Single Source Responsibility:
 1. Obtain primary flexible sheet roofing from a single manufacturer.
 2. Provide secondary materials as supplied by or recommended by manufacturer of primary materials.
- B. Qualifications:
 1. Manufacturer: 10 years experience in the manufacture of single ply elastic membrane roofing.
 2. Contractor: 3 years experience in the installation of single ply elastic membrane roofing.
 3. Personnel: For actual installation of single ply elastic membrane roofing, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Regulatory Requirements: Perform work in strict conformance with applicable provisions of manufacturer's current published specifications, application instructions, recommended details, and standards of practice.
- D. Manufacturer's Observation: Manufacturer's agent shall visit site while roofing work is in progress as necessary, including final inspection for warranty requirements, to observe procedures and methods, keep log of time, instructions given, actual procedures, field conditions, etc., and submit 2 copies to E/A's office.
- E. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A, as well as installers whose work interfaces with or affects roofing, prior to the start of installation.
- F. Notification: Notify E/A at least 24 hours before performing seaming operations.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

- B. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.

1.9 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.10 WARRANTY

- A. Manufacturer's Warranty: Provide a 20 year, non-prorated manufacturer's total system warranty on roof membrane.
- B. Contractor Maintenance Warranty:
 - 1. During a period of 2 years from the date of final acceptance of the Work, maintain roof system, including wood blocking, water barrier membrane, insulation, roof membrane, and flashing, in a watertight condition, and repair all defects which result from faulty workmanship or defective materials, without further cost to Owner, including replacement of any wet insulation caused by such defects.
 - 2. Warranty shall cover leaks caused by accidental punctures: 32 man-hours per year.
 - 3. Warranty shall cover leaks caused by hail:
 - a. Hail up to 2" diameter when 90-mil Sure-Seal or Sure-White OR 75-mil Sure-Tough is installed over Carlisle SecurShield HD, Dens Deck Prime, DensDeck StormX Prime, or Securock adhered with Flexible FAST adhesive (For Adhered Systems Only).
 - 4. Excluded from this warranty: Damage to roof, buildings and contents caused by acts or omissions of the Owner; fire, lightning, winds of peak gust speeds of 90 mph or higher measured at 10 meters above the ground, or other unusual phenomenon of the elements; movement or failure of the supporting building structure that causes membrane or flashing failure; or vapor condensation beneath the roof.
 - 5. Before expiration of the warranty period, inspect roof in presence of Owner and make necessary correction of deficiencies not considered normal.
 - 6. The warranty shall remain in force until necessary repair work has been done.

1.11 MAINTENANCE

- A. Extra Materials:
 - 1. Provide for maintenance purposes, quantity equal to 1 percent of each type of material installed.
 - 2. Furnish from same production run as materials installed.
 - 3. Package and mark to identify location, material type, and color.
 - 4. Deliver and store where directed by Owner.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Membrane Roofing System:
 - 1. Standard of Quality: Design is based on Sure-Seal EPDM Membrane Fully Adhered Roofing System by Carlisle Companies, Inc., Carlisle, PA www.carlisle-syntec.com

2. Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Firestone Building Products, Carmel, IN www.holcimelevate.com
 - b. GenFlex Roofing Systems, Maumee, OH www.genflex.com
 - c. Johns Manville Roofing systems Group, Denver, CO www.jm.com
 - d. Versico, Inc., Akron, OH www.versico.com
 - e. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.
- B. Polyisocyanurate Insulation:
1. Standard of Quality: Design is based on Insulbase Polyiso by Carlisle Companies, Inc. www.carlisle-syntec.com
 2. Acceptable Manufacturers: Subject to compliance with requirements and acceptance by membrane manufacturer, acceptable manufacturers and products are:
 - a. Hy-Therm Spas by Dow Chemical Company, Midland, MI www.dow.com
 - b. Energyguard by GAF Materials Corporation, Wayne, NJ www.gaf.com
 - c. Hunter Panels, Portland ME www.hunterpanels.com
 - d. ISO 95+ by Firestone Building Products, Carmel, IN www.holcimelevate.com
 - e. "NRG" by Johns Manville Roofing systems Group, Denver, CO www.jm.com
 - f. R-Max, Inc., Dallas TX www.rmax.com
 - g. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.
- C. Vapor Barrier Membrane:
1. Standard of Quality: Design is based on VapAir Seal MD Air and Vapor Barrier by Carlisle Companies, Inc. www.carlisle-syntec.com
 2. Acceptable Manufacturers: Subject to compliance with requirements and acceptance by membrane manufacturer, acceptable manufacturers and products are:
 - a. Grace Ice and Water Shield by Grace Construction Products www.gcpat.com
 - b. Deck Guard by Polyguard Products, Ennis, TX www.polyguard.com
 - c. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.
- D. Cover Board:
1. Standard of Quality: Design is based on DensDeck Prime by Carlisle Companies, Inc. www.carlisle-syntec.com
 2. Acceptable Manufacturers: Subject to compliance with requirements and acceptance by membrane manufacturer, acceptable manufacturers and products are:
 - a. DensDeck, Georgia-Pacific Building Products, www.buildgp.com
 - b. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.

E. Roofing System Accessories:

1. Membrane Walkway Pads and Rolls: Subject to compliance with requirements and acceptance by membrane manufacturer, acceptable manufacturers and products are:
 - a. Sure-Seal Pressure-Sensitive Walkway Pads, Carlisle Companies, Inc. www.carlisle-syntec.com
 - b. Manufacturer of comparable products as approved by membrane manufacturer and submitted in compliance with Division 1 Specifications.
2. Fasteners: Subject to compliance with requirements and acceptance by membrane manufacturer, acceptable manufacturers and products are:
 - a. Metal decks: InsulFast Fasteners, Carlisle Companies, Inc. www.carlisle-syntec.com
 - b. Concrete decks: HD 14-10 Fasteners or CD-10 Concrete Fasteners, Carlisle Companies, Inc. www.carlisle-syntec.com
 - c. Manufacturer of comparable products as approved by membrane manufacturer and submitted in compliance with Division 1 Specifications.
3. Adhesive systems: Subject to compliance with requirements and acceptance by membrane manufacturer, acceptable manufacturers and products are:
 - a. Flexible FAST Adhesive by Carlisle Companies, Inc. www.carlisle-syntec.com
 - b. Insta-Stik, Dupont www.dupont.com
 - c. Weather-Tite, Millennium Adhesive Products, Chagrin Falls, OH www.millenniumadhesives.com
 - d. Manufacturer of comparable products as approved by membrane manufacturer and submitted in compliance with Division 1 Specifications.
4. Flashing: Subject to compliance with requirements and acceptance by membrane manufacturer, acceptable manufacturers and products are:
 - a. Sure-Seal Pressure Sensitive Flashing, Carlisle Companies, Inc. www.carlisle-syntec.com
 - b. Manufacturer of comparable products as approved by membrane manufacturer and submitted in compliance with Division 1 Specifications.

2.2 ELASTIC SHEET ROOFING MATERIALS

A. EPDM Membrane:

1. Meet ASTM D4637.
2. Size:
 - a. Non-reinforced: 90-mil.
3. Color: Black.
4. Standard.
5. Minimum properties under indicated ASTM tests:
 - a. Elongation, ultimate: 300 percent minimum, D412, Standard Tests for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
 - b. Tear strength: 150 lbf./in. (23.6 kN/m) minimum, D624, Die C. Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - c. Brittleness point: -49 degrees F minimum, D746.

- d. Resistance to heat aging: D573. Prepare specimens from coating rubber compound, vulcanized in a similar method to reinforced product.
- e. Ozone resistance: D1149 - No cracks after exposure to 100 pphm and ozone in air for 168 hours at 104 degrees F. Wrap specimen around 3-inch mandrel.

2.3 VAPOR BARRIER MEMBRANE

- A. Reinforced composite aluminum foil with self-adhesive SBS backing and removable poly release film.
- B. Comply with:
 - 1. ASTM D5147.
 - 2. ASTM D412 for strength.
 - 3. ASTM E96 D1970 for permeance.

2.4 ROOF INSULATION

- A. Insulation system: Thicknesses as shown on the Drawings.
- B. Provide factory-tapered insulation board, fabricated to slope of 1/4 inch per 12 inches if not shown, OR as indicated on Drawings for saddles, crickets, and other areas without a structural slope.
- C. Provide insulation boards that comply with requirements and reference standards, selected from manufacturer's standard sizes and thicknesses.
- D. Select insulation type compatible with membrane. See manufacturer's requirements.
- E. Thickness:
 - 1. Maximum layer thickness: 2 inches.
 - 2. Minimum insulation thickness: 4 inches at any location.
- F. Polyisocyanurate Insulation:
 - 1. Meet ASTM C1289-06.
 - 2. Maximum 4 foot by 8 foot boards.
 - 3. All packages to have PIMA Quality Mark Certification label.
 - 4. Type II: Felt or glass fiber mat on both surfaces.
 - 5. Class: 1; Grade: 2.
 - 6. Minimum 2 layers.
- G. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.5 COVER BOARD

- A. Gypsum core cover board with fiberglass mat with non-asphaltic coating on the top and bottom faces.
- B. Thickness: As noted on Drawings.

2.6 ROOFING ACCESSORIES

- A. Membrane Walkway:
 - 1. Molded walkway pads or walkway rolls adhered to membrane.
 - 2. Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured pad or roll.
 - 3. Furnished or approved by membrane manufacturer.
 - 4. 30 inches wide and approximately 3/16 inch thick.

- B. Precast Concrete Splash blocks: Contoured; 36 inches by 10-1/2 inches by 3 inches. One at each downspout. Provide sacrificial wear pad directly below splash block.
- C. Adhesives and Sealants:
 - 1. Seam primer, lap sealant, bonding adhesive, water cutoff mastic.
 - 2. Sealing compound for temporary sealing of membrane (water cutoffs): Provide product acceptable to membrane manufacturer.
- D. Fasteners:
 - 1. Factory Mutual approved.
 - 2. Flashing to lumber: Galvanized 1 1/2 inch barbed roofing nails through 1-inch metal discs.
 - 3. Scupper flanges to wood blocking: 1 3/4 inch galvanized roofing nails.
 - 4. Metal decks: A threaded #12 fastener with #3 Phillips drive used for insulation attachment into steel decks.
- E. Elastic Flashing:
 - 1. Self-curing 60 mil thick uncured EPDM membrane laminated to 30 mil thick fully cured pressure sensitive (PS) adhesive.
 - 2. Recommended by manufacturer with associated adhesives. See Section 07 62 00.
- F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories as recommended by manufacturer.

PART 3 – EXECUTION

3.1 SURFACE CONDITIONS

- A. Verify:
 - 1. Deck is completely installed.
 - 2. Surface is free of debris, sharp projections, gross irregularities, unnecessary holes.
 - 3. Required openings through deck are cut and finished, and pipes and similar work projecting through deck are in place.
 - 4. Substrates have been inspected and are determined to be in satisfactory condition.
- B. Compatibility: Verify that membranes and flashings are chemically compatible with nailers and blocking.
- C. Surface Preparation: Keep deck surfaces clean, dry, and free of dust, grease, debris, frost, or other conditions which might affect installation of roofing.
- D. Coordinate between various trades to avoid unnecessary rooftop traffic over sections of roof and to prevent damage to membrane.
- E. Proceed when existing and forecasted weather conditions permit Work to be performed according to manufacturers' recommendations and warranty requirements.
- F. Do not proceed until conditions which would result in an unsatisfactory installation are corrected.
 - 1. Discrepancies: Immediately notify E/A.
 - 2. Commencing work shall be construed as acceptance of roof deck and adjoining surfaces as acceptable to receive membrane sheet roofing.

G. Flexible FAST Adhesive

1. Do not use:
 - a. On insulation boards larger than 4 feet by 4 feet unless approved by manufacturer.
 - b. In inclement weather or below 25 degrees F, or on wet surfaces.
 - c. On active asphalt.

3.2 PREPARATION

- A. Coordinate with other trades so other work available and roofing can be built in without delay.
- B. Plan Work to be carried on continuously to completion.
- C. Start installation in presence of roofing manufacturer's technical personnel.
- D. Installation of sheet membrane and accessories shall be in strict accordance with membrane manufacturer's written instructions.

3.3 INSTALLATION OF ROOFING COMPONENTS

A. Vapor Barrier Membrane:

1. Apply vapor barrier membrane to the metal deck from low to high point, in a shingle fashion, so that laps will shed water. Overlap all edges and stagger end laps per manufacturer's requirements.
2. Provide sheet metal or vapor barrier membrane directly under each end lap, perpendicular to the end lap, to ensure a solid surface to roll the end lap together.
3. Roll seams and end laps per manufacturer's requirements.
4. Place membrane carefully so as to avoid wrinkles and fish mouths.
5. Immediately after installation, broom the sheet to ensure proper contact to the metal.

B. Insulation:

1. Ensure surface of vapor barrier membrane is dry prior to installing insulation.
2. Place insulation over the surface and mechanically fasten to the roof deck accordance with this specification.
 - a. Install insulation over the substrate with boards butted tightly together with no joints or gaps greater than 1/4 inch. Stagger joints both horizontally and vertically if multiple layers are provided.
 - b. Secure insulation to the substrate with the required mechanical fasteners or insulation adhesive according to the manufacturer's specifications.
3. General:
 - a. Lay insulation boards with long dimension perpendicular to metal deck flutes.
 - b. Cut, fit neatly against wood blocking and vertical surfaces.
 - c. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
 - d. Fill voids greater than 1/8 inch with foamed-in-place insulation compatible with rigid material.
 - e. Install tapered insulation to drain to scuppers and roof drains.
 - f. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
 - g. Stagger insulation boards 50 percent from row to row.

- h. Place in minimum 2 layers.
 - i. Stagger joints in both directions in adjoining courses; stagger end joints between layers minimum of 24 inches.
 - j. Butt each panel tightly to adjoining panels, but do not force.
 - 4. Protection:
 - a. Keep insulation dry.
 - b. Protect from damage after installation.
 - c. Lay no more insulation than can be covered with completed roof membrane on same day.
 - d. Ballast unfinished or unballasted roof areas with sandbags before leaving overnight or during inclement weather.
 - e. Protect exposed edges of insulation with water cut offs at end of each day's work.
 - f. Remove water cut-offs completely before resuming work.
- C. Cover Board:
 - 1. Install over insulation with long joints in continuous straight lines with end joints staggered between rows.
 - 2. Stagger joints from joints in insulation below, minimum of 6 inches in each direction.
 - 3. Loosely butt cover boards together.
 - 4. Adhere cover board with approved insulation adhesive using manufacturer approved bead or spray application.
 - 5. Adhere cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
 - 6. Adhere cover boards to resist uplift pressure at corners, perimeter, and field of roof.
- D. Membrane:
 - 1. Unroll and position membrane without stretching. Allow the membrane to relax for approximately 1/2 hour before bonding. Fold the sheet back onto itself so half the underside of the membrane is exposed.
 - 2. Apply the bonding adhesive according to the manufacturer's published instructions and coverage rates, to both the underside of the membrane and the substrate. Allow the adhesive to dry until it is tacky but will not string or stick to a dry finger touch.
 - a. Roll the coated membrane into the coated substrate while avoiding wrinkles. Brush down the bonded half of the membrane sheet with a soft bristle push broom to achieve maximum contact.
 - b. Fold back the unbonded half of the membrane sheet and repeat the bonding procedure.
 - 3. Install adjoining membrane sheets in the same manner, overlapping edges per manufacturer's requirements. Do not apply bonding adhesive to the splice area.
 - 4. Membrane Splicing:
 - a. Position membrane sheet to allow for required splice overlap per manufacturer's requirements.
 - b. Prime membrane surfaces and provide splices and laps per manufacturer's requirements.

- c. Provide splice enhancements as required by manufacturer's specifications.
- d. Roll splice and apply lap sealant per manufacturer's requirements.

3.4 ROOF ACCESSORIES

A. Walkways:

1. Install walkway products in locations indicated in Drawings.
2. Verify location of points of access to roof-mounted equipment via use of roof walkways.
3. Space walkway pads to allow for drainage and expansion during hot weather.
4. Provide 3 inches of space between paver units to allow proper roof drainage.
5. Verify that walkway support isolation pads are in place prior to placement of roof walkway onto low-slope roofing section surface.
6. Install protective mat underneath walkway membrane, if required by manufacturer, and if using pavers.
7. Extend protective mat 6 inches beyond edge of pavers in each direction where pavers do not abut vertical surfaces.
8. Adhere walkway to substrate with compatible adhesive according to roofing membrane manufacturer's written instructions.
9. Test for water-tightness.
10. Clean surfaces.

B. Base Flashing:

1. Install sheet flashings and preformed flashing accessories and adhere to substrates.
2. Apply solvent-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
3. Flash penetrations and field-formed inside and outside corners with sheet flashing.
4. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive.
5. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.
6. Install flashing at parapets, roof edges, curbs, cants.
7. Extend onto roofing at least 3 inches beyond point where sheet roofing fastened to construction.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner may engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to E/A.
- C. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.
- D. Additional testing and inspecting, at contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 PROTECTION AND CLEANING

A. Site Cleaning:

1. Do not allow accumulation of scraps, debris arising from work of this section.
2. Maintain premises in neat, orderly condition.
3. Immediately upon satisfactory completion of work, remove debris, equipment, excess materials from site.

B. System Cleaning:

1. Prevent misplacing roofing materials and adhesives on adjacent surfaces.
2. Immediately remove traces of such materials.

C. Protect completed roof system from damage.

1. Use plywood walkways, wood planking, other precautions as necessary.
2. Institute appropriate procedures for surveillance and protection of roofing during remainder of construction period.
3. Confine traffic over roof to necessary areas, hold to minimum.
4. Repair damage immediately.

D. When construction completed and roofing no longer at risk of construction damage, remove temporary protective measures.

3.7 CONSTRUCTION WASTE

A. Minimize waste generated from construction, renovation, and demolition.

3.8 DEMONSTRATION

A. Maintenance Instructions: Manufacturer's representative (not installer) to schedule and attend meeting with Owner's representatives to explain:

1. Maintenance and Care Instructions.
2. Recommended Maintenance Program.
3. Warranty Requirements.

ROOFING WARRANTY

Project: _____

Project Address: _____

Project No: _____

Date of Final Acceptance: _____

Owner: _____

Address: _____

Roofing Contractor: _____

Address: _____

Phone No: _____

This warranty stipulates that the above-named contractor(s) shall, during a period of 5 years from the date of final acceptance of the work, maintain the roof membrane and flashing systems in a watertight condition and repair all defects which result from faulty workmanship or defective materials, without further cost to the Owner, including replacement of any wet insulation caused by such defects.

Excluded from this warranty may be any and all damage to said roof, the building(s) or their contents, caused by acts or omissions of the Owner; fire, lightning, winds of peak gust speeds of 90 mph or higher, hailstorm, or other unusual phenomenon of the elements; movement or failure of the supporting building structure that causes flashing failure; or vapor condensation beneath the roof.

Exclude from this warranty any damages to the building(s) or the contents.

Before expiration of the above warranty period, roofing contractor shall inspect the roof in the presence of the Owner's representative and make necessary correction of all deficiencies not considered normal. The warranty shall remain in force until the necessary repair work has been completed.

ROOFING CONTRACTOR

Signed: _____

Title: _____

Date: _____

END OF SECTION 07 53 23

SECTION 07 62 00 – Sheet Metal Flashing and Trim

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide sheet metal flashing and trim for:
 - 1. Metal counter flashing and base flashing.
 - 2. Exterior wall flashing and expansion joints.
 - 3. Roof flashing caps and accessories.
 - 4. Exposed metal trim and fascia units.
 - 5. Reglets.
 - 6. Scuppers.
 - 7. Sheet metal accessories including, but not limited to:
 - a. Joint sealants for sheet metal flashing.
 - b. Water barrier membrane.
 - c. Fasteners.
- B. Related Sections:
 - 1. Section 03 41 00 - Plant-Precast Structural Concrete
 - 2. Section 04 20 00 - Unit Masonry Assemblies
 - 3. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 4. Section 07 41 13 - Metal Roofing and Wall Panels
 - 5. Section 07 46 17 - Metal Soffit and Fascia Systems
 - 6. Section 07 53 23 - EPDM Membrane Roofing
 - 7. Section 07 71 23 - Gutters and Downspouts

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. A167 - Stainless and Heat Resistant Chromium Nickel Steel Plate, Sheet
 - 2. A653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Coated (Galvannealed) by the Hot-Dip Process
 - 3. A853 - Steel Wire, Carbon
 - 4. B32 - Specifications for Solder Metal
 - 5. B101 - Lead Coated Copper Sheet and Strip
 - 6. B209 - Aluminum Sheet and Plate
 - 7. B370 - Copper Sheet and Strip
 - 8. C920 - Elastomeric Joint Sealants
 - 9. D522 - Mandrel Test for Organic Coatings, Formability
 - 10. D1970 - Self-Adhering Polymer Modified Bituminous Sheet Materials

11. D2244 - Color Tolerances
12. D2794 - Impact Resistance
13. D4214 - Evaluation of Degree of Chalking
14. E111 - Modulus Testing, Elasticity
15. E228 - Test for Thermal Expansion
16. G90 - Performing Accelerated Weathering of Non-Metallic Materials

B. SMACNA: Architectural Sheet Metal Manual

1.4 SYSTEM DESCRIPTION

- A. Design Requirements: Provide watertight metal copings on entire roof perimeter.
- B. Performance Requirements:
1. Sheet metal flashing and trim shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.
 2. Low Sloped Roofs: Design to resist uplift pressure calculated according to ANSI/SPRI ES 1.

1.5 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings: Include layout, profiles, methods of joining, and anchorage details.
- D. Samples:
1. Color: Submit manufacturer's standard color samples with Product Data and Shop Drawings.
 2. Samples of sheet metal flashing, trim, and accessory items in specified finish, showing full range of variations expected.

1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide sheet metal flashing and trim units made of components of standard construction furnished by 1 manufacturer as coordinated assemblies.
- B. Qualifications:
1. Manufacturer: 5 years experience in the manufacture of sheet metal flashing and trim.
 2. Contractor: 3 years experience in the installation of sheet metal flashing and trim.
 3. Personnel: For actual installation of sheet metal flashing and trim, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Regulatory Agencies:
1. Meet UL requirements for fire resistance of roof covering materials and impact resistance.
 2. Meet wind/uplift resistance of ANSI/SPRI ES 1 per IBC.
- D. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.7 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.8 COORDINATION

- A. Furnish metal base flashings, gravel stops, other work required to be built into roofing and flashing promptly so roofing operations may be carried on continuously to completion without delay.

1.9 WARRANTIES

- A. Manufacturer: Non-prorated 20-year written warranty covering fade, chalking and film integrity including labor and material through the 20th year.
- B. Contractor:
 - 1. Sheet metal system and related flashing shall be warranted in writing stipulating that contractor agrees to maintain metal flashing system in a watertight condition for a period of 5 years at the contractor's own expense.
 - 2. Warranty shall cover any condition caused by defective material and the installation and ordinary wear and tear.
 - 3. Warranty does not cover damage due to natural disaster not covered by insurance, accidents, misuse or vandalism.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Flashing and Trim:
 - 1. Standard of Quality: Design is based on PAC-CLAD Peterson Aluminum, Elk Grove, IL www.pac-clad.com
 - 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Una-Clad by Elevate, Nashville, TN www.holcimelevate.com
 - b. ATAS International, Allentown, PA www.atas.com
 - c. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
- B. Manufactured Products:
 - 1. Standard of Quality: Design is based on Metal Era, Inc, Waukesha WI, www.metalera.com
 - 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. W.P. Hickman Company, Asheville, NC www.wph.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
- C. Water Barrier Membrane: Standard of Quality: Design is based on CCW WIP 300HT by Carlisle Coatings and Waterproofing www.carlisle-ccw.com
 - 1. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Ice and Water Shield, Grace Company, www.grace.com
 - b. Winterguard, CertainTeed, Valley Forge, PA www.certainteed.com
 - c. Polyguard Inc., Ennis, TX www.polyguardproducts.com
 - d. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

A. Sheet Metal:

1. Verify recycled content from manufacturer.
2. Performance Requirements:
 - a. Color Change: ASTM D2244, Not greater than 5 NBS color units.
 - b. Chalking: 8 or better, ASTM D4214.
 - c. Minimum yield: ASTM A853.
 - d. Formability: ASTM D522.
 - e. M.O.E.: ASTM E111.
 - f. COTE: ASTM E228.
 - g. Impact resistance: ASTM D2794, 70 inch/pound, no tape pick-off.
3. Galvanized Steel:
 - a. Standard open hearth copper bearing steel with "Paint-Grip" galvanized coating.
 - b. 24 gauge minimum. For use as keepers or when otherwise covered.
 - c. Pre-painted sheets of hot-dipped galvanized steel of commercial weight and quality, ASTM A653, G90.
 - d. Painted side shall be covered with a factory applied strippable film.
 - e. Apply washcoat of 0.3 to 0.4 mil dry film thickness to unpainted side.
 - f. Gauges: As indicated on Drawings. Where not indicated, minimum gauges:
 - g. Fascia, coping, and other roof edge flashing exposed view with an exposed vertical face of 8 inch or less: 24 gauge.
 - h. Hook strips and keepers: 24 gauge.
 - i. Gutter hangers and downspout straps: 16 gauge.
 - j. All other sheet metal work: 24 gauge.
4. Stainless Steel: ASTM A167, AISI 302/304, No. 2D finish, temper as required for forming and performance; 0.015 inch thick (28 gauge), except as otherwise indicated.

2.3 SHEET METAL ACCESSORIES

A. Nails and Fasteners:

1. Galvanized nails and cadmium-plated screws and washers in connection with galvanized iron and steel, which will not stain, produce electrolytic reaction or be detrimental to complete installation.
2. Same metal as sheet metal flashing or recommended by sheet metal manufacturer. Avoid noncompatible or dissimilar metals due to risk of galvanic corrosion.
3. Match finish of exposed heads with material being fastened.

B. Solder: ASTM B32.

1. Stainless steel: Grade Sn60 with acid flux of type recommended by stainless steel sheet manufacturer.
2. Zinc: 60 percent lead and 40 percent tin with low antimony.

C. Joint Sealant: Elastomeric 20-year silicone, per ASTM C920, Type S, Grade NS, Class 50

- D. Adhesives: Recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.
- E. Other Materials: Other materials not specifically described but required for complete, proper installation of sheet metal and flashing, subject to acceptance of E/A.

2.4 MANUFACTURED PRODUCTS

A. Reglets:

- 1. Factory-mitered and welded corners and junctions.
- 2. Material:
 - a. Stainless steel.
 - b. Galvanized steel.
 - c. Prefinished steel.
- 3. Type:
 - a. Surface-mounted type.
 - b. Concrete type.
 - c. Flexible flashing retainer.
 - d. Counterflashing wind-resistant clips.

B. Flashings and Fascia:

- 1. Preformed Coping:
 - a. 22 gauge prefinished metal (steel).
 - b. Concealed joint covers.
 - c. Metal drain support chairs, same color and finish as coping cap.
 - d. 20 gauge galvanized steel cleats.
 - e. 20 year, 110 mph wind warranty.
 - f. FM 1-90 approved for wind uplift.
 - g. Finish: Selected from manufacturer's full range of finishes and colors.
 - h. Product: Permasnap.
- 2. Preformed Roof Edge:
 - a. 0.063 aluminum.
 - b. FM 1-90 approved for wind uplift.
 - c. 20 year, 110 mph wind warranty.
 - d. Concealed joint splice plates.
 - e. Finish: Selected from manufacturer's full range of finishes and colors.
 - f. Product: Econosnap.
- 3. Formed Fascia Spillout Scupper:
 - a. 0.063 aluminum.
 - b. Product: Hickman Fascia Spillout Scupper.

2.5 WATER BARRIER MEMBRANE

A. Cold-applied Self-adhering Membrane:

- 1. High-strength polyethylene film coated on 1 side with a thick layer of adhesive consistency rubberized asphalt.
- 2. Membrane to be able to withstand temperature of 200 degrees F without adhesive degradation.

3. ASTM D1970.
4. Thickness: 0.004 inch.
5. Provide complete with manufacturer's recommended primer.

2.6 FABRICATION

- A. General Requirements:
 1. Comply with SMACNA's "Architectural Sheet Metal Manual."
 2. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Fabricate with strippable film in place.
 4. Accurately form with brakes, straight, true, and sharp; plain surfaces free from warps and buckles and tool marks.
 5. Fabricate nonmoving seams with flat-lock seams. Where joint movement is necessary, provide 1-inch-deep interlocking hooked flanges, filled with mastic sealant.
 6. Tin edges to be seamed, form seams, and solder.
 7. Match profiles exactly at connections.
 8. Exposed edges to be beaded or returned for strength and appearance.
 9. Allow for expansion and contraction.
- B. Reinforcement: Provide ribs, cleats, and reinforcement necessary to make sections rigid and substantial.
- C. Seams, Joints:
 1. Locate joints of roof edges, other sheet metal work exposed to view with respect to precast tee stems, control joints, other architectural features as indicated on Drawings or as directed by E/A.
 2. Overlap in direction of flow.
 3. Use concealed cover plates.
 4. Where appearance is not a factor, fabricate in 8 or 10-foot lengths.
 5. Design field joints to permit expansion.
 6. Use joint covers or lapped joints with "s" clips; do not solder.
 7. Locate field joints at least 12 inches, no more than 3 feet, from actual corner.
- D. Penetration Sleeves: Fabricate with minimum 8-inch-high stack, of diameter 1 inch larger than penetrating element.

2.7 FINISHES

- A. Coating System: 2-coat system of organic coating on the face side consisting of fluorocarbon base top coat applied over quality matched primer with white wash coat applied to back side for additional protection.
 1. Colors: Up to 2 colors will be selected by Architect from manufacturer's full range of finishes and colors.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades:
 1. Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.

2. Coordinate Work with interfacing and adjoining Work, for proper sequencing of each installation.
 3. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.
- B. Verification of Conditions: Verify that flashing and sheet metal may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved.

3.2 METAL PROTECTION

- A. Do not place dissimilar metals in contact nor in position where drainage will occur across them.
- B. Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
- C. Water Barrier Membrane:
1. Install as recommended by manufacturer at locations indicated on Drawings.
 2. Use of primer is required.

3.3 INSTALLATION

- A. General:
1. Apply fabrication instructions of this Section to field installation.
 2. Install with strippable film in place.
 3. Install work neatly and anchor securely.
 4. Overlap seams in direction of flow and slope all horizontal surfaces for drainage.
 5. Join parts with rivets or sheet metal screws where necessary for strength or stiffness.
 6. Whenever possible, secure metal by means of clips or cleats without nailing through metal, in no case shall nails, rivets, or screws be exposed on outside of fascia, copings, etc.
 7. Secure metal flashings at roof edges according to ANSI/SPRI ES 1 Loss Prevention Data Sheet 1-49 for wind zone of Project.
 8. Equipment support flashing: Coordinate with roofing and equipment installation. Weld or seal flashing to equipment support member.
 9. Finished work to be water, weather tight.
- B. Expansion Provisions:
1. Provide for thermal expansion of exposed flashing and trim.
 2. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner of intersection.
 3. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.
- C. Joint Sealants: Apply wherever required to ensure watertight installation of sheet metal flashing after removing protective film.

3.4 ADJUSTING

- A. Replace or repair sheet metal flashing and trims that have been damaged or deteriorated beyond successful repair by finish touching or similar repair procedures.

3.5 CLEAN UP

- A. Immediately after completing work, remove strippable film.
- B. Clean sheet metal surfaces with mild soap and water to be suitable to receive specified finishes.
- C. Remove substances that might cause corrosion of metal or deterioration of finishes.

3.6 PROTECTION

- A. Provide final protection and maintain conditions to ensure flashing and trim are without damage or deterioration other than natural weathering at the time of Substantial Completion.

SHEET METAL WARRANTY

Project: _____

Project Address: _____

Project No: _____

Date of Final Acceptance: _____

Owner: _____

Address: _____

Sheet Metal Contractor: _____

Address: _____

Phone No: _____

Roofing Contractor: _____

Address: _____

This warranty stipulates that the above-named contractor(s) shall, during a period of 5 years from the date of final acceptance of the work, maintain the sheet metal flashing systems and repair all defects which result from faulty workmanship or defective materials, without further cost to the Owner, including replacement of any wet insulation caused by such defects.

Excluded from this warranty may be any and all damage to said roof, the building(s) or their contents, caused by acts or omissions of the Owner; fire, lightning, winds of peak gust speeds of 90 mph or higher, hailstorm, or other unusual phenomenon of the elements; movement or failure of the supporting building structure that causes flashing failure; or vapor condensation beneath the roof.

Exclude from this warranty any damages to the building(s) or the contents.

Before expiration of the above warranty period, the contractor(s) shall inspect the sheet metal in the presence of the Owner and make necessary correction of all deficiencies not considered normal. The warranty shall remain in force until the necessary repair work has been completed.

SHEET METAL CONTRACTOR

Signed: _____

Title: _____

Date: _____

ROOFING CONTRACTOR

Signed: _____

Title: _____

Date: _____

END OF SECTION 07 62 00

SECTION 07 71 23 – Gutters and Downspouts

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Gutters.
 - 2. Downspouts.
 - 3. Trim pieces including, but not limited to:
 - a. Endcaps.
 - b. Downspout outlets.
 - c. Downspout strainers.
 - 4. Accessories including, but not limited to:
 - a. Precast concrete splashblocks.
 - b. Gutter straps.
 - c. Downspout straps.
 - d. Anchors and fasteners.
 - e. Protective backing paint.
 - f. Protective back coating.
 - g. Fasteners.
 - h. Removable leaf screen.
- B. Related Sections:
 - 1. Section 03 41 00 - Plant-Precast Structural Concrete
 - 2. Section 07 41 13 - Metal Roofing and Wall Panels
 - 3. Section 07 46 17 - Metal Soffit and Fascia System
 - 4. Section 07 62 00 - Sheet Metal Flashing and Trim
 - 5. Section 07 92 00 - Joint Sealants

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM B209 - Aluminum Alloy Sheet
- B. SMACNA - Architectural Sheet Metal Manual

1.4 SUBMITTALS

- A. Refer to Division 1 Specifications
- B. Shop Drawings: Indicate general construction, configurations, jointing methods and locations, fastening methods, locations and installation details.

- C. Product Data: Submit manufacturer's current Product Data, including handling, storage, installation instructions, and maintenance recommendations on prefabricated components.
 - D. Samples: Provide color and material samples of gutters and downspouts.
- 1.5 QUALITY ASSURANCE
- A. Comply with SMACNA for nominal sizing of components for rainfall intensity determined by a storm occurrence of 1 in 10 years.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Stack preformed and prefinished material to prevent twisting, bending or abrasion, and to aid ventilation. Slope to drain.
 - B. Prevent contact with materials during storage that may cause discoloration, staining or damage.
- 1.7 PROJECT CONDITIONS
- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Standard of Quality: Design is based on PAC-CLAD by Peterson Aluminum, Elk Grove, IL www.pac-clad.com
- B. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - 1. Una-Clad by Elevate, Nashville, TN www.holcimelevate.com
 - 2. W.P. Hickman Company, Asheville, NC www.wph.com
 - 3. Manufacturer of comparable products submitted in compliance with Division 1 Specifications

2.2 MATERIALS

- A. 3105-type alloy aluminum sheet.
 - 1. Minimum tensile strength 24,000 psi.
 - 2. ASTM B209.
 - 3. .050" for gutters and downspouts
 - 4. Straps per SMACNA requirements
 - 5. Color as selected by E/A. Owner reserves the right to select up to two (2) colors.

2.3 COMPONENTS

- A. Gutters:
 - 1. Comply with SMACNA requirements.
 - 2. Size: 6-inch by 6-inch minimum.
- B. Downspouts:
 - 1. Comply with SMACNA requirements.
 - 2. Size: 6-inch by 6-inch minimum.
- C. End caps, downspout outlets, elbows, straps, joint fasteners, and downspout strainers profiled to suit gutters and downspouts.

2.4 ACCESSORIES

- A. Provide or fabricate accessories designed for use with manufacturer's gutter and downspout system.
- B. Anchorage Devices: SMACNA requirements.
- C. Gutter Supports: Straps.
- D. Downspout Supports: Straps.
- E. Continuous removable leaf screen with sheet metal frame and hardware cloth screen.

2.5 FABRICATION

- A. Field measure site conditions prior to fabricating work.
- B. Fabricate with required connection pieces.
- C. Form sections square, true and accurate in size, in maximum possible lengths and free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- D. Hem exposed edges of metal.
- E. Seal metal joints watertight.

2.6 SHOP FINISHING

- A. Shop prepare with cleaning process to ensure maximum paint adhesion.
- B. Coat inside of gutters, downspouts, and elbows with corrosion-inhibiting pretreatment and a protective polyester coating.
- C. Coat exteriors with corrosion-inhibiting pretreatment and a baked-on polyester topcoat.
- D. Protective Back Coating:
 - 1. FS TT-C-494, bituminous, solvent type, acid resistant.
 - 2. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.
- E. Color:
 - 1. Selected by Architect and Owner from manufacturer's full range of finishes and colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work and conditions are as indicated on Shop Drawings.
- B. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

- A. Install downspouts and accessories according to manufacturer's instructions.
- B. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
- C. Apply backing paint to metal back surfaces.
- D. Apply bituminous protective backing on surfaces in contact with dissimilar materials.
- E. Slope gutters 1/16 inch per foot minimum.
- F. Seal metal joints watertight.
- G. Set splash blocks under downspouts.

3.3 REPAIR/RESTORATION

- A. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance. Use materials, procedures recommended or furnished by manufacturer.
- B. Replace damaged materials with new materials complying with specified requirements.

3.4 CLEANING

- A. Site:
 - 1. Do not allow accumulation of scraps, debris arising from work of this section.
 - 2. Maintain premises in neat, orderly condition.
- B. System:
 - 1. Clean exposed surfaces using materials and methods recommended by manufacturer.
 - 2. When Work is completed, remove unused materials, containers, equipment, and debris.

3.5 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer to ensure work is without damage or deterioration at time of Substantial Completion.

END OF SECTION 07 71 23

SECTION 07 72 00 – Roof Accessories

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide roof specialties and accessories including, but not limited to:
 - 1. Roof hatches.
 - 2. Accessories:
 - a. Safety Railing.
 - b. Railing Gate.
 - c. Ladder Safety Post.
- B. The following is not included in this section:
 - 1. Manufactured curbs for mechanical equipment (refer to Mechanical Specifications).
- C. Related Sections:
 - 1. Section 03 41 00 - Plant-Precast Structural Concrete
 - 2. Section 05 12 00 - Steel Joist Framing
 - 3. Section 05 31 00 - Steel Decking
 - 4. Section 05 50 00 - Metal Fabrications
 - 5. Section 07 21 00 - Thermal Insulation
 - 6. Section 07 53 23 - EPDM Membrane Roofing
 - 7. Section 07 62 00 - Sheet Metal Flashing and Trim
 - 8. Section 07 92 00 - Joint Sealants
 - 9. Section 22 10 06 - Plumbing Piping Specialties

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance and cleaning recommendations.
- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections, details of components, joint locations and configurations within system and between system and adjoining system. From the project manual, include a copy of the specification section that applies.
- D. Samples:
 - 1. For each type of exposed factory-applied color finish required and for each type of roof accessory indicated, prepared on Samples of size to adequately show color.
 - 2. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components if requested by E/A.

- E. Maintenance Manual: Provide to Owner, maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide roof specialty and accessory units made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of roof specialties and accessories, with 6 projects of similar size, scope and type of which 3 have been in successful use for 3 years or longer.
 - 2. Contractor: 3 years experience in the installation of roof specialties and accessories.
 - 3. Personnel: For actual installation of roof specialties and accessories, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Certifications: Provide to E/A, certification of installer from manufacturer of roof specialties and accessories.
- D. Field Samples: If requested, furnish sample of each type of roof specialties and accessories to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.
- E. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.5 PROJECT CONDITIONS

- A. Existing Conditions: Drawings do not purport to show actual dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.6 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Adjust location of roof accessories that would interrupt roof drainage routes or roof expansion joints, with approval of E/A.

1.7 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Roof Hatch:
 - 1. Standard of Quality: Design is based on products of J.L. Industries, Bloomington, MN www.jlindustries.com
 - 2. Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Babcock-Davis, Arlington, MA www.babcockdavis.com
 - b. Bilco Company, New Haven, CT www.bilco.com

- c. Milcor, Lima, OH <http://www.milcorinc.com/>
- d. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

- A. Accessories: Other materials not specifically described but required for complete, proper installation of roof specialties and accessories, subject to acceptance of E/A.

2.3 COMPONENTS

A. Roof Hatches:

- 1. Model: RHDG Diamond Series – Galvannealed Steel Roof Hatch
- 2. Size: As shown on the Drawings.
- 3. Construction:
 - a. Curb: 14 gauge steel, 12 inch high curb with 3-1/2 inch wide flange including holes for securing to roof deck, include integral counter flashing.
 - b. Cover: Insulated 14 gauge galvanized steel exterior, with 22 gauge galvanized steel liner.
 - c. Finish: textured white polyester powder coat. Hardware zinc or chrome plated.
 - d. Door seal: Neoprene draft seal gasket.
 - e. Insulation: 1-inch fiber board insulation surrounding base. 1-inch glass fiber insulation with thermal resistance R-6 between exterior door cover and liner.
 - f. Hinges: Heavy-duty pintel hinge.
 - g. Linkage: Heavy gage automatic hold open arm with red vinyl grip for opening and closing.
 - h. Closure: Gas cylinder damper.
 - i. Latch: Positive snap latch with turn handles on exterior and interior. Padlock hasps on inside.

B. Safety Railing System for Roof Hatch:

- a. Model: Saf-T-Hatch Safety Railing
- b. System to include rails, clamps, fasteners, safety barrier at railing opening, and all accessories required for a complete installation.
- c. Provide Self-latching gate.
- d. Weep holes to drain entrapped water in hollow sections of handrail and railing members exposed to exterior or moisture from condensation.
- e. Close exposed ends of handrail and railing members with prefabricated end fittings.
- f. Finish: Safety yellow powder coat.

C. Railing Gate:

- a. Model: SHG-2436
- b. Self-closing, rigid galvanized steel gate with spring hinge.
- c. Finish: Safety yellow powder coat.

D. Ladder Safety Post:

- a. Model: LP-4
- b. Post to lock in place on full extension.

- c. Provide release mechanism to return post to closed position.
- d. Material: Steel tube, galvanized.
- e. Manufacturer's standard complete system including rails, clamps, fasteners, safety barrier at railing opening, and all accessories required for a complete installation.
- f. Weep holes to drain entrapped water in hollow sections of handrail and railing members exposed to exterior or moisture from condensation.
- g. Close exposed ends of handrail and railing members with prefabricated end fittings.
- h. Finish: Safety yellow powder coat.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and ready to receive roof accessories.
- C. Verify dimensions of roof openings for roof accessories and that they may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- D. Discrepancies: Immediately notify E/A in writing. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.

3.3 INSTALLATION

- A. Install accessories according to manufacturer's written instructions.
- B. Anchor securely in place and capable of resisting forces specified.
- C. Install accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.
- D. Install accessories to fit substrates and to result in watertight performance.
- E. Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation recommended by manufacturer.
- F. Coat concealed side of uncoated aluminum and stainless steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or Cementitious construction.
- G. Where installing exposed-to-view components of roof accessories directly on Cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
- H. Install roof accessories level, plumb, true to line and elevation, and without warping, jobs in alignment, excessive oil canning, buckling, or tool marks.
- I. Access Hatch: Install according to manufacturer's recommendations and as shown on Drawings.

3.4 REPAIR/RESTORATION

- A. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance. Use materials, procedures recommended or furnished by manufacturer.

3.5 ADJUSTING

- A. Adjust units to operate in proper manner and easily without binding.
- B. Replace damaged materials with new materials complying with specified requirements.

3.6 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from work of this section. Maintain premises in neat, orderly condition.
- B. System:
 - 1. Remove temporary covering and other provisions made to minimize soiling of other work.
 - 2. Promptly clean surfaces not to receive roof specialties and accessories; repair surfaces stained, marred or otherwise damaged during work.
 - 3. Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.
 - 4. Clean exposed surfaces of roof specialties and accessories using materials and methods recommended by manufacturer.
 - 5. When work is completed, remove unused materials, containers, equipment, and debris.

3.7 PROTECTION

- A. General: Provide final protection and maintain conditions in a manner acceptable to manufacturer to ensure work is without damage or deterioration at time of Substantial Completion.

END OF SECTION 07 72 00

SECTION 07 84 00 – Firestopping

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Firestopping for penetrations through:
 - a. Fire-resistance-rated floor and roof construction.
 - b. Fire-resistance-rated walls and partitions.
 - c. Smoke barriers and construction enclosing compartmentalized areas.
 - 2. Sealant joints in fire-resistance-rated construction.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 03 41 00 - Plant-Precast Structural Concrete
 - 3. Section 04 20 00 - Unit Masonry Assemblies
 - 4. Section 07 21 00 - Thermal Insulation
 - 5. Section 07 92 00 - Joint Sealants

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. C665 - Mineral Fiber Blanket for Thermal Insulation
 - 2. C719 - Adhesion and Cohesion of Elastomeric Joint Sealants under Cyclic Movement
 - 3. C920 - Elastomeric Joint Sealant
 - 4. E84 - Surface Burning Characteristics of Building Materials
 - 5. E119 - Fire Tests of Building Construction and Materials
 - 6. E814 - Fire Tests of Through-Penetration Fire Stops

1.4 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. Provide firestopping systems to resist the spread of fire according to requirements indicated, and the passage of smoke and other gases.
 - 2. Provide products that upon curing do not re-emulsify, dissolve, leach, breakdown, or other deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture characteristic during and after construction.
 - 3. Provide firestop sealants sufficiently flexible to accommodate motion such as pipe vibration, water hammer, thermal expansion, and other normal building movement without damage to the seal.

4. Firestopping materials shall conform to Flame (F) and Temperature (T) ratings as required by local Building Code and as tested by nationally accepted test agencies per ASTM E814.
5. Rated Systems:
 - a. F-Rated systems: Provide as determined per ASTM E814, must be a minimum of 1 hour but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.
 - b. T-Rated systems:
 - 1) T rating, when required by code authority, shall be based on measurement of the temperature rise on the penetrating items. The fire test shall be conducted with a minimum positive pressure differential of 0.01 inches of water column.
 - 2) For the following conditions, provide T ratings, in addition to F ratings, as determined per ASTM E814, where indicated and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas:
 - a) Penetrations located outside of wall cavities.
 - b) Penetrations located outside fire-resistive shaft enclosures.
 - c) Penetrations located in construction containing doors required to have a temperature-rise rating.
 - d) Penetrating items larger than a 4 inch diameter nominal pipe or 16 square inches in overall cross-sectional area.
 - c. L-Rated systems: Where through-penetration firestop systems are indicated in smoke barriers, provide systems with L ratings of not more than 3.0 cfm/square foot at both ambient temperatures and 400 degrees F.
6. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions both during and after construction.
 - a. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - b. For floor penetrations with annular spaces exceeding 4 inches or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means.
 - c. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
 - d. Provide products with flame-spread values of less than 25 and smoke-developed values of less than 450, as determined per ASTM E84.
7. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as determined per ASTM E119, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.

1.5 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance and cleaning recommendations.
- C. Shop Drawings: Submit showing system fabrication, installation drawings, including details of components, joint locations and configurations within system and between system and adjoining system.

1. Include firestop design designation of qualified testing and inspecting agency evidencing compliance with requirements for each condition indicated.
 2. Submit schedule of product used for each type of joint.
- D. Samples: Submit samples of materials and components if requested by E/A.
- E. Quality Assurance/Control Submittals:
1. Test Reports: Product test reports from, and based on tests performed by, a qualified testing and inspecting agency evidencing compliance of firestopping.
 2. Certificates: Product certificates signed by manufacturers, certifying that their products comply with specified requirements.
- F. Maintenance Manual: Provide to Owner, maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.

1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide firestopping throughout Project from one manufacturer to the greatest extent possible.
- B. Qualifications:
1. Manufacturer: 5 years experience in the manufacture of firestopping, with 6 projects of similar size, scope and type of which 3 have been in successful use for 3 years or longer.
 2. Contractor: 3 years experience in the installation of firestopping.
 3. Installer: Use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work, approved by FMG 4991 "Approval of Firestop Contractors."
- C. Certifications: Provide to E/A, certification of installer from manufacturer of firestopping.
- D. Regulatory Requirements:
1. Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements and those specified under Performance Requirements:
 - a. Firestopping tests to be performed by a qualified testing and inspecting agency that is acceptable to authorities having jurisdiction.
 - b. Through-penetration firestop systems and fire-resistive joint sealant systems are identical to those tested per ASTM E814 under conditions where positive furnace pressure differential of at least 0.01 inch of water (2.5 Pa) is maintained at a distance of 0.78 inch below the fill materials surrounding the penetrating items in the test assembly. Provide rated systems complying with the following requirements:
 - 1) Products bear classification marking of qualified testing and inspecting agency.
 - 2) Systems correspond to those indicated by reference to through-penetration firestop system designations listed by UL in their "Fire Resistance Directory," or by another qualified testing and inspecting agency.
- E. Field-Erected Mockups:
1. General: Before installing firestopping, erect mock-up for each different through-penetration firestop system indicated to verify selections made and to demonstrate qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final installations:
 - a. Location: Locate mock-up on site in location and size indicated or, if not indicated, as directed by E/A.
 - b. Erect mock-up in presence of E/A after having provided 7 days notification of date and time when mockup is to be constructed.

- c. Acceptance: Obtain E/A's acceptance of mock-up before start of final unit of work.
 - d. Maintenance: Retain and maintain mock-up during construction in undisturbed condition as a standard for judging completed unit of work.
 - e. Accepted mock-up in undisturbed condition at time of Substantial Completion may become part of completed unit of work.
- F. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.
- G. Owner may employ and pay a qualified inspection agency to check installed firestopping systems for compliance with requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver firestop system products to Site in original, unopened containers or packages with intact and legible manufacturers' labels identifying:
 - 1. Product and manufacturer.
 - 2. Date of manufacture.
 - 3. Lot number.
 - 4. Shelf life.
 - 5. Qualified testing and inspecting agency's classification marking applicable to Project.
 - 6. Curing time.
 - 7. Mixing instructions for multicomponent materials.
- B. Store and handle materials for firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.8 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Do not install when:
 - a. Ambient or substrate temperatures are outside limits permitted by manufacturers.
 - b. Substrates are wet due to rain, frost, condensation, or other causes.
 - 2. Ventilation: Ventilate per manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.
 - 3. Provide products containing no asbestos, PCBs, lead, or ethylene glycol.
 - 4. Do not use any product containing solvents or requiring disposal as hazardous waste.
- B. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.9 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate firestop systems.
- C. Notify Owner's inspecting agency at least 7 days in advance of firestop installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up firestop installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers are:
 - 1. 3M Fire Protection Products Divisions www.3m.com/firestop
 - 2. Grace Construction Products www.gcpat.com
 - 3. Hilti, Inc. www.hilti.com
 - 4. Specified Technologies Inc. (STI) www.stifirestop.com
 - 5. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 COMPONENTS

- A. Compatibility: Provide firestopping and joint sealants composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application.
- B. Fill Materials:
 - 1. Safing Insulation:
 - a. Fibers bonded and preformed into flexible batts. Asbestos free.
 - b. ASTM C665, Types I and III.
 - c. Facing: Unfaced scrim facing on one side.
 - 2. Job-Mixed Vinyl Compound:
 - a. Prepackaged vinyl-based powder product for mixing with water at Site to produce a paintable compound, passing flame-spread and smoke-developed ratings of zero per ASTM E84.
 - 3. Mortar:
 - a. Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Site to form a non-shrinking, homogenous mortar.
 - b. Product:
 - 1) CP637, Hilti.
 - 2) SpecSeal SSM, STI.
 - 4. Silicone Foams:
 - a. Multi-component, silicone-based liquid elastomer that, when mixed, expands and cures in place to produce a flexible, non-shrinking foam.
 - b. Product:
 - 1) FS Fireblocks, Hilti.
 - 2) Pensil PENN 200, STI.
 - 3) 2001 Silicone RTV Foam, 3M.
 - 5. Silicone Sealants:
 - a. Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealant of grade indicated below:
 - 1) Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and Non-sag formulation for openings in vertical and other surfaces requiring a non-slumping/gunnable sealant, unless indicated firestop system limits use to Non-sag grade for both opening conditions.

- 2) Grade for horizontal surfaces: Pourable (self-leveling) grade for openings in floors and other horizontal surfaces.
- 3) Grade for vertical surfaces: Non-sag grade for openings in vertical and other surfaces.
- b. Product:
 - 1) FS601 Firestop Sealant, Hilti.
 - 2) Pensil PEN 300, STI.
 - 3) 2000+ Silicone, 3M.
6. Solvent-Release-Curing Intumescent Sealants:
 - a. Solvent-release-curing, single-component, synthetic-polymer-based sealant of grade indicated below:
 - 1) Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and Non-sag formulation for openings in vertical and other surfaces requiring a non-slumping/gunnable sealant, unless indicated firestop system limits use to Non-sag grade for both opening conditions.
 - 2) Grade for horizontal surfaces: Pourable (self-leveling) grade for openings in floors and other horizontal surfaces.
 - 3) Grade for vertical surfaces: Non-sag grade for openings in vertical and other surfaces.
 - b. Product: Fire Barrier CP 25WB+ Caulk, 3M.
7. Firestop Devices:
 - a. Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
 - b. Product:
 - 1) CP642, Hilti.
 - 2) SpecSeal LLC Collars, STI.
 - 3) Plastic Pipe Device, 3M.
8. Fire Barrier Pillow:
 - a. Product:
 - 1) 3M Fire Barrier Pillow; self-contained, highly intumescent firestop product for use in through-penetration firestops that achieves a 3 hour fire ratings when tested by Underwriters Laboratory, Inc. according to ASTM E 814 (UL1479).

C. Fire-Resistive Elastomeric Joint Sealants:

1. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that complies with ASTM C920 requirements, including those referenced for Type, Grade, Class, and Uses, and requirements specified in this Section applicable to fire-resistive joint sealants.
2. Sealant Colors: Provide color of exposed joint sealants to comply with the following:
 - a. Provide selections made by E/A from manufacturer's full range of standard colors for products of type indicated.
3. Single-Component, Neutral-Curing Silicone Sealant: Type S; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, G, A, and (as applicable to joint substrates indicated) O.

- a. Additional Movement Capability: Provide sealant with the capability to withstand the following percentage changes in joint width existing at time of installation, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C719, and remain in compliance with other requirements of ASTM C920 for uses indicated:
 - 1) 100 percent movement in extension and 50 percent movement in compression for a total of 150 percent movement.
 - b. Product:
 - 1) CP6015, Hilti.
 - 2) SpecSeal ES, STI.
 - 4. Multicomponent, Non-sag, Urethane Sealant: Type M; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, A, and (as applicable to joint substrates indicated) O.
 - a. Additional movement capability: Provide sealant with the capability to withstand the following percentage change in joint width existing at time of installation, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C719, and remain in compliance with other requirements of ASTM C920 for uses indicated:
 - 1) 50 percent movement in both extension and compression for a total of 100 percent movement.
 - 5. Single-Component, Non-sag, Urethane Sealant:
 - a. Type S; Grade NS; Class 25; and Uses NT, M, A, and (as applicable to joint substrates indicated) O.
- D. Accessories: Provide components that are needed to install fill materials and to comply with Performance Requirements. Use only components specified by the manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:
 - 1. Permanent forming/damming/backing materials including the following:
 - a. Slag/rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated formboard.
 - d. Joint fillers for joint sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.

2.3 MIXES

- A. For those products requiring mixing prior to application, comply with firestopping manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application indicated.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect, with installer present, and verify that work is complete to point where this installation may properly commence.

- B. Verification of Conditions: Verify that firestopping may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A in writing. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work, adjacent areas, and materials of other trades.
- B. Surface Preparation:
 - 1. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:
 - a. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
 - b. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 - c. Remove laitance and form release agents from concrete.
 - 2. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. Through-Penetration Firestops:
 - 1. Comply with manufacturer's installation instructions and drawings pertaining to products and applications indicated.
 - 2. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 3. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
 - 4. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:
 - a. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 - b. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - c. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
- B. Fire-resistive Joint Sealants:
 - 1. Comply with manufacturer's installation instructions and drawings pertaining to products and applications indicated.
 - 2. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 3. Install fill materials for fire-resistive joint systems by proven techniques to produce following results:
 - a. Fill voids and cavities formed by openings and forming/packing/ backing materials as required to achieve fire-resistance ratings indicated.

- b. Apply fill materials so they contact and adhere to substrates formed by joints.
- c. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Identify through-penetration firestop systems with preprinted metal or plastic labels.
- B. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or Firestop systems.
- C. Use mechanical fasteners for metal labels.
- D. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted.
- E. Include the following information:
 - 1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Through-penetration Firestop system designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Name of manufacturer.
 - 6. Name of installer.

3.5 FIELD-QUALITY CONTROL

- A. Site Tests:
 - 1. Inspecting agency employed and paid by Owner may examine completed firestopping to determine if it is being installed in compliance with requirements.
 - 2. Inspecting agency will report observations promptly and in writing to contractor and E/A.
 - 3. Where deficiencies are found, repair or replace firestopping at no cost to the Owner, so that it complies with requirements
 - 4. Additional inspecting, at contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 - 5. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.

3.6 ADJUSTING

- A. Repair or replace damaged materials with new materials complying with specified requirements.

3.7 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from work of this section. Maintain premises in neat, orderly condition.
- B. System:
 - 1. Remove temporary covering and other provisions made to minimize soiling of other work.
 - 2. Promptly clean surfaces not to receive firestopping; repair surfaces stained, marred, or otherwise damaged during work.
 - 3. When work is completed, remove unused materials, containers, equipment, and debris.

3.8 DEMONSTRATION

- A. Maintenance Instructions: Manufacturer's representative to schedule and attend meeting with Owner's representatives to explain:
 - 1. Maintenance and Care Instructions.
 - 2. Recommended Maintenance Program.
 - 3. Warranty Requirements.

3.9 PROTECTION

- A. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion.
- B. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.

END OF SECTION 07 84 00

SECTION 07 92 00 – Joint Sealants

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide sealant and backup materials:
 - 1. Exterior construction joints.
 - 2. Exterior concrete slab joints.
 - 3. Interior concrete slab joints.
 - 4. Aluminum, sheet metal, glass and glazing joints.
 - 5. Interior joints: Door frames, casework to wall, backsplash to wall, intersection of walls, interior window sill to wall joints, wall to floor joints and steel stairs or where as directed by A/E.
- B. The following joint sealant is not included in this section:
 - 1. Sheet Metal Flashing and Trim (Section 07 62 00).
- C. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 03 41 00 - Plant-Precast Structural Concrete
 - 3. Section 04 20 00 - Unit Masonry Assemblies
 - 4. Section 07 62 00 - Sheet Metal Flashing and Trim
 - 5. Section 07 84 00 - Firestopping
 - 6. Section 08 44 13 - Glazed Aluminum Curtain Walls
 - 7. Section 08 45 00 - Translucent Wall and Roof Assemblies

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. C834 - Latex Sealants
 - 2. C919 - Use of Sealants in Acoustical Applications
 - 3. C920 - Elastomeric Joint Sealants
 - 4. C1021 - Laboratories Engaged in Testing Sealants
 - 5. C1193 - Standard Guide for Use of Sealants
 - 6. C1521 - Evaluation of Adhesion of Installed Weatherproofing Sealant Joints
 - 7. E119 - Fire Tests of Building Construction and Materials
 - 8. E548 - Evaluation and Assessment of Analytical Chemical Laboratories
- B. Sealant, Waterproofing, and Restoration Institute (SWRI)

1.4 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

- B. Environmental Requirements:
 - 1. Avoid indoor use of sealants that may contribute to indoor air quality problems, including the following:
 - a. Butyl rubber.
 - b. Solvent-based acrylic.
 - c. Neoprene.
 - d. Styrene butadiene rubber.
 - e. Nitrile.
 - f. Methylene chloride or chlorinated hydrocarbons.
 - g. Products containing bactericides and fungicides classified as phenol mercury acetates, phenol phenates, or phenol formaldehyde.
 - h. Provide acrylic latex or silicone sealants with less than 50 g/l VOCs.
 - i. Provide polyurethane products with less than 200 g/l VOCs.

1.5 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data:
 - 1. Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
 - 2. Provide Product Data on manufacturer's adhesion and stain testing.
- C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Color Samples: Submit manufacturer's standard color samples with Product Data and Shop Drawings.
- E. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.
- F. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- G. Field Test Report Log: For each elastomeric sealant application.
- H. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

1.6 QUALITY ASSURANCE

- A. Provide joint sealants units made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of joint sealants.
 - 2. Contractor: 3 years experience in the installation of joint sealants.
 - 3. Personnel: For actual installation of joint sealants, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.

- C. Regulatory Requirements:
1. Silicone Sealants: Certified by Sealant, Waterproofing, and Restoration Institute (SWRI).
- D. Product Testing: Obtain test results for Product Test Reports under Submittals Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the commencement of the Work.
1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated, as documented according to ASTM E548.
 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
 3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
 4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
- E. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by E/A.
 2. Conduct field tests for each application indicated below:
 - a. Each type of elastomeric sealant and joint substrate indicated.
 - b. Each type of nonelastomeric sealant and joint substrate indicated.
 3. Notify E/A 7 days in advance of dates and times when test joints will be erected.
 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 5. Method below is the first of 4 test methods recommended in Appendix X1.1 in ASTM C1193. Revise if one of the other three test methods is more appropriate for Project joint conditions.
 - a. Test method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193.
 - b. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 6. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.
- F. Mockups:
1. At start of Project, perform mockup of required sealant Work at one area of building. Perform minimum of 1 mockup for each different combination of substrates to be sealed. Coordinate mockup areas with E/A.
 2. Install mockups and test in presence of sealant manufacturer's authorized representative and E/A to ensure installation procedures are consistent with warranty requirements.

3. After sealant has achieved sufficient cure as coordinated with manufacturer's representative, conduct adhesion pull tests, or non-destructive testing, as directed by E/A. Conduct tests per ASTM C1521.
 4. Confirm results of adhesion tests as acceptable by E/A, Owner or Owner's representative, and sealant manufacturer prior to proceeding with Work.
 5. Leave approved mockups in place to establish standards and guidelines for acceptable installation of sealant Work and acceptable appearance.
- G. Preinstallation Meetings: The caulk installers, manufacturer's technical representative, and window installer shall meet with E/A prior to the start of installation.
- 1.7 PROJECT CONDITIONS
- A. Environmental Requirements:
1. Below 40 degrees F ambient temperature, refer to manufacturer's recommendations.
 2. Ensure joint substrates are dry and frost-free.
 3. Remove contaminants from joint substrate capable of interfering with adhesion.
- 1.8 WARRANTY
- A. Provide manufacturer's 5-year standard material warranty.
- B. Include coverage for replacement of sealant materials which fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Joint Sealants:
1. Standard of Quality: Design is based on products of Tremco, Beachwood, OH www.tremcosealants.com
 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Dow Corning, Midland, MI www.dow.com
 - b. BASF, Florham Park, NJ www.basf.com
 - c. STS Coatings, West Seneca, NY www.stscoatings.com
 - d. Pecora Corporation, Harleysville, PA www.pecora.com
 - e. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
- B. Backer Rod/Backup Filler Materials:
1. Acceptable Manufacturers; subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Exterior Joints: Non-absorbent; Sof-Rod by Nomaco www.nomaco.com
 - b. Interior Joints: Open-cell, Denver Foam by Backer Rod Manufacturing and Supply www.backerrod.com
 - c. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

- A. Do not use materials stored longer than their maximum recommended shelf life.

- B. Exterior Construction Joint Sealant:
1. Multi-component Polyurethane Polymer:
 - a. ASTM C920, Type M, Grade NS, Class 50, use NT, M, A, O.
 - b. Product:
 - 1) Dymonic FC by Tremco.
 - 2) NP-2 by BASF.
 2. Silyl-terminated Polyether Sealant (MS polymer):
 - a. Low-modulus, high-movement, nonsag, fast-curing.
 - b. ASTM C920.
 - c. Type and grade: S (single component) and NS (nonsag).
 - d. Class: 100/50 for vertical joints.
 - e. Product:
 - 1) Sonolastic 150 with VLM Technology by BASF.
 - 2) Great Seal PE-150 by STS Coatings.
 3. Preformed Silicone:
 - a. Low modulus precured silicone extrusion combined with neutral-curing silicone sealant.
 - b. For bonding extrusions to substrates and repair of construction joints.
 - c. Extreme movement capability; high tear resistance.
 - d. Size: To fit joint widths.
 - e. Product:
 - 1) Sil-Span by Pecora.
 - 2) 123 Silicone Seal by Dow Corning.
- C. Exterior Concrete Slab Joint Sealant:
1. Multi-component polyurethane joint sealant.
 2. ASTM C920; Type M, Grade P, Class 25 and TT S 00227E, Type 1, Class A Zero VOC.
 3. Product:
 - a. Self leveling:
 - 1) Dymonic 100 by Tremco.
 - 2) SL-2 by BASF.
 - b. Slope grade:
 - 1) THC-901 by Tremco
 - 2) SL-2 Slope Grade by BASF.
- D. Exterior Concealed Joints Under Thresholds: 1-part butyl rubber caulk conforming to FS TT-S-001657, Type 1.
- E. Interior Concrete Slab Joint Sealant:
1. Dymonic 100 by Tremco.
 2. MasterSeal by BASF.

- F. Aluminum, Sheet Metal, Glass and Glazing Joint Sealants:
1. Silicone, One-part:
 - a. Neutral cure, high performance, medium modulus,
 - b. Meeting Federal Specification TT S 00230C (COM NBS), Type II, Class A, TT 001543A(COM NBS), Class A.
 - c. ASTM C920, Type S, Grade NS, Class 50, use NT, M, G, A, O.
 - d. Product:
 - 1) Spectrum 2 by Tremco.
 - 2) Series 890NST by Pecora.
 - 3) Dow Corning 791.
 2. Silyl-terminated Polyether Sealant:
 - a. Low-modulus, high-movement, nonsag, fast-curing.
 - b. ASTM C920.
 - c. Type and grade: S (single component) and NS (nonsag).
 - d. Class: 100/50 for vertical joints.
 - e. Product:
 - 1) Sonolastic 150 with VLM Technology by BASF.
 - 2) Great Seal PE-150 by STS Coatings.
- G. Interior Joint Sealants:
1. Interior Dry Areas: Fast setting acrylic latex sealant meeting ASTM C834, Type P, Grade NF.
 - a. Product: Tremflex 834, by Tremco.
 - b. Maximum VOC content: 42 grams per liter.
 2. Interior Wet Areas: 1-part mildew-resistant silicone rubber conforming to ASTM C920, Type S, Grade NS.
 - a. Product: Tremsil 200 by Tremco.
- H. Fire-resistant Joint Sealant:
1. Manufacturer's standard sealant and accessory materials with fire-resistance rating matching fire endurance testing by ASTM E119, Underwriters Laboratory, Inc., or other jurisdiction.
 2. Accessory materials for fire stopping sealants: Provide forming, joint-fillers, packing, other accessory materials required for installation of fire stopping sealants as applicable to installation conditions indicated.
 3. Product:
 - a. Dymonic 100 by Tremco.
 - b. Tremstop Acrylic by Tremco.
 - c. NP-2 by BASF.
- I. Backup Filler Materials: Non-oily, non-staining, non-gassing, back-up filler or other filler completely compatible with sealant, approved by sealant manufacturer.
- J. Other Materials: Other materials not specifically described but required for complete, proper installation of joint sealants, subject to acceptance of E/A.
- K. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction and field tests.

- L. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

2.3 EQUIPMENT

- A. Must be specifically recommended for use by manufacturer of sealant being installed.

2.4 FINISHES

- A. Exterior: Selected by E/A from manufacturer's full range of colors.
- B. Interior: Match paint color or adjoining substrate color using manufacturers full range of colors.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that joint sealants may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Surfaces to be Caulked: Verify that surfaces are sound, thoroughly dry, clean, free of oil, grease, laitance, rust, and other foreign material that would prevent proper adhesion, and that concrete and mortar are thoroughly cured.
- B. Masonry Cleaning: Complete before surface preparation is begun.
 - 1. Prepare joints and surfaces to receive sealants according to sealant manufacturer instructions.
 - 2. Rake and clean out joints to full depth and width.
 - 3. Clean concrete, masonry, other porous materials by brushing, grinding, other mechanical means, to provide sound, clean surface.
 - 4. Remove dust, dirt, loose particles resulting from mechanical cleaning by vacuuming or blowing out joints with compressed air.
- C. Clean glass, metal, and non-porous surfaces.
- D. Remove protective coatings on metal using solvent that leaves no residue.
 - 1. Use clean white cloths or lintless paper towels to apply solvent, and wipe surfaces dry with dry cloths or paper towels.
 - 2. Do not allow solvent to air dry without wiping.
- E. Mask joints as necessary to protect adjacent surfaces.
 - 1. Apply masking tape in continuous strips and carefully align with edge of joint.
 - 2. Remove masking immediately after joints have been sealed and tooled.

3.3 BACK-UP MATERIALS

- A. Verify compatibility of filler material with sealant before installation.
- B. Install appropriate size backer rod directly into the control joint, larger than joint per manufacturer's recommendations, and in manner to provide concave sealant profile.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Where joint depth does not permit installation of backer rod, install adhesive-backed polyethylene bond-breaker tape along entire back of joint to prevent 3-sided adhesion of joint sealant.
- E. Use filler about 1/3 to 1/2 wider than width of joint so filler exerts sufficient pressure to provide substantial resistance to displacement.

3.4 SEALANT PRIMER

- A. Prime all joints. Do not allow primer to get outside of joints.
- B. Apply as recommended by manufacturer of sealant.
- C. Prime and seal on same workday.

3.5 APPLICATION OF SEALANT

- A. Apply strictly according to manufacturer's instructions, using nozzle of sufficient size to fill joint completely.
- B. Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
 4. Install joint sealant to all joints except those that allow moisture to drain.
 5. Caulk wide joints with three passes.
 6. Run a bead at each inside corner, fill joint with third pass.
- E. Tool joints immediately after application of material to ensure full contact with adjacent surfaces.
- F. Strike off excess material. Finished bead is to be flush with adjoining surfaces, unless otherwise indicated on Drawings.

3.6 INSTALLATION OF PREFORMED FOAM SEALANTS

- A. Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints.
- B. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.7 CURING

- A. Allow minimum 7 days for full cure.
- B. Do adhesion testing after 7 days.

- C. Painting Sealant:
 - 1. Allow 7 days to cure before applying paint.
 - 2. Match sealant to paint colors.

3.8 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform 10 tests for the first 1,000 feet of joint length for each type of elastomeric sealant and joint substrate.
 - b. Perform 1 test for each 1,000 feet of joint length thereafter or 1 test per each floor per elevation.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab or Method B, Exposed Surface Finish Hand Pull Tab or Method C, Field-Applied Sealant Joint Hand Pull Flap or Method D, Water Immersion in Appendix X1 in ASTM C1193, as appropriate for type of joint-sealant application indicated.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; do this by extending cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.
 - 4. Inspect tested joints and report on the following:
 - a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 - b. Whether sealants filled joint cavities and are free of voids.
 - c. Whether sealant dimensions and configurations comply with specified requirements.
 - 5. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 - 6. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

3.9 ADJUSTING

- A. Non-compliant Work: Allow inspections of Work and assist in testing requested by manufacturer's representative and E/A. Remove adjacent Work until location is reached where installation was performed properly.
- B. Remove and replace uncured sealant.

3.10 CLEAN UP

- A. Remove masking, excess material, smears as work progresses.
- B. Leave adjacent surfaces clean and free of sealant and primer.

3.11 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion.

- B. If damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 00

END OF DIVISION 07 – THERMAL AND MOISTURE PROTECTION

DIVISION 08 – OPENINGS

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08 43 13	Aluminum-Framed Storefront
08 44 13	Glazed Aluminum Curtain Walls
08 45 00	Translucent Wall and Roof Assemblies
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08 80 00	Glazing
08 90 00	Louvers and Vents
END OF INDEX	

SECTION 08 11 13 – Hollow Metal Doors and Frames (Commercial)

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Steel swing doors:
 - a. Flush door.
 - 2. Steel frames:
 - a. Door.
 - b. Interior lites.
 - 3. Steel door and frame accessories including, but not limited to:
 - a. Glazing beads.
 - b. Door silencers.
 - c. Fire rated door grille/louver.
 - d. Plaster guards.
 - e. Grout holes and plugs for frames in precast walls.
- B. Furnish the following for other sections to install including, but not limited to:
 - 1. Masonry anchors.
 - 2. Steel stud anchors and shoes.
 - 3. Wall anchors for precast walls.
- C. Perform the following:
 - 1. Prepare the door for hardware.

- D. Related Sections:
 - 1. Section 03 41 00 - Plant-Precast Structural Concrete
 - 2. Section 04 20 00 - Unit Masonry Assemblies
 - 3. Section 08 71 00 - Door Hardware
 - 4. Section 08 80 00 - Glazing
 - 5. Section 09 91 00 - Painting

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware
 - 2. A653 - Steel Sheet Galvanized or Galvannealed by the Hot Dip Process
 - 3. A1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low Alloy
 - 4. A1011 - Steel, Sheet and Strip, Hot Rolled Carbon, Structural, High-Strength
 - 5. E136 - Combustion Properties of Materials
 - 6. E2074 - Fire Tests of Door Assemblies
- B. Door and Hardware Institute (DHI): Recommended Locations for Builder's Hardware
- C. NFPA 80 - Standard for Fire Doors and Windows
- D. SDI:
 - 1. 100 - Standard Steel Doors and Frames
 - 2. 105 - Erection Instructions for Steel Frames

1.4 SUBMITTALS

- A. Per Section 01 33 00 Submittal Procedures.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Schedule of steel doors and frames using same reference numbers for details and openings as those on Drawings.
- D. Shop Drawings:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details.
 - 3. Frame details for each frame type, including dimensioned profiles.
 - 4. Details of locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, accessories, joints, and connections.
 - 7. Details of glazing frames and stops showing glazing.
 - 8. Details of fire rated door grille/louwer.
 - 9. Details of conduit and preparations for electrified door hardware and controls.

- E. Coordination Drawings: Drawings of each opening, including door and frame, drawn to scale and coordinating door hardware. Show elevations of each door design type, showing dimensions, locations of door hardware, and preparations for power, signal, and control systems.
- F. Samples for Initial Selection: For units with factory-applied color finishes.
- G. Oversize Construction Certification: For steel door assemblies required to be fire rated and exceeding limitations of labeled assemblies, include statement that doors comply with requirements of design, materials, and construction but have not been subjected to fire test.
- H. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of steel door and frame.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide steel door and frame units made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
 - 1. Manufacturer: 5 years' experience in the manufacture of steel door and frame.
 - 2. Contractor: 3 years' experience in the installation of steel door and frame.
 - 3. Personnel: For actual installation of steel door and frame, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Regulatory Requirements:
 - 1. Steel Door Institute: Comply with standards of ANSI/SDI-100.
 - 2. Fire-rated Door Assemblies: NFPA 80; tested, listed, labeled according to ASTM E2074 by nationally recognized independent testing and inspection agency acceptable to authorities having jurisdiction.
- D. Field Samples: If requested, furnish sample of each type of steel door and frame to E/A for review prior to manufacture/ installation. E/A will forward approved sample to the Site for installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Storage:
 - 1. Store at building site under cover.
 - 2. Place on minimum 4-inch-high wood blocking, with 1/4-inch space between stacked doors to promote air circulation.
 - 3. Avoid use of non-vented plastic, canvas shelters that would create humidity chamber.
 - 4. If cardboard wrapper on door becomes wet, remove immediately.

1.7 PROJECT CONDITIONS

- A. Drawings do not purport to show actual dimensions but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.8 COORDINATION

- A. Coordinate installation of anchorages for steel frames.
- B. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in concrete or masonry. Deliver to Site in time for installation.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Hollow Metal Doors:
 - 1. Standard of Quality: Design is based on products of Steelcraft, Cincinnati, OH www.steelcraft.com
 - 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Ceco Door, Milan, TN www.cecodoor.com
 - b. Curries, Mason City, IA www.curries.com
 - c. Member of SDI; manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
- B. Fire rated door grille/louver:
 - 1. Standard of Quality: Design is based on products of Nailor Industries, Inc., Houston, TX www.nailor.com
 - 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. National Guard Products, Memphis, TN www.ngp.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

- A. Hot-rolled Steel Sheets: Commercial steel (CS), pickled and oiled; comply with ASTM A1011, type B. Free of scale, pitting, or surface defects.
- B. Cold-rolled Steel Sheets: Commercial steel (CS); comply with ASTM A1008, type B.
- C. Galvanized Steel Sheets: Zinc-coated carbon, commercial steel (CS) type B; ASTM A653, with minimum A40 zinc-iron-alloy (galvannealed) coating designation.
- D. Supports, Anchors: Fabricate of not less than 18-gauge galvanized sheet steel. Galvanize units to be built into exterior walls according to ASTM A153, Class B.
- E. Inserts, Bolts, Fasteners: Manufacturer's standard units, except hot-dip galvanized items to be built into exterior walls, comply with ASTM A153.
- F. Shop Applied Primer Paint: Rust-inhibitive enamel or paint, air-drying or baking, suitable as base for specified finish paints.

2.3 FABRICATION

- A. Steel Door and Frame Units: Rigid, neat in appearance, free from defects, warp, or buckle. Where practicable, fit and assemble in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment to assure proper assembly at the Site.
- B. Cold-rolled Steel: Exposed faces of doors and panels, including stiles, rails of nonflush units.
- C. Cold-rolled or hot-rolled steel at fabricator's option: Frames, concealed stiffeners, reinforcement, edge channels, louvers, moldings.
- D. Exposed Fasteners: Countersunk flat Phillips heads unless otherwise indicated.
- E. Finish Hardware Preparation:
 - 1. Factories prepare steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in the Division 1 Specifications.

2. Reinforce doors and frames to receive nontemplated mortised and surface-mounted door hardware.
 3. Comply with Door Hardware Institute specifications and ANSI A250 for door and frame preparation and location for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
- G. Galvanizing: Exterior doors and frames
- H. Weep Holes: Provide in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- I. Shop Painting:
1. Clean, treat, paint exposed surfaces of units, including galvanized surfaces.
 2. Clean steel surfaces of mill scale, rust, oil, grease, dirt, other foreign materials.
 3. Correct minor irregularities with metallic putty sanded smooth before application of paint.
 4. Apply shop coat prime paint of even consistency to provide uniformly finished surface ready to receive finish paint.

2.4 STANDARD STEEL DOORS

- A. Flush Swing Door Construction:
1. Interior Doors:
 - a. Face sheets fabricated from cold-rolled steel sheet.
 - b. Level: SDI Grade III (extra heavy duty).
 - c. Model:
 - 1) B Series (16 gauge) Metallic-coated A60: Full flush face, including top of door.
 - d. Core: Steel stiffeners with batt insulation.
- B. End Closures:
1. Close off top and bottom of doors with 18-gauge (minimum) end closure channels, flush top, inverted bottom.
 2. At all doors exposed to the elements with an inverted top channel provide a steel closure channel, screw attached and welded full width of door on both edges, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
 3. Provide sealant at top of all doors for water-tight condition.
- C. Edges: Bevel edges latch edge or on both sides.
- D. Swing Door Hardware - SDI recommended hardware reinforcing gauges:
1. Hinge Reinforcements: 7-gauge: 1 1/2 inches by 9 inches.
 2. High Frequency Hinge Reinforcement: Provide ALL frames with mortise butt type hinges with minimum 14 gauge high frequency hinge reinforcements over the top and bottom of the hinge reinforcement at all hinge locations.
 3. Cylindrical Lock Reinforcement Units: 14 gauge.
 4. Mortised Hardware: 14 gauge, preparation according to ANSI A250 where applicable. Reinforce, drill and tap to receive hardware.
 5. Closer Reinforcements: Fabricate according to ANSI/SDI A250.6 with full sleeve closer reinforcement plates full width of frame minimum 14 gauge.
 6. Other Hardware: Refer to SDI recommendations (minimum).
 7. Through Bolting: Not allowed.

- E. Accessories:
1. Glazing Beads: Removable glazing bead on interior side of glass only; exterior glazing stop shall be non-removable; Provide muntins if indicated on Drawings.
 2. Provide "Z" style overlapping astragals on all pairs of doors: The use of astragals shall comply with the requirements of applicable building codes and NFPA 80.
 3. Fire rated door grille/louver:
 - a. Complies with UL 10C, ASTM E152, and NFPA 80 and 252.
 - b. Material: 18 gauge, cold rolled steel frame with 16 gauge blades.
 - c. Closing Assembly: 165°F (74°C) UL listed fusible link with stainless steel operating spring and action bar.
 - d. Size and rating as indicated on the Drawings.
 - e. Free Area: 45%.
 - f. Finish: Aluminum.
 - g. Product: 61DGD-FR.
- F. Label Requirements: Meet all requirements, as set forth by Underwriters Laboratories, Inc., for all label classifications. UL Laboratories, Inc. or Warnock Hersey requirements shall take precedence in all cases.

2.5 STANDARD STEEL FRAMES

- A. General Requirements:
1. Verify quantities and suitability of fasteners.
 2. Conceal fastenings, unless otherwise indicated.
 3. Exterior Frames: Metallic-coated A60 steel sheet with mitered corners.
 4. Interior Frames: Metallic-coated A60 steel sheet with mitered corners.
 5. Continuous welded and backwelded corners (through stops).
 6. Thickness: 0.053-inch-thick steel sheet.
 7. Reinforce for hardware using the SDI Hardware Reinforcing Gauges as a minimum standard.
 8. Provide welded steel cap plate at top of frame jambs at partial height doors without a frame head.
- B. Door Silencers: Except on weatherstripped frames, drill stops to receive 3 silencers on strike jambs of single-swing frames, 2 silencers on heads of double-swing frames.
- C. Plaster Guards: 26-gauge steel plaster guards or mortar boxes, welded to frame, at back of finish hardware cutouts where mortar or other materials might obstruct hardware operation, and to close off interior of openings.
- D. Glazing Beads: On frame assemblies indicated to have glazed openings, the frame shall be provided with glazing beads designed to receive the glass and gaskets.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect, with Installer present, and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that steel doors and frames may be installed according to original design, installation tolerances, pertinent codes and regulations, and pertinent portions of referenced standards.

- C. Discrepancies:
 - 1. Immediately notify E/A.
 - 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 - 3. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory.
- B. Prior to installation and with installation spreaders in place, adjust and securely brace steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive non-templated mortised and surface-mounted door hardware.

3.3 INSTALLATION

- A. Install steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Frames:
 - 1. Comply with SDI-105:
 - 2. Except for frames located at in-place concrete or masonry and at drywall installations, place prior to construction at enclosing walls and ceilings.
 - 3. Set accurately in position, plumbed, aligned, braced securely until permanent anchors set.
 - 4. Remove temporary braces and spreaders after wall construction is completed, leaving surfaces smooth and undamaged.
 - 5. Install frames with removable glazing stops located on secure side of opening.
 - 6. Install fire-rated frames according to NFPA 80.
- C. Anchors (see details on plan to determine appropriate anchorage system):
 - 1. Floor anchors: Provide for each jamb and mullion that extends to floor and secure with post-installed expansion anchors. Powder-actuated fasteners may be used if indicated and approved on Shop Drawings.
 - 2. Masonry Type: Provide minimum 5 anchors per jamb. Hinge Jamb: 1 anchor just below top hinge, anchors just above and below each hinge. Strike Jamb: Just above and below strike location, other space evenly above and below strike location.
 - 3. In-place concrete or masonry construction: Set, secure to adjacent construction with machine screws and masonry anchorage devices.
 - 4. In-place gypsum board partitions: Secure frames in place with post-installed expansion anchors through floor anchors at each jamb. Countersink anchors and fill and make smooth, flush, and invisible on exposed faces.

5. Stud Wall Type: At Steel stud applications, Spot weld 16-gauge recessed steel channel anchor provide minimum 5 anchors per jamb. [Hinge Jamb: 1 anchor just below top hinge, anchors just above and below each hinge. Strike Jamb: Just above and below strike location, other space evenly above and below strike location. Spot welding shall not be visible through frame.
 6. Where frames require existing opening anchors, "dimple" to receive countersunk flathead expansion anchor screws, setting screw heads below surface of frame. Fill countersink with metal putty, grind smooth to match adjacent surface. Prime affected area to match shop finish.
- D. Door Installation:
1. Fit accurately in frames within clearances specified in SDI-100.
 2. Shim as necessary.
 3. Place fire-rated doors with clearances specified in NFPA 80.
- 3.4 ADJUSTING, CLEANING
- A. Remove and replace defective work, including steel doors or frames that are warped, bowed, or otherwise unacceptable.
 - B. Clean doors and frames immediately after installation.
 - C. Prime Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat; apply touch-up of compatible air-drying primer.
 - D. Galvannealed Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
 - E. Final Adjustments: Check, readjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.
- 3.5 SCHEDULE
- A. Furnish items in amounts indicated on Drawings or required for complete and operable door and facility.
 - B. Coordinate Schedule with Drawings and notify E/A of any door not scheduled.

END OF SECTION 08 11 13

SECTION 08 14 00 – Wood Doors

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Premium grade flush wood doors:
 - a. Solid core.
 - b. Type of face:
 - 1) Wood veneer faced.
 - 2. Wood door accessories including, but not limited to:
 - a. Glazing frames.
 - b. Transoms to match doors.
- B. Perform the following:
 - 1. Prepare doors for hardware.
- C. The following is not included in this section:
 - 1. Door Hardware (Section 08 71 00).
- D. Related Sections:
 - 1. Section 06 40 23 - Interior Architectural Woodwork
 - 2. Section 08 11 13 - Hollow Metal Doors and Frames (Commercial)
 - 3. Section 08 71 00 - Door Hardware
 - 4. Section 08 80 00 - Glazing
 - 5. Section 09 91 00 - Painting

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ANSI A208 - Medium Density Fiberboard
- B. ASTM E90 - Measurement of Airborne Sound Transmission Loss of Building Partitions
- C. Conform to IBC code for state in which Project is located.
- D. NFPA 80 - Fire Doors and Windows

1.4 DEFINITIONS

- A. MDO: Medium Density Overlay

1.5 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Product Data:
 - 1. For each type of door, include details of core and edge construction and trim for openings. Include factory-finishing specifications.

- C. Shop Drawings:
 - 1. Submit manufacturer's Shop Drawings showing system fabrication, installation drawings, including schedules, elevations, sections, details of components.
 - 2. Show location, size, and hand of each door, location and extent of hardware blocking, special beveling, and fire ratings for fire doors.
 - a. Indicate compliance with positive pressure.
- D. Submit certified independent laboratory test results of screw holding, split resistance, hinge loading, and acoustic decibels with Shop Drawings.
- E. Samples:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches for each material and finish.
 - 2. For each wood species and transparent finish, provide set of 3 samples showing typical range of color and grain to be expected in the finished Work.
 - 3. If requested, furnish sample of each type of wood door to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Provide wood door units made of components of standard construction furnished by one manufacturer as coordinated assembly.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of wood doors.
 - 2. Contractor: 3 years experience in the installation of wood doors.
 - 3. Personnel: For actual installation of wood doors, use journeymen carpenters skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Regulatory Requirements:
 - 1. Comply with IBC.
 - a. Neutral Pressure Testing.
 - b. Positive Pressure Testing.
 - 2. Industry Standards: Comply with AWI standards, latest edition.
 - a. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
 - b. Provide WIC-Certified Compliance Certificate for Installation.
 - 3. Smoke Control: Meet smoke control and smoke gasketing testing requirements of UL 1784.
- D. Labeling: Doors shall bear an identifying label indicating the manufacturer, door number, and order number, as well as fire rating where applicable, conforming to requirements of Intertek Testing Services-Warnock Hersey or Underwriters Laboratories.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Package doors individually in plastic bags or cardboard cartons.
- B. Mark each door on top and bottom rail with opening number used on Shop Drawings.
- C. Protect installed work of other trades. In the event of damage, immediately repair, replace to acceptance of E/A, at no additional cost to Owner.
- D. Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature between 60 and 90 degrees F and relative humidity between 25 and 55 during the remainder of the construction period.

- E. Store doors flat and off the floor. Do not store on edge.
- F. When handling doors, do not drag across other doors or surfaces. Handle with clean hands or gloves.

1.8 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.9 WARRANTY

- A. Door Manufacturer's Warranty:
 - 1. Submit written agreement on door manufacturer's standard form signed by manufacturer, installer, and contractor, agreeing to repair or replace defective doors that:
 - a. Warp (bow, cup, or twist) more than 1/4 inch in a 42- by 84-inch section.
 - b. Show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - c. Do not conform to tolerance limitations of referenced quality standards.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty shall be in effect during the following periods or time after date of Substantial Completion.
 - a. Solid Core Interior Door: Life of Installation.

1.10 MAINTENANCE

- A. Provide Owner with one sample bottle of cleaning solution recommended by manufacturer of wood doors.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Premium Grade Flush Doors:
 - a. Standard of Quality: Design is based on products of VT Industries, Holstein, IA www.vtindustries.com
- 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Oshkosh Architectural Wood Doors, Oshkosh, WI www.oshkoshdoor.com
 - b. Lynden Door, Lynden, WI www.lyndendoor.com
 - c. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.2 DOOR FABRICATION

- A. Interior, veneer-faced doors: 5 ply, flush, bonded doors.
- B. Product: Heritage Collection.
- C. Core:
 - 1. Particleboard:
 - a. Comply with ANSI A208.1, Grade 1-LD-2.
 - b. Provide wood blocking as needed to eliminate through-bolting hardware OR as follows:
 - 1) 5-inch top-rail blocking in doors indicated to have closers.

- 2) 5-inch bottom-rail blocking in exterior doors and doors indicated to have kick, mop, or armor plates.
 - 3) 5-inch mid-rail blocking in doors indicated to have exit devices.
- D. Door Assembly:
 - 1. Bond stiles and rails to core.
 - 2. Sand entire assembly flat as a unit to ensure minimal telegraphing of core components through face veneers.
- E. Composite Crossbands:
 - 1. Apply to core in hot press using Type 1, exterior, water-resistant adhesive, before application of hardwood edges.
 - 2. Exposed Crossbanding: Not allowed along stile edges.
- F. Veneer:
 - 1. Grade: Premium.
 - 2. Veneer: AA Grade.
 - 3. Thickness: 1 3/4 inches.
 - 4. Species:
 - a. White Birch.
 - 5. Cut:
 - a. Plain sliced.
 - 6. Match:
 - a. Veneer match: Book match or slip match.
 - b. Assembly of spliced veneers: Center match.
 - c. Pair and set match. Provide for doors hung in same opening or separated only by mullions.
 - d. Room match: Match door faces within each separate room.
 - e. Transom match: Continuous match.
 - 7. Refer to Drawings for stain color selection.
- G. Vertical Edges:
 - 1. Vertical edges to be matching or compatible hardwood.

2.3 WOOD DOOR ACCESSORIES

- A. Glass Stops: Wood veneer beading; species to be the same as the face veneer, and complying to UL/WHI requirements for 20 minute or higher rated doors.
 - 1. Flush rectangular beads.
 - 2. Recessed tapered beads.
 - 3. Lipped tapered beads.
 - 4. Manufacturer's standard shape.
- B. Applied Moulding:
 - 1. Profile 5, glued.
 - 2. Moulding must not interfere with the operation of the door, hardware, or accessories.
 - 3. Factory-applied finish.
- C. Other Materials: Materials not specifically described but required for complete, proper installation of wood doors, subject to acceptance of E/A.

2.4 FABRICATION

- A. Fabricate doors in sizes indicated for Project-site fitting.
- B. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
 - 1. Comply with clearance requirements of referenced quality standard for fitting.
 - 2. Comply with requirements in NFPA 80 for fire-rated doors.
- C. Factory machine doors for hardware that is not surface applied.
 - 1. Locate hardware to comply with DHI WDHS-3.
 - 2. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 - 3. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- D. Transom and Side Panels:
 - 1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors.
 - 2. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
 - 3. Fabricate door and transom panels with full-width, solid lumber, (rabbeted) meeting rails.
 - 4. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.
- E. Openings:
 - 1. Cut and trim openings through doors to comply with applicable requirements of referenced standards for kinds of doors required.
 - 2. Light Openings: Trim openings with moldings of material and profile indicated.
 - 3. Louvers: Factory install prefinished louvers in prepared openings.
- F. Wood Veneered Doors:
 - 1. Prefit to openings with clearance of 1/8 inch at top and sides, 1/2 inch at bottom. Bevel both stiles 1/8 inch in 2 inches.
 - 2. Factory seal top and bottom rails.
 - 3. Factory machine for locksets, butts, and other related hardware, using templates furnished by the hardware supplier. Include pilot holes for hinge screws and lock fronts.
 - 4. 1/4 inch nominal outer stile of same species of face veneer.
 - 5. Veneered stile edge not acceptable.

2.5 SHOP PRIMING

- A. Doors for Transparent Finish: Shop seal faces and edge of doors, including cutouts, with stain, other required pretreatments, and first coat of finish. See Section 09 91 00.

2.6 FACTORY FINISHING

- A. Finish must meet or exceed performance standards of AWI TR-6 catalyzed polyurethane.
- B. Finish to be water based stain and ultraviolet (UV) cured polyurethane sealer to comply with EPA Title 5 guidelines for Volatile Organic Compound (VOC) emissions limitations.
- C. Color: To be selected by E/A from manufacturer's standard AND exotic colors.
- D. Hardware: Match finishes specified in Section 08 71 00.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing Work, carefully inspect and verify that Work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that wood doors may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
 - 1. Verify that opening sizes and tolerances are ready to receive this Work.
 - 2. Do not install doors in frame openings that are not plumb or are out of tolerance for size or alignment.
 - 3. Carefully inspect the locations of door installation and notify E/A of any conditions which would adversely affect the installation or subsequent operation of the door.
- C. Discrepancies:
 - 1. Immediately notify E/A.
 - 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 - 3. Reject doors with defects.

3.2 INSTALLATION

- A. Comply with pertinent codes, regulations, original design, referenced standards.
- B. Hardware: See Section 08 71 00 for installation.
- C. Installation:
 - 1. Square, plumb, straight, firmly anchored into position.
 - 2. Comply with manufacturer's written instructions, referenced quality standard, and as indicated on Drawings.
 - 3. Align and fit doors in frames with uniform clearances and bevels as indicated below:
 - a. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold.
 - 4. Do not trim positive pressure rated doors for width. Follow manufacturer's instructions to install.
- D. Coordinate installation of glass and glazing.

3.3 ADJUSTING

- A. Adjust hardware and door for proper function and smooth operation, proper latching, without force or excessive clearances:
- B. Set nails and fasteners for putty; firmly putty holes.
- C. Doors shall show no evidence of repair or refinishing.
 - 1. Use fine grain sandpaper to completely eliminate scratches, abrasions, etc. in the finished surface.
 - 2. Restore factory finish if fitting or machining is required at Site.
- D. Within 4 days of fitting doors, seal exposed surfaces with minimum 2 coats polyurethane.
- E. Place poly bags over doors to provide protection during remainder of construction.

END OF SECTION 08 14 00

SECTION 08 16 00 – Corrosion Resistant Doors and Frames

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Flush, corrosion-resistant, fiberglass reinforced plastic doors.
 - 2. Fiber reinforced plastic frames.
 - 3. Door and frame accessories including, but not limited to:
 - a. Glazing beads.
 - b. Door silencers.
- B. Furnish the following for other sections to install including, but not limited to:
 - 1. All anchors and reinforcing/blocking for installation in concrete, masonry, or wood construction. Refer to plans for locations of each wall construction type.
- C. Perform the following:
 - 1. Prepare the door for hardware.
- D. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete
 - 2. Section 04 20 00 - Unit Masonry Assemblies
 - 3. Section 06 10 53 - Rough Carpentry
 - 4. Section 08 71 00 - Door Hardware
 - 5. Section 08 80 00 - Glazing

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ANSI:
 - 1. A117.1 - Handicap Accessibility
 - 2. A250.4 - Door Swing Test
- B. ASTM:
 - 1. D256 - Pendulum Impact Resistance of Plastics
 - 2. D570 - Water Absorption of Plastics
 - 3. D635 - Burn Extent
 - 4. D638 - Tensile Properties of Plastics
 - 5. D790 - Flexural Properties of Plastics
 - 6. D1308 - Effect of Household Chemicals of Organic Finishes
 - 7. D1621 - Compressive Properties of Rigid Cellular Plastics
 - 8. D1623 - Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
 - 9. D2126 - Response of Rigid Cellular Plastics to Thermal and Humid Aging
 - 10. E2583 - Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor

11. D6670 - Volatile Organic Emissions from Indoor Materials/Products
 12. E84 - Flame Spread and Smoke Development
 - C. NFPA:
 1. 80 - Standard for Fire Doors and Windows
 2. 252 - Fire Tests of Doors and Assemblies
 - D. UL 10B - Fire Tests of Door Assemblies
- 1.4 DEFINITIONS
- A. FRP: Fiber Reinforced Plastic
- 1.5 SYSTEM DESCRIPTION
- A. Performance Requirements:
1. Swinging Door Cycle Test, Doors and Frames, ANSI A250.4: Minimum of 25,000,000 cycles, with no failure of any design features of the door system.
 2. Impact Strength: ASTM D256, 15 foot-pounds per inch of notch.
 3. Tensile Strength: ASTM D638 14,000 psi.
 4. Flexural Strength: ASTM D790 21,000 psi.
 5. Water Absorption: ASTM D570 0.20 percent after 24 hours.
 6. Stain Resistance: Meet ASTM D1308.
 7. Chemical Resistance: Excellent rating per ASTM D543.
 8. Thermal and Humid Aging Foam Core: ASTM D2126 Nominal value, 158 degrees F and 100 percent humidity for 14 days, minus 5.14 percent volume change.
 9. Compressive Strength, Foam Core: ASTM D1621, nominal value 79.9 psi.
 10. Tensile Adhesion, Foam Core: ASTM D1623, nominal value 45.3 psi.
 11. Indentation Hardness: ASTM D2583, nominal value 0.20 percent after 24 hours.
- 1.6 SUBMITTALS
- A. Per Section 01 33 00 Submittal Procedures.
- B. Product Data: Submit manufacturer's current Product Data including specifications, test reports, handling, storage and installation instructions, and maintenance and cleaning recommendations.
- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections, details of components, anchor types and spacing, location of cutouts for hardware, internal reinforcement, and configurations within system and between system and adjoining system.
- D. Samples:
1. Door: Submit manufacturer's sample of door showing face sheets, core, framing, and finish.
 2. Color: Submit manufacturer's standard color samples for each type of finish.
 3. Submit samples of anchors, fasteners, hardware, frames, assembled corner sections and other materials and components if requested by E/A.
- E. Maintenance Manual: Provide to Owner, maintenance, and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.
- 1.7 QUALITY ASSURANCE
- A. Single Source Responsibility: Provide door and frame units made of components of standard construction furnished by one manufacturer as coordinated assemblies.

- B. Qualifications:
 - 1. Manufacturer: 15 years' experience in the manufacture of FRP doors and frames, with 6 projects of similar size, scope, and type of which 3 have been in successful use for 3 years or longer.
 - 2. Contractor: 3 years' experience in the installation of doors and frames.
 - C. Regulatory Requirements:
 - 1. Fire rated door and panel construction shall conform to products tested under NFPA252 and UL 10B.
 - 2. Install door and panel assembly conforming to NFPA 80 for fire rated class and schedule.
 - 3. Flame Spread: All FRP component parts, including gelcoat finish, shall have a flame spread classification of 25 or less per ASTM E84 and shall be self-extinguishing per ASTM D635 unless operating conditions dictate otherwise.
 - 4. Resins: Resins shall comply with USDA and FDA standards for incidental food contact, if applicable to this project.
 - D. Certifications: Provide to E/A, certification of installer from manufacturer of doors and frames.
 - E. Field Samples: If requested, furnish sample of each type of door and frame to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.
 - F. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Store doors in a vertical position on blocking, clear of the floor, and with blocking between the doors to permit air circulation between the doors.
- 1.9 WARRANTY
- A. Warrant doors, frames, and factory installed hardware against failure in materials and workmanship, including excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction more than normal weathering.
 - B. Standard Period.
 - 1. Ten years starting on date of shipment.
 - C. Limited lifetime
 - 1. Covers failure of corner joinery, core deterioration, and delamination or bubbling of door skin and corrosion of all-fiberglass products while the door is in its specified application in its original installation.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Standard of Quality: Design is based on Special-Lite, SL-17 Pebble Grain FRP/ Aluminum Hybrid Door and AF-150 Pultruded Fiberglass Frame, Decatur, MI www.special-lite.com
- B. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - 1. Kawneer Flushline, Norcross, GA www.kawneer.us
 - 2. Cline Doors, Series 200BE, Bradenton, FL www.clinedoors.com
 - 3. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

A. FRP Face Sheets:

1. One continuous seamless piece of FRP material of suitable structural integrity.
2. Thickness: 0.120 inch.
3. Exterior surfaces treated with ultraviolet inhibitors.
4. Reinforce resin with fiberglass 25 percent by weight.
5. Abuse resistant.
6. Mortises: Provided by door manufacturer.
7. Integral finish/color.
8. Texture: Pebble Grain.

B. Core:

1. Poured in place polyurethane foam.
 - a. Density: Minimum of 5 pounds per cubic foot.
 - b. R-Value of door leaf: Minimum of 9.

C. Aluminum Members:

1. Extrusions: ASTM B221.
2. Sheet and Plate: ASTM B209.
3. Alloy and Temper: As required by manufacturer for strength, corrosion resistance, application of required finish, and control of door.

D. Fasteners:

1. Material: Stainless steel or other noncorrosive metal.
2. Compatibility: Compatible with items to be fastened.
3. Exposed Fasteners: Screws with finish matching items to be fastened.

E. Other Materials: Materials not specifically described but required for complete, proper installation of fiber reinforced door and frame, subject to acceptance of E/A.

2.3 FABRICATION

A. General Requirements:

1. Fabricate doors and frames as shown on the Drawings and according to best shop practices, free from defects and neat in appearance.
2. Field measure before fabrication and show recorded measurements on Shop Drawings.
3. Complete cutting, fitting, forming, drilling, and grinding of metal before assembly.
4. Remove burrs from cut edges.
5. Form exposed surfaces free from warp, wave, and buckle, with all corners square, unless otherwise shown.
6. Set each member in proper alignment and relationship to other members with all surfaces straight and in a true plane.
7. Frames shall be rigid.
8. Fit: Maintain continuity of line and accurate relation of planes and angles.
9. Secure attachments and support at mechanical joints with hairline fit at contacting members.

- B. Doors:
1. Total Thickness: Nominal 1-3/4 inches.
 2. Stiles and Rails:
 - a. Full stile and rail structure, providing an impenetrable barrier between the edge of the door and the core material.
 - b. Primary support for hardware accessories and attachments.
 - c. One continuous piece construction.
 3. Corners: Mitered.
 4. Support and seal window lite and louver cutouts in the door panel so that no moisture or contaminants shall penetrate the door cavity. 25 mil of resin-rich gelcoat to be integrally molded into window/louver and window/louver retainers.
 5. Support louver structures and lites by systems that are corrosion resistant.
 6. Hardware Preparation:
 - a. Mortise and reinforce doors to allow application of hinges and locks, according to the hardware schedule.
 - b. Attach hinges by using stainless steel wood screws.
 - c. Pilot holes shall be in strict accordance with manufacturer's recommendations.
- C. Reinforcements:
1. Reinforce members and joints with plates, tubes or angles for rigidity and strength.
 2. Door panels shall be adequately reinforced, and compression members fabricated from suitable corrosion resistant materials as to accommodate hinges (both mortised and surface), closers, locksets (both cylindrical and mortise type), kickplates, push-pull plates, exit devices, etc.
 3. Doors shall contain sufficient internal reinforcing in the areas of through bolt hardware as specified. Reinforcement shall be a corrosion resistant compression member with the ability to resist through-bolt torquing and maintain the sealed integrity of the panel.
- D. Door Construction using Aluminum Stiles and Rails:
1. Provide joinery of 3/8-inch diameter full-width tie rods through extruded splines top and bottom as standard tubular shaped stiles and rails reinforced to accept hardware as specified.
 2. Securing internal door extrusions: 3/16-inch angle blocks and locking hex nuts for joinery. Welds, glue, or other methods are not acceptable.
 3. Furnish extruded stiles and rails with integral reglets to accept face sheets. Lock face sheets into place to permit flush appearance.
 4. Rail caps or other face sheet capture methods are not acceptable.
 5. Extrude top and bottom rail legs for interlocking continuous weather bar.
 6. Meeting Stiles: Pile brush weather seals. Extrude meeting stile to include integral pocket to accept pile brush weather seals.
 7. Bottom of Door: Install bottom weather bar with nylon brush weatherstripping into extruded interlocking edge of bottom rail.
 8. Glue: Use of glue to bond sheet to core or extrusions is not acceptable

- E. Door Accessories:
1. Hardware: Refer to 08 71 00-Door Hardware
 2. Glazing, Glass Lites: Ensure glazing or glass lite support structures are weather sealed to prevent moisture and contaminants from entering. Allow for ready access for repair without affecting the sealed integrity of the cut-out in the door panel itself.
 3. Louvers:
 - a. Fabricate from suitable corrosion-resistant, polymer materials and be subject to the same performance guarantee as the door panels.
 - b. Inverted Y-type, fixed blade.
 - c. 12 inches minimum from bottom of door.
 - d. Insect screen.
 4. Transoms: Identical to doors in construction, material thickness, color, and reinforcement.
 5. Security Grate:
 - a. Frame perimeter: 1 inch by 1 inch by 1/8-inch steel angle.
 - b. Expanded metal, 1/4-inch diameter, round hole perforated, 14 gauge steel sheet.
 - c. Factory paint to match door finish.
- F. Fiberglass Frames:
1. Construct from fiberglass component parts and materials according to the manufacturer's standard method of construction.
 2. Reinforce with anchor blocks and prepare for the attachment of hinges, closers, exit devices and other hardware.
 3. Mortises shall be prepared by the factory.
 4. Hardware reinforcements shall be made from polymer materials unless alternates are approved:
 - a. Corner reinforcement: 4 inches by 4 inches by 5-3/8 inch by 1/4-inch pultruded fiberglass angle. Attach to head bar at factory using stainless steel countersunk screws or suitable polymer rivets.
 - b. Mortise hinge reinforcement: 1 1/2 inch by 7 inches by 1/2-inch-thick polymer. Attach to frame by means of bonding and stainless-steel countersunk screws.
 - c. Closer reinforcement: Same as mortise hinge reinforcement less screws.
 - d. Strike reinforcement: 1-1/2 inches by 9 inches by 3/4-inch-thick polymer material. Attach to head bar at factory using stainless steel countersunk screws or suitable polymer rivets.
- G. Frame Accessories:
1. Anchors:
 - a. Frame units shall be suitably prepared to meet the requirements of the adjacent construction.
 - b. Masonry construction: T-strap or wire anchors.
 - c. Stud Construction: FRP anchor blocks or compression anchors.
 - d. Foam adhesive/sealant: Provide continuous around frame at perimeter of each opening.

2. Frames Fabricated from Component Parts: Provide cap to cover exposed screw heads.
3. Frames that require masonry anchors and tabs shall be suitably prepared to ensure sound and reliable installation.

2.4 SHOP FINISHES

A. FRP and Steel:

1. Door and frame to shop primed and painted.
2. Color: As selected by Architect from manufacturer's full range of standard and optional colors, or as indicated on the Drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that doors and frames may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies:
 1. Immediately notify E/A in writing.
 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 3. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

A. Protection:

1. Protect installed work and materials of other trades.
2. Protect frames from scratches and other blemishes caused by construction of surrounding walls.

3.3 INSTALLATION

- A. Install doors and frames according to ANSI/SDI-100, and as specified in NFPA 80.
- B. Doors:
 1. No modifications shall be made to the doors without the manufacturer's explicit approval.
 2. Install door louvers plumb and level.
- C. Frames:
 1. Coordinate with wall construction for anchor placement.
 2. Coordinate installation of doors and frames with installation of glass and glazing and finish door hardware.
 3. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by E/A.

3.4 SITE TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.5 REPAIR/RESTORATION

- A. Touch up marred finishes but replace units that cannot be restored to factory-finished appearance.
- B. Use materials and procedures recommended or furnished by manufacturer.

3.6 ADJUSTING

- A. Adjust units to operate in proper manner and easily without binding.
- B. Replace damaged materials with new materials complying with specified requirements.

3.7 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from work of this section. Maintain premises in neat, orderly condition.
- B. System:
 - 1. Remove temporary covering and other provisions made to minimize soiling of other work.
 - 2. Clean exposed surfaces of doors and frames using materials and methods recommended by manufacturer.
 - 3. When work is completed, remove unused materials, containers, equipment, and debris.

3.8 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to manufacturer to ensure work is without damage or deterioration at time of Substantial Completion.

END OF SECTION 08 16 00

SECTION 08 31 13 – Access Doors and Frames

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Insulated, flat, translucent sandwich panel system.
 - 2. Structural grid.
 - 3. Battens and perimeter closure system including flashings.
 - 4. Translucent insulated plastic wall system accessories including, but not limited to:
 - a. Sealing tape.
 - b. Fasteners.
 - c. Insulation.
- B. Related Sections:
 - 1. Section 03 41 00 - Plant-Precast Structural Concrete
 - 2. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 3. Section 07 92 00 - Joint Sealants

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. AAMA:
 - 1. 1503 - Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections
 - 2. 2604 - High Performance Organic Coatings on Aluminum Extrusions and Panels
- B. ASTM:
 - 1. C297 - Test for Tensile Strength of Sandwich Construction
 - 2. D635 - Rate and Extent of Burning
 - 3. D1002 - Test for Shear Strength of Single Lap Joint Adhesively-Bonded Metal
 - 4. D1037 - Properties of Wood-Base Fiber and Particle Panel Materials
 - 5. D1183 - Resistance of Adhesives to Aging
 - 6. D2244 - Color Tolerances and Differences
 - 7. E84 - Surface Burning Characteristics
 - 8. E108 - Fire Tests of Roof Coverings

1.4 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. The translucent insulated panel system shall consist of factory prefabricated flat sandwich panels including installation by a manufacturer's authorized contractor.
 - 2. Manufacturer shall be responsible for the design, configuration and fabrication of the translucent wall system.

B. Performance Requirements:

1. The manufacturer shall be responsible for the configuration and fabrication of the complete panel system.
 - a. When requested, include span analysis data.
 - b. Standard panel system shall have less than 0.01 cfm/ft² air leakage by ASTM E 283 at 6.24 PSF (50 mph) and no water penetration by ASTM E 331 at 15 PSF; and structural testing by ASTM E 330.
 - c. Structural Loads: Provide system capable of handling the components and cladding loads indicated on the Drawings. System to meet design loads, either in the specifications or as indicated on the Drawings, whichever is greater.
2. Deflection Limits:
 - a. Walls: Limited to L/60 or X of clear span for each assembly component.
3. Thermal Movements:
 - a. Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1) Temperature Change (Range): 110 degrees F (43 degrees C), ambient; 150 degrees F (66 degrees C), material surfaces.

1.5 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings:
 1. Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections, details of components, joint locations and configurations within system and between system and adjoining system.
 2. Show details of fabrication and installation of panels, battens and closures.
- D. Samples:
 1. Initial Color Selection: Submit manufacturer's standard color samples for each type of finish with Product Data and Shop Drawings.
 - a. When requested, submit samples for each exposed finish required, in same thickness and material indicated for the work and in the size indicated below.
 - 1) Sandwich panels: 7 inch x 12 inch unit.
 - 2) Factory finished aluminum: 3 inch long sections.
 2. Color Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics. Include notification to E/A if selection is not within specified price range.
 3. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components if requested by E/A.
- E. Quality Assurance/Control Submittals:
 1. Test Reports: Certified by independent testing organization for each type and class of panel system. Reports shall verify that the materials will meet all performance requirements of this specification. Test reports required include:
 - a. ASTM E84: Flame Spread and Smoke Development
 - b. ASTM D635: Burn Extent

- c. ASTM D2244: Color Difference
 - d. ASTM C297, ASTM D1002: Bond Strength
 - e. ASTM D1037: Accelerated Aging
 - f. ASTM E108: Class "A" Roof System
- F. Maintenance Manual: Provide to Owner maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.

1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide translucent insulated wall and skylight system units made of components of standard construction furnished by 1 manufacturer as coordinated assemblies.
- B. Qualifications:
- 1. Manufacturer:
 - a. Ten (10) years experience in the manufacture of translucent insulated wall and skylight system, with six (6) projects of similar size, scope and type of which three (3) have been in successful use for five (5) years or longer.
 - b. Panel system must be listed by an ANSI accredited evaluation service, which requires quality control inspections and fire, structural, and water infiltration testing of sandwich panel systems by an accredited agency.
 - c. Quality control inspections shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components, and production sandwich panels for conformance with AC 177 "Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems" as issued by the ICC-ES.
 - 2. Installer: Installation shall be by an experienced installer, with 7 years experience in the installation of translucent insulated wall and skylight systems in projects of similar types and sizes.
 - 3. Personnel: For actual installation of translucent insulated wall and skylight system, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Certifications: Provide to E/A, certification of installer from manufacturer of translucent insulated wall and skylight system.
- D. Field Samples: If requested, furnish sample of each type of translucent insulated wall and skylight system to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.
- E. Regulatory Requirements:
- 1. Insulated wall and skylight system must be listed by the ICC Evaluation Service (ICC-ES) which requires quality control inspections and fire, structural, and water infiltration testing of sandwich panel systems by an approved agency.
 - 2. Quality control inspections and required testing shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components, and production sandwich panels for conformance with "Acceptance Criteria for Sandwich Panels" as regulated by the ICC-ES.
 - 3. Skylight system shall pass Class A Roof Burning Brand Test by ASTM E108 or be UL listed as a Class A Roof by UL 790.
- F. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver panel system, components, and materials in manufacturer's standard protective packaging.
- B. Store panels according to manufacturer's recommendations.
- C. Store panels on long edge, several inches above the ground, blocked and under cover to prevent warping.

1.8 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.9 WARRANTY

- A. Provide manufacturer's 10-year limited warranty covering color stability, delamination, and fiber bloom.
- B. Installer shall warrant system against water leakage and weather tightness for 10 years.
- C. Warranties shall be provided in writing.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Standard of Quality: Design is based on products of Kalwall Corporation, Manchester, NH www.kalwall.com
- B. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - 1. Major Industries, Wausau, WI www.majorskylights.com
 - 2. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

- A. Face Sheets:
 - 1. Glass fiber reinforced thermoset resins by insulated panel system fabricator for architectural use.
 - 2. Thermoplastic polycarbonate or acrylic faces are not acceptable.
 - 3. The exterior face shall have a permanent glass erosion barrier to provide maximum long term resistance to reinforcing fiber exposure. Plastic film overlays or coatings are not acceptable
 - 4. The exterior face shall have a self-cleaning thermoset acrylic urethane surface molecularly bonded under factory controlled conditions, and fully field restorable if worn or damaged. Tedlar film is not acceptable.
 - 5. Flammability:
 - a. The interior face sheet shall have a flame spread rating no greater than 50 and smoke developed no greater than 250 when tested according to ASTM E84.
 - b. Burn extent by ASTM D635 shall be no greater than 1 inch.
 - c. Faces shall not deform, deflect or drip when subject to fire or flame.
 - 6. Weatherability: The full thickness of the exterior face shall not change color more than 3.0 Adams Units (Delta E by ASTM D2244) after 5 years outdoor South Florida weathering at 7 degrees facing south, determined by the average of at least 3 white samples without a protective film or coating to ensure maximum, long term stability.

7. Appearance:
 - a. Face sheets shall be uniform in color to prevent splotchy appearance.
 - b. Faces shall be completely free of ridges and wrinkles that prevent proper surface contact in bonding to the aluminum grid core.
 - c. Clusters of air bubbles/pinholes that collect dirt and moisture will not be acceptable.
 8. Strength: The exterior face sheet shall be uniform in strength and repel an impact equal to 70 foot pounds without fracture or tear according to SPI Shatter Resistance Test.
- B. Structural I-Beam Grid:
1. Thermally broken aluminum of 6063-T6 or 6005-T5 alloy.
 2. Provide for mechanical interlocking of muntin-mullion and perimeter to prevent high and low intersections which do not allow full bonding surface to contact with face material.
 3. Width: No less than 7/16 inch.
 4. Machined to tolerances of not greater than plus or minus 0.002 inch.
 5. Thermal Break: Minimum 1 inch.
- C. Battens and Perimeter Closure System:
1. Extruded 6063-T6 and 6063-T5 aluminum screw clamp-tight closure system.
 2. Curved closure system may be roll formed.
 3. Thermal break perimeter systems shall be factory prefabricated with perimeter closures factory sealed to panels.
 4. "U" = 0.50 or less.
 5. Fasteners: 300 series stainless steel screws (excluding final fasteners to the building).
 6. Flexible Sealing Tape: Manufacturer's standard pre-applied to closure system at the factory under controlled conditions.
- D. Laminate Adhesives:
1. Heat and pressure resin type engineered for structural sandwich panel use.
 2. Adhesive shall pass testing requirements specified by ICBO "Acceptance Criteria for Sandwich Panel Adhesive"
 3. Minimum Strength:
 - a. 750 PSI tensile strength by ASTM C297 after 2 exposures to 6 cycles each of the aging conditions prescribed by ASTM D1037.
 - b. 500 PSI shear strength average of 5 exposures per ASTM D1002:
 - 1) 50 percent relative humidity at 73 degrees F: 540 PSI.
 - 2) Accelerated aging by ASTM D1183 at room temperature: 800 PSI.
 - 3) 182 degrees F: 100 PSI.
 - 4) 500 hour oxygen bomb by ASTM D572: 1400 PSI.
- E. Condensation Drip Flashing:
1. Include manufacturer's condensation flashing at sill of translucent wall panel.
 2. Drain flashing to exterior.
 3. Color: As selected by E/A from manufacturer's standard range of colors.

- F. Other Materials: Other materials not specifically described but required for complete, proper installation of translucent insulated wall and skylight system, subject to acceptance of E/A.

2.3 FABRICATION

A. Panels:

1. Sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking thermally broken aluminum I-beams.
2. Adhesive bonding line to be straight, cover the entire width of the I-beam, and have a neat, sharp edge.
3. Thickness: 2-3/4 inches.
4. Insulation: U factor 0.23 thermally broken.
5. Light Transmission: 20 percent.
6. Shading Coefficient: 0.12.
7. Thermally Broken Panels:
 - a. Minimum Condensation Resistance Factor of 80 as measured by AAMA 1503 on the bond line.
 - b. Minimum CRF of 90 at center of grid cell.
8. Grid Pattern: Verti-Kal™, 10 inch nominal spacing.
9. To ensure bonding strength, white spots at intersections of muntins and mullions shall not exceed 4 for each 40 square feet of panel, nor shall they be more than 3/64 inch in width.

B. Aluminum Clamp-Tite Installation System:

1. Thermally broken-flat clamp-tite screw type closure system shall be of extruded aluminum alloy and temper as recommended by manufacturer.
2. Sealing tape: Manufacturer's standard, pre-applied to aluminum clamp-tite installation system at the factory under controlled conditions.
3. Fasteners: 300 series stainless steel screws for aluminum clamp-tite installation system, excluding final fasteners to the building.

2.4 FINISHES

- A. All exposed aluminum to be acrylic/ urethane-based copolymer corrosion resistant finish.
- B. Meet performance requirements of ANSI/AAMA 2604.
- C. Aluminum Clamp-Tite Installation System:
1. Factory applied finish meeting the performance requirements of AAMA 2604.
 2. Color as selected by E/A from manufacturer's full range of colors.
- D. Face Sheets:
1. Uniform in appearance.
 2. Color:
 - a. Exterior face sheets: Ice Blue.
 - b. Interior face sheets: Crystal.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.

- B. Verification of Conditions: Verify that system may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies:
 - 1. Immediately notify E/A in writing.
 - 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 - 3. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or apply sealant or tape recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturer.
 - 3. Where aluminum will contact pressure-treated wood, separate dissimilar materials by methods recommended by manufacturer.

3.3 INSTALLATION

- A. Install translucent panel system in strict accordance with approved Shop Drawings as supplied by manufacturer.
- B. Anchor component parts securely in place by permanent mechanical attachment system and to accommodate thermal and mechanical movements.
- C. Set sill and curb members in a full bed of sealant compound, or with joint fillers or gaskets to provide weather-tight construction.
- D. Install joint sealants at perimeter joints and within panel system according to manufacturer's installation instructions.
- E. Clean aluminum before sealants are applied.

3.4 FIELD QUALITY CONTROL

- A. Water Test: Test according to procedures in AAMA 501.
- B. After other trades have completed work on adjacent material, carefully inspect translucent panel installation and touch up marred finishes, but replace units that cannot be restored to factory-finished appearance.

3.5 ADJUSTING

- A. Make adjustments necessary to ensure proper installation and weather-tight conditions.

3.6 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from work of this section. Maintain premises in neat, orderly condition.
- B. System: Clean inside and outside of system surfaces using materials and methods recommended by manufacturer.

3.07 DEMONSTRATION

- A. Maintenance Instructions: Manufacturer's representative to schedule and attend meeting with Owner's representatives to explain:
 - 1. Maintenance and Care Instructions.
 - 2. Recommended Maintenance Program.
 - 3. Warranty Requirements.

END OF SECTION 08 31 13

SECTION 08 36 13 – Sectional Steel Overhead Doors

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Insulated overhead door.
 - 2. Track assemblies.
 - 3. Electric Door Operators.
 - 4. Primary Entrapment Protection Devices.
 - 5. Accessories including, but not limited to:
 - a. Weather seals.
 - b. Vision panels.
 - c. LED stop and go lights.
- B. Related Sections:
 - 1. Section 03 41 00 - Plant-Precast Structural Concrete
 - 2. Section 05 50 00 - Metal Fabrications
 - 3. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 4. Section 07 92 00 - Joint Sealant
 - 5. Section 09 91 00 - Painting
 - 6. Division 26 - Electrical

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. A653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot Dip Process
 - 2. B209/209M - Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - 3. B221/221M – Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
- B. AAMA 2604 - Powder Coatings
- C. DASMA TDS-163 - U-factor and R-value for Residential and Commercial Garage Doors
- D. ANSI/DASMA 102 - Specifications for Sectional Doors

1.4 SYSTEM DESCRIPTION

- A. Design Requirements: Provide insulated overhead doors, track assemblies, electric door operators, primary entrapment devices, and traffic lights.
- B. Performance Requirements:
 - 1. Design doors to withstand positive and negative wind loads as calculated according to applicable building code, and as indicated on the Drawings.

1.5 SUBMITTALS

- A. Per Section 01 33 00 Submittal Procedures
- B. Product Data: Manufacturer's current Product Data, including specifications, handling, storage and installation instructions, nameplate data and ratings for motors, and maintenance recommendations.
- C. Name of installer if other than sectional overhead door supplier. Only door supplier shall install doors except with written permission of E/A.
- D. Shop Drawings, including configurations between system and adjoining system.
 - 1. Complete list of all materials, including bearings and bracings.
 - 2. Inserts, anchorages to be set in concrete or built into masonry for installation of units, with setting drawings, templates, and directions for installation. See concrete and masonry sections for installation.
- E. Samples:
 - 1. Initial Selection: Submit manufacturer's standard color samples for each type of finish with Product Data and Shop Drawings.
 - 2. Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics. Include notification to E/A if selection is not within specified price range.
- F. Quality Assurance/Control Submittals:
 - 1. Test Reports from Independent Testing Laboratories: True U-Value of door section.
 - 2. Certificates: Installed door complies with performance requirements.

1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide sectional overhead door units made of components of standard construction furnished by one manufacturer as coordinated assembly.
- B. Certifications:
 - 1. Manufacturer: 10 years experience in the manufacture of sectional overhead doors.
 - 2. Contractor: 5 years experience in the installation of sectional overhead doors, and authorized by the door manufacturer.
 - 3. Personnel: For actual installation of sectional overhead doors, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Certifications: Provide to E/A, certification of installer from manufacturer of sectional overhead doors will fit and operate for the life of the door warranty.
- D. Regulatory Requirements: Meet OSHA requirement for state in which project is located.
- E. Field Samples: If requested, furnish corner section of each type of sectional overhead door to E/A for review prior to manufacture/installation.
- F. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.7 PROJECT CONDITIONS

- A. Existing Conditions: Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.8 WARRANTY

- A. Door materials, workmanship, and operation shall be guaranteed for a period of one year from Substantial Completion. The contractor shall pay for service trips.

- B. Manufacturer's Limited Warranty:
 - 1. Standard finish warranty against cracking, checking, or peeling for 10 years.
 - 2. Custom color finish limited warranty period for 5 years.
 - 3. Delamination warranty for 10 years.
 - 4. Parts and hardware for 1 year.
 - 5. Extended 8 year hardware warranty option.
- C. The finish shall be guaranteed against rusting on any installed door for a period of one year from Substantial Completion.

1.9 MAINTENANCE

- A. Extra Materials:
 - 1. Provide for maintenance purposes, 6 units of each type, size, of roller installed.
 - 2. Furnish from same production run as materials installed.
 - 3. Package and mark to identify building and material type and color.
 - 4. Deliver and store where directed by Owner.
- B. Maintenance Service: Service on a regular basis (minimum two times) for a period of one year.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Industrial Grade Exterior Doors:
 - 1. Standard of Quality for design is based on Clopay Doors, Model 3722, Cincinnati, OH www.clopaydoor.com
 - 2. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - a. Midland Garage Door Mfg. Co. of Chaska, MN
www.midlandgaragedoor.com 2-Inch ThermoGuard Door
 - b. Overhead Door Company, Dallas TX www.overheaddoor.com
Thermacore Door Model 850
 - c. Wayne-Dalton Corp., Mt. Hope, OH www.wayne-dalton.com
Thermospan 200-20
 - d. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.
- B. Electric Door Operators:
 - 1. Jack Shaft Type Operators:
 - a. Standard of Quality for design is based on Overhead Door Company, Model RSX, Dallas TX www.overheaddoor.com
 - b. Other Acceptable Manufacturer's: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - 1) Nice North America, Carlsbad, CA www.na.niceforyou.com
 - 2) Manufacturer of comparable products submitted in compliance with Division 1 Specifications.
 - 2. Trolley Type Operators:
 - a. Standard of Quality for design is based on Overhead Door Company, Model RSX, Dallas TX www.overheaddoor.com

- b. Other Acceptable Manufacturer's: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - 1) Nice North America, Carlsbad, CA www.na.niceforyou.com
 - 2) Manufacturer of comparable products submitted in compliance with Division 1 Specifications.
 - C. Primary Entrapment Protection Devices:
 - 1. Standard or Quality for design is based on products by Miller Edge, Model MLC-K36, West Grove, PA www.milleredge.com
 - 2. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - a. Assa Abloy, www.assaabloyentrance.com
 - b. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.

2.2 DOORS

- A. Industrial Grade Flush Steel Doors, Thermally Broken, Polyurethane Insulated
 - 1. Door Panel Construction:
 - a. Panels: Foamed in place polyurethane core construction between exterior and interior steel skins.
 - b. Steel Skins:
 - 1) Formed from roll formed commercial or drawing quality steel sheet.
 - 2) Hot-dip galvanized per ASTM A924/A942M and ASTM A653/A653M.
 - 3) Pre-painted with primer and baked on polyester topcoat.
 - 4) Sections formed to create weather tight tongue-in-groove meeting joint.
 - c. Reinforcing:
 - 1) Galvanized and primed steel reinforcement located under each hinge location, pre-punched for hinge attachment.
 - d. Provide stiffeners on panels to eliminate any thermal warping or bowing at exterior doors.
 - 2. Premium Duty Door Construction:
 - a. Style: Flush steel doors, thermally broken, polyurethane insulated.
 - b. Overall Panel Thickness: 2 inches.
 - c. Steel Skin Thickness: Minimum 20 gauge 0.034 inch exterior, minimum 27 gauge 0.016 inch interior.
 - d. End Stiles:
 - 1) Galvanized steel end stiles, with pre-punched holes for hardware attachment.
 - 2) Minimum 18 gauge, 0.045 inch thick for single end hinge style and 16 gauge 0.056 inch minimum for double end hinge style.
 - e. Astragal: U-shaped flexible PVC in retainer of full-length 0.055 inch rigid PVC.
 - f. Insulation:
 - 1) Insulate inner core of steel sections with high-density polyurethane foam-type insulation.

- 2) Seal ends and exposed insulation to protect from moisture.
- 3) Enclose insulation with manufacturer's standard steel sheet secured to door panel.
- 4) Minimum R-value: 18.4 according to DASMA TDS-163.
- 5) CFC-free and HCFC-free polyurethane, full encapsulated.
- g. International Energy Code:
 - 1) ASTM E283-12
 - 2) ANSI/DASMA 105-2012
 - 3) U-Factor: 0.16
 - 4) Air Infiltration: 0.022 cfm @ 25 mph.
- h. Finish:
 - 1) Flush stucco embossed texture, white interior color.
 - 2) Exterior color: Color to be selected by E/A from full range of colors or as indicated on the Drawings.
- i. Weatherstripping: Provide complete perimeter seals. Provide flexible top seal, flexible jamb seal and U shaped bottom seal.
- 3. Track Assemblies:
 - a. Furnish standard, low headroom, high lift, or full vertical lift track assemblies as indicated on the Drawings, with galvanized steel mounting angles.
 - b. Track: Heavy-duty, double-angle, 11-gauge galvanized steel.
 - c. Support and brace horizontal track at two (2) places on each side (double back hung), and cross brace.
 - d. On high-lift doors, provide alignment support of vertical track extension at joint with radius track via diagonal wall brace or other approved means.
 - e. Provide low headroom kit.
 - f. Vertical tracks minimum 0.061 inch galvanized steel tapered and mounted for wedge type closing.
 - g. Horizontal tracks minimum 0.075 inch galvanized steel, reinforced with minimum 0.0897 inch galvanized steel angles as required:
- 4. Track Width: 3" track as indicated.
- 5. Provide standard lift track, unless noted otherwise on the Drawings.
- 6. Spring Counterbalance:
 - a. Torsion spring counterbalance mechanism sized to weight of the door, with high strength galvanized aircraft cable with minimum 7 to 1 safety factor.
 - b. Standard Cycle Spring: 10,000 cycle.

2.3 ELECTRIC DOOR OPERATORS

- A. Door operation shall be standard, low headroom, high lift, or full vertical lift to match track assembly, as indicated on the Drawings. Door operator type to coordinate with track assembly.
- B. Jack Shaft Type Electric Door Operators:
 - 1. Adjustable disc friction-type clutch, instant reversing contactor, starter, manual reset overload protection, limit switch and heavy duty solenoid actuated brake.

2. Quick disconnect for emergency operation. Extend quick disconnect through a minimum of two eyelets down to approximately 6 feet above finish floor using 5/32 inch diameter cable with 6 inch loop at bottom end.
 3. Control circuit, 24 volt. Control station shall be 3-button momentary contact open/stop/ hold close, fully guarded.
 4. Jack shaft type:
 - a. Industrial duty jack shaft operator; 208 volt, 3 phase, 3/4 HP minimum (Verify and coordinate with the information located in the electrical plans / specifications and with the electrical contractor. Contractors who do not verify such information will be subject to all costs associated with making all overhead doors operational.)
 - b. UL-Listed or approved equivalent.
 5. Door Drive: Full #48 roller chain with emergency disconnect for manual door operation.
 6. Radio Transmitter: Logic 5.0 on-board; accept Security+ 2.0 rolling code technology remote controls and binary DIP switch remote controls.
- C. Trolley Type Electric Door Operators:
1. Industrial-Duty Operator: Continuous-duty, high-starting torque motor with overload protection and emergency disconnect for manual door operation.
 - a. Electric Operator: Industrial-duty assembly, cULus listed and cULus labeled, complete with electric motor and factory-prewired motor controls, internal auxiliary reversal circuit, 3-button open/close/stop control station, conduit-encased wiring from control circuit to motor, and accessories required for proper operation; operator shall be capable of driving door at a speed of approximately 8 to 12 inches per second. Vertical operator profile shall not exceed 12 inches.
 - b. Drive Reduction: Heavy-duty 5L V-belt and chain/sprocket secondary; all reduction sprockets and pulleys shall be drilled and pinned to steel shafts plated for resistance to corrosion; operator shall be equipped with permanently lubricated ball bearings on output shaft, adjustable friction clutch and quick-disconnect door arm to facilitate manual operation.
 - c. Brake: Electric solenoid-actuated brake capable of stopping and holding a door at any position.
 - d. Limit Switches: Fully adjustable, linear-driven limit mechanism synchronizing operator with door; low-friction nylon limit nuts fitted on threaded steel shaft that rotates on oil-tight self-lubricating bronze bushings; motor shall be removable without affecting limit switch settings.
 - e. Electric Motor: High-starting torque, continuous-duty, industrial-type protected against overload by current sensing and thermal overload devices. For 3-phase applications, incoming voltage field-selectable between 208V, 230V and 460V 60 Hz by properly positioning connector.
 - 1) Motor Specification: 208/230/460V 60 Hz, 3-phase, 1/2 HP
 - f. Motor Control and Enclosure: UL-approved microprocessor solid-state type and shall include the capability to select one of seven (7) wiring types; additional features shall include a maintenance alert diagnostic system, programmable Timer-to-Close with timer defeat input, mid-stop programming capabilities and a maximum run timer to provide motor overrun protection; motor control shall be housed in a NEMA 1 enclosure integral to the operator and shall conform to ANSI/NEMA ICS 6.

- g. Radio Receiver: On-board, 3-channel receiver with standard external antenna; equipped to accept Security+ 2.0 Rolling Code Technology remote controls and trinary DIP switch remote controls. Tri-band frequency (310/315/390 MHz) sends multiple radio signals to bypass radio interference.
 - h. Trolley Assembly: 2 inches H x 2 inches W galvanized steel angle rails with cast aluminum trolley including plated steel rail spacers with a nylon chain-guide assembly.
 - i. Door Drive: Full #48 roller chain with emergency disconnect for manual door operation.
 - D. Control Units
 - 1. 3-Button Control Station: 3-button station providing open/close/stop functionality shall be NEMA Type 1 with maintenance alert indicator to signal intervals for routine door and operator maintenance.
- 2.4 PRIMARY ENTRAPMENT PROTECTION DEVICES
- A. All accessories to be compatible with electric door operator. Contractor is responsible for ensuring entire system operates as intended.
 - B. Photo Sensors:
 - 1. Monitored Light Curtain:
 - a. Non-contact, photo beam reversing sensor system.
 - b. One pair of through-beam photo eyes.
 - c. UL-325
 - d. 36 inches high.
- 2.5 ACCESSORIES
- A. Weather Seals:
 - 1. Continuous, rubber, neoprene, or flexible vinyl adjustable weatherstrip gasket at top.
 - 2. Tube seals between panel sections.
 - 3. Compressible astragal on bottom.
 - 4. Continuous flexible seals at door jamb edges for fully weather-tight installation.
 - B. Vision Panels:
 - 1. Provide factory-installed, clear double-glazed acrylic lights with minimum 1/4-inch air space per door on sectional steel overhead doors. See plans for the number and layout of acrylic lights and vision panels.
 - 2. Size: Minimum 23 inches by 8 inches in number as indicated on the Drawings.
 - 3. Set lights in a sealed extruded rubber gasket sealed in door section.
 - C. LED Stop and Go Lights:
 - 1. All accessories to be compatible with electric door operator. Contractor is responsible for ensuring entire system operates as intended.
 - 2. Two position LED traffic signal in polycarbonate enclosure.
 - 3. 8 inch diameter lenses.
 - 4. Rotate-to-lock visors.
 - 5. Product and locations as indicated on the Drawings.
 - D. Other materials not specifically described but required for complete, proper installation of sectional overhead doors, subject to acceptance of E/A.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that sectional overhead doors may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies:
 - 1. Immediately notify E/A.
 - 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 - 3. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.

3.3 INSTALLATION

- A. Track Assemblies:
 - 1. Slope tracks at proper angle from vertical, or otherwise design to ensure tight closure at jambs when door unit is closed.
 - 2. Weld or bolt to track supports.
 - 3. Fasten vertical track assembly to framing at not less than 24 inches on center.
 - 4. Hang horizontal track from structural overhead framing with angle or channel hangers, welded and bolt-fastened in place.
 - 5. Provide sway bracing, diagonal bracing, and reinforcing as required for rigid installation of track, door-operating equipment.
 - 6. Secure, reinforce, and support as required for size; weighted to provide strength, rigidity, to ensure against sag, sway, detrimental vibration during opening, closing of doors.
 - 7. Support, attach tracks at opening jambs with continuous angle welded to tracks and attached to wall.
 - 8. Support horizontal (ceiling) tracks with continuous angle welded to track, supported by laterally-braced attachments to overhead structural members at curve and end of tracks.
 - 9. Install horizontal tracks or high lift doors at 1'-0" maximum from bottom of roof structure.
- B. Safety Protection: Install as required for proper operation of safety equipment specified.

3.4 REPAIR/RESTORATION

- A. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance.
- B. Use materials and procedures recommended or furnished by manufacturer.

3.5 ADJUSTING

- A. Upon completion of installation, including work by other trades, lubricate, test, and adjust doors to operate easily, free from warp, twist, and distortion; and provide a weather-tight fit for the entire perimeter.

3.6 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from work of this section. Maintain premises in neat, orderly condition.
- B. System: Clean exposed surfaces of sectional overhead doors using materials and methods recommended by manufacturer.

- C. Labels: Upon completion of cleaning, provide and attach label to each door indicating name of manufacturer and name of installing contractor.

3.7 DEMONSTRATION

- A. Startup Services: Provide the services of a factory-authorized service representative to provide start-up service and to demonstrate and train Owner's representative:
 - 1. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
 - 2. Train Owner's representative on procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventative maintenance.
 - 3. Review data in the "Operating and Maintenance Manual".
- B. Maintenance Instructions: Manufacturer's representative to schedule and attend meeting with Owner's representatives to explain:
 - 1. Maintenance and Care Instructions.
 - 2. Recommended Maintenance Program.
 - 3. Warranty Requirements.

3.8 PROTECTION

- A. Protect installed doors from damage prior to acceptance by Owner.

3.9 SCHEDULES

- A. See Door Types located on Drawings.

END OF SECTION 08 36 13

SECTION 08 41 13 – Aluminum Entrance Doors

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Aluminum Framed Entrance Doors:
 - a. Wide stile, 5" (127 mm) vertical face dimension, 1-3/4" (44.5 mm) depth, high traffic applications.
 - 2. Aluminum Door accessories required for a complete installation.
 - 3. Hardware (see Section 08 71 00 – Door Hardware for basis of door hardware requirements.)
- B. The following is not provided in this section:
 - 1. Glazing (Section 08 80 00)
- C. Related Sections:
 - 1. Section 07 92 00 -Joint Sealants
 - 2. Section 08 43 13 - Aluminum-Framed Storefront
 - 3. Section 08 70 00 - Door Hardware
 - 4. Section 08 80 00 - Glazing

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 DEFINITIONS

- A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufacturers Association (AAMA) – AAMA Glossary (AAMA AG).

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Aluminum-framed entrance system shall withstand the effects of the following performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Aluminum Framed Entrance Performance Requirements:
 - 1. Air Infiltration: For single acting offset pivot or butt hung entrances in the closed and locked position, the test specimen shall be tested according to ASTM E 283 at a pressure differential of 1.57 psf (75 PA) for single and pairs of doors. A single 3'0" x 7'0" (915 mm x 2134 mm) entrance door and frame shall not exceed 1.0 cfm/ft². A pair of 6'0" x 7'0" (1830 mm x 2134 mm) entrance doors and frame shall not exceed 1.0 cfm/ft².
 - 2. Structural Performance: Corner strength shall be tested per the Kawneer dual moment load test procedure and certified by an independent testing laboratory to ensure weld compliance and corner integrity [Testing procedure and certified test results available upon request].

1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, and fabrication methods, dimensions of individual components and profiles, hardware, finishes, and installation instructions for each type of aluminum-framed entrance door indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, and attachments to other work, operational clearances and installation details.
- C. Physical Samples for Initial Selection: Physical samples of finishes specified/required for all products specified in this section.
- D. Samples for Verification: For aluminum-framed entrance door and components required.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type of aluminum-framed entrance doors.
- F. Fabrication Sample: Corner sample consisting of a door stile and rail, of full-size components and showing details of the following:
 - 1. Joinery, including welds.
 - 2. Glazing.
- G. Other Action Submittals:
 - 1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An installer which has had successful experience with installation of the same or similar units required for the project and other projects of similar size and scope.
- B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum-framed entrance doors and storefronts that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.
- C. Source Limitations: Obtain aluminum-framed entrance door through one source from a single manufacturer. Obtain each type and variety of aluminum, steel and wood door hardware from the same manufacturer, unless otherwise indicated.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum-framed entrance doors and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements". Do not modify size and dimensional requirements.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup for type(s) of swing entrance door(s) indicated, in location(s) shown on Drawings.
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination".

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of aluminum-framed entrance door openings by field measurements before fabrication and indicate field measurements on Shop Drawings.

1.8 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product:
1. Kawneer Company Inc., Norcross, GA www.kawneer.com
 2. The door stile and rail face dimensions of the [500] entrance door will be as follows:

Door	Vertical Stile	Top Rail	Bottom Rail	Optional Bottom Rail
190	2-1/8" (54 mm)	2-1/4" (58 mm)	3-7/8" (99 mm)	10" (254 mm)
350	3-1/2" (89 mm)	3-1/2" (89 mm)	6-1/2" (166 mm)	10" (254 mm)
500	5" (127 mm)	5" (127 mm)	6-1/2" (166 mm)	10" (254 mm)
 3. Major portions of the door members to be 0.125" (3.2) nominal in thickness and glazing molding to be 0.05" (1.3) thick.
 4. Glazing gaskets shall be either EPDM elastomeric extrusions or a thermoplastic elastomer.
 5. Provide adjustable glass jacks to help center the glass in the door opening.
- B. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers are:
1. Oldcastle Building Envelope (OBE), Terrell, TX www.obe.com
 2. CMI Architectural Products, Inc., Minneapolis, MN www.cmiarch.com
 3. Tubelite, Reed City, MI www.tubeliteinc.com
 4. Member of AAMA, manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.2 MATERIALS

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum-framed entrance door manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.090" (2.3 mm) wall thickness at any location for the main frame and door leaf members.
- B. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum-framed entrance door members, trim hardware, anchors, and other components.
- C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semi-rigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.

2.3 FRAMING SYSTEM

- A. Entrance Framing:
 - 1. Kawneer 451 / 451T Wall System.
- B. Non-Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposed shall be stainless steel.
- D. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
- E. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- F. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

2.4 GLAZING

- A. Glazing: As specified in Division 08 Section "Glazing".
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type

2.5 HARDWARE

- A. General: All hardware including cylinders shall be supplied by section 08-7100 for installation in Section 08-4113. Aluminum door and frame supplier shall supply weatherstrip. (Supply Aluminum door and frame manufacturers heavy-duty weatherstrip and sweeps.) Hardware as specified in Section 08 71 00 – Door Hardware.

2.6 FABRICATION

- A. Fabricate aluminum-framed entrance doors in sizes indicated. Include a complete system for assembling components and anchoring doors.
- B. Fabricate aluminum-framed glass doors that are reglazable without dismantling perimeter framing.
 - 1. Door corner construction shall consist of mechanical clip fastening, SIGMA deep penetration plug welds and 1-1/8" (29 mm) long fillet welds inside and outside of all four corners. Glazing stops shall be hook-in type with EPDM glazing gaskets reinforced with non-stretchable cord.
 - 2. Accurately fit and secure joints and corners. Make joints hairline in appearance.
 - 3. Prepare components with internal reinforcement for door hardware.
 - 4. Arrange fasteners and attachments to conceal from view.
- C. Weather-stripping: Provide weather-stripping locked into extruded grooves in door panels or frames as indicated on manufacturer's drawings and details.

2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Factory Finishing:
 - 1. Kawneer Permafluor™ (70% PVDF), AAMA 2605, Fluoropolymer Coating. Color as selected by Architect and Owner from full range of available colors, or as indicated on the Drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated installation.
 - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
 - 2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76.2 mm) of opening.
 - 3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum-framed entrance doors, hardware, accessories, and other components.
- B. Install aluminum-framed entrance doors level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill threshold in bed of sealant, as indicated, for weather tight construction.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Upon Owner's written request, provide periodic site visit by manufacturer's field service representative.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean aluminum surfaces immediately after installing aluminum-framed entrance doors. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- B. Clean glass immediately after installation. Comply with glass manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08 41 13

SECTION 08 43 13 – Aluminum Framed Storefront

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Aluminum Framing Systems:
 - a. Storefront-type framing system.
 - b. Frames for entrances.
 - 2. Aluminum storefront accessories including, but not limited to:
 - a. Joint sealants for aluminum entrances and storefront.
 - b. Anchors and attachment devices.
 - c. Weatherstripping.
- B. The following are not included in this section:
 - 1. Exterior entrance and interior vestibule doors
 - 2. Door Hardware
 - 3. Glazing.
- C. Related Sections:
 - 1. Section 07 92 00 -Joint Sealants
 - 2. Section 08 41 13 - Aluminum Entrance Doors
 - 3. Section 08 71 00 - Door Hardware
 - 4. Section 08 80 00 - Glazing

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 DEFINITIONS

- A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufacturers Association (AAMA) – AAMA Glossary (AAMA AG).

1.4 PERFORMANCE REQUIREMENTS

- A. Storefront System Performance Requirements:
 - 1. Air Leakage: The test specimen shall be tested according to ASTM E 283. Air Leakage rate shall not exceed 0.06 cfm/ft² (0.3 l/s · m²) at a static air pressure differential of 6.2 psf (300 Pa) with interior seal, or, rate shall not exceed 0.06 cfm/ft² (0.3 l/s · m²) at a static air pressure differential of 1.6 psf (75 Pa) without interior seal. CSA A440 Fixed Rating.
 - 2. Water Resistance: The test specimen shall be tested according to ASTM E 331. There shall be no leakage at a minimum static air pressure differential of 12 psf (383 Pa) as defined in AAMA 501.

3. Uniform Load: A static air design load of 40 psf (1680 Pa) shall be applied in the positive and negative direction according to ASTM E 330. There shall be no deflection in excess of $L/175$ of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
4. Seismic: When tested to AAMA 501.4, system must meet design displacement of $0.010 \times$ the story height and ultimate displacement of $1.5 \times$ the design displacement.
5. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:
 - a. Temperature Change (Range): 0 deg F (-18 deg C); 180 deg F (82 deg C).
 - b. Test Interior Ambient-Air Temperature: [75 deg F (24 deg C)] .
 - c. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5 for a minimum 3 cycles.
6. Condensation Resistance (CRF): When tested to AAMA Specification 1503, the condensation resistance factor shall not be less than:
 - a. Glass to Exterior – 71frame and 71glass (low-e) or 69frame and 58glass (clear).
7. Sound Transmission Class (STC) and Outdoor-Indoor Transmission Class (OITC): When tested to AAMA Specification 1801 and according to ASTM E1425 and ASTM E90, the STC and OITC Rating shall not be less than:
 - a. Glass to Exterior – 31 (STC) and 31 (OITC).
8. Windborne-Debris-Impact Resistance Performance: Shall be tested according to ASTM E 1886, information in ASTM E 1996 and TAS 201/203.
 - a. Large-Missile Impact: For aluminum-framed systems located within 30 feet (9.1 m) of grade.
 - b. Small-Missile Impact: For aluminum-framed systems located above 30 feet (9.1 m) of grade.
9. Blast Mitigation Performance: Shall be tested or proven through analysis to meet ASTM F1642, GSA-TS01, and UFC 04-010.01 performance criteria.
10. To meet UFC 04-010.01, B-3.1 Standard 10 for Windows and Skylights, the following options are available:
 - a. Section B-3.1.1 Dynamic analysis.
 - b. Section B-3.1.2 Testing.
 - c. Section B-3.1.3 ASTM F2248 Design Approach.
11. Environmental Product Declarations (EPD): Shall have a Type III product specific EPD created from a Product Category Rule specific to North America.
12. Material Ingredient Reporting: Shall have a complete list of chemical ingredients to at least 100ppm (0.01%) that covers 100% of the product, acceptable documentation includes:
 - a. Manufacturer's inventory with Chemical Abstract Service Registration Number (CASRN or CAS#).
 - 1) Kawneer's Material Transparency Summary (MTS).

- b. (Trifab™ 451T) Cradle to Cradle certification: Either document below is acceptable for this option.
 - 1) Cradle to Cradle Certified™ with Material Health section Silver or above.
 - 2) Silver level or above Material Health Certificate.
- c. Red List Free DECLARE label.

1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, hardware, finishes, and installation instructions for each type of aluminum-framed storefront system indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware, and attachments to other work, operational clearances and installation details.
- C. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.
- D. Samples for Verification: For aluminum-framed storefront system and components required.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type of aluminum-framed storefront.
- F. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12" (304.8 mm) lengths of full-size components and showing details of the following:
 - 1. Joinery.
 - 2. Anchorage.
 - 3. Expansion provisions.
 - 4. Glazing.
 - 5. Flashing and drainage.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An installer which has had successful experience with installation of the same or similar units required for the project and other projects of similar size and scope.
- B. Manufacturer Qualifications: A manufacturer capable of providing aluminum-framed storefront system that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.
- C. Source Limitations: Obtain aluminum-framed storefront system through one source from a single manufacturer. Product can be composed of up to 40% recycled material.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum-framed storefront system and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements". Do not modify size and dimensional requirements.
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup for type(s) of storefront elevation(s) indicated, in location(s) shown on Drawings.
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination".

- G. Structural-Sealant Glazing: Comply with ASTM C 1401, "Guide for Structural Sealant Glazing" for design and installation of structural-sealant-glazed systems.
 - H. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.
- 1.7 PROJECT CONDITIONS
- A. Field Measurements: Verify actual dimensions of aluminum-framed storefront openings by field measurements before fabrication and indicate field measurements on Shop Drawings.
- 1.8 WARRANTY
- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty.
 - 1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product:
 - 1. Kawneer Company Inc., Norcross, GA www.kawneer.com
 - a. Trifab VG 451 Framing System – 2" x 4-1/2" Non-Thermal Center Glazed, Screw Spline.
 - b. Trifab VG 451T Framing System – 2" x 4-1/2" Thermal Center Glazed, Screw Spline.
- B. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers are:
 - 1. Oldcastle Building Envelope (OBE), Terrell, TX www.obe.com
 - 2. CMI Architectural Products, Inc., Minneapolis, MN www.cmiarch.com
 - 3. Tubelite, Reed City, MI www.tubeliteinc.com
 - 4. Member of AAMA, manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.2 MATERIALS

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum storefront manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" (1.8 mm) wall thickness at any location for the main frame and complying with ASTM B 221: 6063-T6 alloy and temper.
 - 1. Recycled Content:
 - a. Provide documentation that aluminum has a minimum of 50% mixed pre- and post-consumer recycled content with a sample document illustrating project specific information that will be provided after product shipment.
 - b. Once product has shipped, provide project specific recycled content information, including:
 - 1) Indicate recycled content; indicate percentage of pre- and post-consumer recycled content per unit of product.
 - 2) Indicate relative dollar value of recycled content product to total dollar value of product included in project.
 - 3) Indicate location recovery of recycled content.
 - 4) Indicate location of manufacturing facility.

- B. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum framing members, trim hardware, anchors, and other components, including the components that framing will be attached and fastened to.
- C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.
- E. Sealant: For sealants required within fabricated storefront system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.
- F. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.

2.3 STOREFRONT FRAMING SYSTEM

- A. Kawneer Trifab VG 451 and VG 451T.
 - 1. 451T – Kawneer Isolock
 - a. Thermal Break with ¼" separation consisting of a two-part chemically curing, high density polyurethane which is mechanically and adhesively joined to aluminum storefront sections. Thermal Break shall be designed according to AAMA TIR-A8 and tested according to AAMA 505
- B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposes shall be stainless steel.
- D. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action
- E. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- F. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

2.4 GLAZING SYSTEM

- A. Glazing: As specified in Division 08 Section 08 80 00 Glazing.
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.
- D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

- E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:
 - 1. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.
 - a. Color: Black
 - 2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.
 - a. Color: Matching structural sealant.

2.5 ACCESSORY MATERIALS

- A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants".
- B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil (0.762 mm) thickness per coat.

2.6 FABRICATION

- A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fit joints; make joints flush, hairline and weatherproof.
 - 3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
 - 4. Physical and thermal isolation of glazing from framing members.
 - 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 6. Provisions for field replacement of glazing.
 - 7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- B. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
- C. Storefront Framing: Fabricate components for assembly using manufacturer's standard installation instructions.
- D. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Factory Finishing:
 - 1. Kawneer Permafluor™ (70% PVDF), AAMA 2605, Fluoropolymer Coating (Color as selected by Architect and Owner from full range of available colors), or as indicated on the Drawings.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weather tight framed aluminum storefront system installation.
 - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
 - 2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76 mm) of opening.
 - 3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum-framed storefront system, accessories, and other components.
- B. Install aluminum-framed storefront system level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weather tight construction.
- D. Install aluminum-framed storefront system and components to drain condensation, water penetrating joints, and moisture migrating within aluminum-framed storefront to the exterior.
- E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

- A. Field Tests: Architect shall select storefront units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.
 - 1. Testing: Testing shall be performed by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements. Testing Standard per AAMA 503, including reference to ASTM E 783 for Air Infiltration Test and ASTM E 1105 Water Infiltration Test.
 - a. Air Infiltration Tests: Conduct tests according to ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft², whichever is greater.
 - b. Water Infiltration Tests: Conduct tests according to ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 8 psf (300 Pa).
- B. Manufacturer's Field Services: Upon Owner's written request, provide periodic site visit by manufacturer's field service representative.

3.4 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean aluminum surfaces immediately after installing aluminum-framed storefronts. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- B. Clean glass immediately after installation. Comply with glass manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08 43 13

SECTION 08 44 13 – Glazed Aluminum Curtain Walls

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Aluminum curtain wall framing system.
 - 2. Aluminum curtain wall accessories including, but not limited to:
 - a. Joint sealants for aluminum curtain wall.
 - b. Anchors and attachment devices.
- B. The following is not included in this section:
 - 1. Glazing.
- C. Related Sections:
 - 1. Section 07 92 00 - Joint Sealants
 - 2. Section 08 41 13 - Aluminum Entrance Doors
 - 3. Section 08 71 00 - Door Hardware
 - 4. Section 08 80 00 - Glazing

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 DEFINITIONS

- A. For fenestration industry standard terminology and definitions, refer to the Fenestration & Glazing Industry Alliance (FGIA) Glossary (AAMA AG-13).

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance:
 - 1. Product to comply with the specified performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction, as determined by testing of glazed aluminum curtain walls representing those indicated for this project.
 - 2. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 3. Failure includes any of these events:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Loosening or weakening of fasteners, attachments, and other components.
 - d. Failure of operating units.
- B. Wind Loads:
 - 1. The curtain wall system shall include anchorage that is capable of withstanding the following wind load design pressures per governing codes.

- C. Air Leakage:
1. The test specimen shall be tested according to ASTM E 283.
 2. Air infiltration rate shall not exceed 0.06 cfm/ft² (0.3 l/s · m²) at a static air pressure differential of 6.2 psf (300 Pa).
- D. Water Resistance:
1. Static:
 - a. The test specimen shall be tested according to ASTM E 331.
 - b. There shall be no leakage at a minimum static air pressure differential of 12 psf (575 Pa) as defined in AAMA 501.
 2. Dynamic:
 - a. The test specimen shall be tested according to AAMA 501.1.
 - b. There shall be no leakage at an air pressure differential of 12 psf (575 Pa) as defined in AAMA 501.
- E. Uniform Load:
1. A static air design load of 40 psf (1915 Pa) shall be applied in the positive and negative direction according to ASTM E 330.
 2. There shall be no deflection in excess of L/175 of the span of any framing member at design load.
 3. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.
- F. Seismic:
1. When tested to AAMA 501.4, system must meet design displacement (elastic) of 0.010 times the story height and ultimate displacement (inelastic) of 1.5 times the design displacement.
 2. When tested to AAMA 501.6, system must meet dynamic seismic drift causing glass fallout (Δ Fallout) of 4.75" or 0.0300 times the story height.
- G. Thermal Transmittance (U-factor), Physical Test:
1. Thermal transmittance test results according to AAMA 1503 or CSA A440 are based upon 1" (25.4 mm) clear insulating glass (1/4", 1/2" AS, 1/4").
 2. When tested using AAMA 1503, the thermal transmittance (U-factor) shall not be more than 0.66 Btu/hr/(hr·ft²·°F).
- H. Condensation Resistance Factor (CRF):
1. Condensation resistance test results according to AAMA 1503 or CSA A440 are based upon 1" (25.4 mm) clear insulating glass (1/4", 1/2" AS, 1/4").
 2. If using CRF: When tested using AAMA 1503, the CRF_{frame} and CRF_{glass} shall not be less than 66 and 60 respectively.
- I. Sound Transmission Loss:
1. When tested to ASTM E90 and ASTM E1425, the Sound Transmission Class (STC) and Outdoor/Indoor Transmission Class (OITC) shall not be less than:
 - a. STC 31 or OITC 26 based upon 1" (25.4 mm) insulating glass (1/4", 1/2" AS, 1/4")
 - b. STC 37 or OITC 30 based upon 1" (25.4 mm) laminated glass (1/4" laminated, 1/2" AS, 1/4" laminated).

- J. Windborne-Debris-Impact Resistance Performance:
 - 1. Performance shall be tested according to TAS 201/203, ASTM E1886 and information in ASTM E1996:
 - a. Large-Missile Impact: For aluminum-framed systems located within 30 feet (9.1 m) of grade.
 - b. Small-Missile Impact: For aluminum-framed systems located above 30 feet (9.1 m) of grade.
- K. Environmental Product Declaration (EPD): Shall have a Type III Product-Specific EPD created from a Product Category Rule.

1.5 SUBMITTALS

- A. Product Data:
 - 1. For each type of product indicated, include:
 - a. Construction details.
 - b. Material descriptions.
 - c. Dimensions of individual components and profiles.
 - d. Finishes.
 - e. Provide a sample document illustrating project-specific information that will be provided after product shipment.
 - f. After product has shipped, provide project-specific recycled content information:
 - 1) Indicate recycled content, including the percentage of pre- and post-consumer recycled content per unit of product.
 - 2) Indicate the relative dollar value of recycled content product to the total dollar value of product included in the project.
 - 3) Indicate the location for recovery of recycled content.
 - 4) Indicate the location of the manufacturing facility.
- B. Shop Drawings:
 - 1. Plans.
 - 2. Elevations.
 - 3. Sections.
 - 4. Full-size details.
 - 5. Attachments to other work.
- C. Samples for Initial Selection:
 - 1. Provide samples for units with factory-applied color finishes.
- D. Samples for Verification:
 - 1. Provide a verification sample for each type of exposed finish required, in manufacturer's standard sizes.
- E. Product Test Reports:
 - 1. Provide test reports for glazed aluminum curtain walls.
 - 2. Test reports must be based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency.
 - 3. Test reports must indicate compliance with performance requirements.

- F. Fabrication Sample:
 - 1. Provide a fabrication sample of each vertical-to-horizontal intersection of aluminum-framed curtain wall systems, made from 12" (304.8 mm) lengths of full-size components and showing details of the following:
 - a. Joinery
 - b. Glazing

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer must have successfully installed the same or similar systems required for the project and other projects of similar size and scope.
- B. Manufacturer Qualifications:
 - 1. Manufacturer must be capable of fabricating glazed aluminum curtain walls that meet or exceed the stated performance requirements.
- C. Source Limitations:
 - 1. Obtain aluminum curtain wall system through one source from a single manufacturer.
- D. Product Options:
 - 1. Information on drawings and in specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 - 2. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Pre-installation Conference:
 - 1. Conduct conference at project site to comply with requirements in Division 01 Project Management and Coordination Section.

1.7 PROJECT CONDITIONS

- A. Field Measurements:
 - 1. Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication.
 - 2. Indicate measurements on shop drawings.

1.8 WARRANTY

- A. Submit manufacturer's standard warranty for owner's acceptance.
- B. Warranty Period:
 - 1. Two years from Date of Substantial Completion of the project provided however that in no event shall the Limited Warranty begin later than six months from date of shipment by manufacturer.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product:
 - 1. Kawneer Company, Inc., Norcross, GA www.kawneer.com

2. 1620UT Curtain Wall System® with 1" (25.4 mm) double-glazed insulating glass:
 - a. Sight line: 2" (50.8 mm)
 - b. Outside-glazed pressure plate format
 - c. System depth: 6" (152.4 mm) for 1" (25.4 mm) insulating glazing and 1/4" (6.3 mm) monolithic glazing
3. Tested to AAMA 501, ASTM E 1886, E 1996, and TAS 201, 202, 203
- B. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers are:
 1. Oldcastle Building Envelope (OBE), Terrell, TX www.obe.com
 2. CMI Architectural Products, Inc., Minneapolis, MN www.cmiarch.com
 3. Tubelite, Reed City, MI www.tubeliteinc.com
 4. Member of AAMA, manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.2 MATERIALS

- A. Aluminum Extrusions:
 1. Alloy and temper recommended by glazed aluminum curtain wall manufacturer for strength, corrosion resistance, and application of required finish.
 2. Not less than 0.070" (1.8 mm) wall thickness at any location for the main frame.
 3. Complying with ASTM B221: 6063-T6 alloy and temper.
- B. Aluminum Sheet Alloy:
 1. Shall meet the requirements of ASTM B209.
- C. Fasteners:
 1. Aluminum, nonmagnetic stainless steel or other materials must be non-corrosive and compatible with aluminum members, trim hardware, anchors, and other components.
- D. Anchors, Clips, and Accessories:
 1. Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.
 2. Anchors, clips, and accessories shall provide sufficient strength to withstand the design pressure indicated.
- E. Pressure Plate:
 1. Pressure plate shall be aluminum.
 2. Pressure plate shall be fastened to the mullion with stainless steel screws.
- F. Reinforcing Members:
 1. Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating.
 2. Reinforcing members must provide sufficient strength to withstand the design pressure indicated.
- G. Sealant:
 1. For sealants required within fabricated curtain wall system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

- H. Thermal Barrier:
 - 1. Thermal separator shall be extruded of a silicone compatible elastomer that provides a minimum 1/4" (6.3 mm) separation.
- I. Tolerances:
 - 1. References to tolerances for wall thickness and other cross-sectional dimensions of glazed curtain wall members are nominal and in compliance with AA Aluminum Standards and Data.

2.3 CURTAIN WALL FRAMING

- A. Framing Members:
 - 1. Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 - 2. Glazing System: Four-sided captured.
 - 3. Glazing Plane: Front.
- B. Glass:
 - 1. Monolithic glass options:
 - a. 1/4" (6.3 mm)
 - 2. Insulating glass options:
 - a. 1" (25.4 mm)
- C. Brackets and Reinforcements:
 - 1. Manufacturer's standard high-strength aluminum with non-staining, non-ferrous shims for aligning system components.
- D. Framing Sealants:
 - 1. Shall be suitable for glazed aluminum curtain wall as recommended by sealant manufacturer.
- E. Fasteners and Accessories:
 - 1. Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories must be compatible with adjacent materials.
 - 2. Where exposed, fasteners and accessories shall be stainless steel.
- F. Perimeter Anchors:
 - 1. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
- G. Packing, Shipping, Handling, and Unloading:
 - 1. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- H. Storage and Protection:
 - 1. Store materials so that they are protected from exposure to harmful weather conditions.
 - 2. Handle material and components to avoid damage.
 - 3. Protect material against damage from elements, construction activities, and other hazards before, during, and after installation.

2.4 GLAZING

- A. Glazing to meet requirements in Division 08 Glazing Section.
- B. Glazing Gaskets:
 - 1. Gaskets to meet requirements of ASTM C864.

- C. Spacers and Setting Blocks:
 - 1. Manufacturer's standard elastomeric type.
 - D. Bond-Breaker Tape:
 - 1. Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.
 - E. Glazing Sealants:
 - 1. As recommended by manufacturer for joint type.
- 2.5 OPERABLE UNITS
- A. Doors comply with Division 08 Aluminum-Framed Entrances and Storefronts Section.
- 2.6 FABRICATION
- A. Extrude or form aluminum shapes before finishing.
 - B. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing that maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from exterior.
 - 6. Fasteners, anchors, and connection devices that are concealed from view to the greatest extent possible.
 - 7. Internal weeping system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
 - C. Curtain Wall Framing:
 - 1. Fabricate components for assembly using shear block system following manufacturer's standard installation instructions.
 - D. After fabrication, clearly mark components to identify their locations in project according to shop drawings.
- 2.7 ALUMINUM FINISHES
- A. Finish designations that are prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - B. Factory Finishing:
 - 1. Kawneer Permafluor™ (70% PVDF), AAMA 2605, Fluoropolymer Coating. Color as selected by Architect and Owner from full range of available colors, or as indicated on the Drawings.

PART 3 – EXECUTION

- 3.1 EXAMINATION
- A. With installer present, examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of the work.
 - B. Proceed with installation only after correcting unsatisfactory conditions

3.2 INSTALLATION

A. Curtain Wall System Installation:

1. Install curtain wall systems plumb, level, and true to line, without warp or rack of frames, within manufacturer's prescribed tolerances, and complying with installation instructions.
2. Provide support and anchor in place.
3. Dissimilar Materials:
 - a. Provide separation of aluminum materials from sources of corrosion or electrolytic action contact points.
4. Glazing:
 - a. Glass shall be outside-glazed.
 - b. Glass shall be held in place with extruded aluminum pressure plates anchored to the mullion using stainless steel fasteners that are spaced no more than 9" (228.6 mm) on center.
5. Water Drainage
 - a. Each light of glass shall be compartmentalized using joint plugs and silicone sealant to divert water to the horizontal weep locations.
 - b. Weep holes shall be located in the horizontal pressure plates and covers to divert water to the exterior of the building.

B. Related Products Installation:

1. Sealants (Perimeter):
 - a. Refer to Joint Treatment (Sealants) Section.
2. Glass:
 - a. Refer to Glass and Glazing Section.
 - b. Reference: ANSI Z97.1, CPSC 16 CFR 1201, and GANA Glazing Manual.

3.3 FIELD QUALITY CONTROL

A. Field Tests:

1. E/A shall select curtain wall units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter-caulked, and cured.
2. Conduct tests for air infiltration and water penetration with manufacturer's representative present.
3. Tests that do not meet the specified performance requirements and units that have deficiencies shall be corrected as part of the contract amount.
4. Testing shall be performed per AAMA 503 by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements.
5. Air Infiltration Tests:
 - a. Conduct tests according to ASTM E 783.
 - b. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft², whichever is greater.
6. Water Infiltration Tests:
 - a. Conduct tests according to ASTM E 1105.
 - b. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 8 psf (383 Pa).

B. Manufacturer's Field Services:

1. Upon owner's written request, provide periodic site visit by manufacturer's field service representative.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Adjusting: Not applicable.

B. Protection:

1. Protect installed product's finish surfaces from damage during construction.
2. Protect aluminum curtain wall system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.

C. Cleaning:

1. Repair or replace damaged installed products.
2. Clean installed products according to manufacturer's instructions prior to owner's acceptance.
3. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.
4. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 08 44 13

SECTION 08 45 00 – Translucent Wall and Roof Assemblies

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Insulated, flat, translucent sandwich panel system.
 - 2. Structural grid.
 - 3. Battens and perimeter closure system including flashings.
 - 4. Translucent insulated plastic wall system accessories including, but not limited to:
 - a. Sealing tape.
 - b. Fasteners.
 - c. Insulation.
- B. Related Sections:
 - 1. Section 03 41 00 - Plant-Precast Structural Concrete
 - 2. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 3. Section 07 92 00 - Joint Sealants

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. AAMA:
 - 1. 1503 - Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections
 - 2. 2604 - High Performance Organic Coatings on Aluminum Extrusions and Panels
- B. ASTM:
 - 1. C297 - Test for Tensile Strength of Sandwich Construction
 - 2. D635 - Rate and Extent of Burning
 - 3. D1002 - Test for Shear Strength of Single Lap Joint Adhesively-Bonded Metal
 - 4. D1037 - Properties of Wood-Base Fiber and Particle Panel Materials
 - 5. D1183 - Resistance of Adhesives to Aging
 - 6. D2244 - Color Tolerances and Differences
 - 7. E84 - Surface Burning Characteristics
 - 8. E108 - Fire Tests of Roof Coverings

1.4 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. The translucent insulated panel system shall consist of factory prefabricated flat sandwich panels including installation by a manufacturer's authorized contractor.
 - 2. Manufacturer shall be responsible for the design, configuration and fabrication of the translucent wall system.

B. Performance Requirements:

1. The manufacturer shall be responsible for the configuration and fabrication of the complete panel system.
 - a. When requested, include span analysis data.
 - b. Standard panel system shall have less than 0.01 cfm/ft² air leakage by ASTM E 283 at 6.24 PSF (50 mph) and no water penetration by ASTM E 331 at 15 PSF; and structural testing by ASTM E 330.
 - c. Structural Loads: Provide system capable of handling the components and cladding loads indicated on the Drawings. System to meet design loads, either in the specifications or as indicated on the Drawings, whichever is greater.
2. Deflection Limits:
 - a. Walls: Limited to L/60 or X of clear span for each assembly component.
3. Thermal Movements:
 - a. Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1) Temperature Change (Range): 110 degrees F (43 degrees C), ambient; 150 degrees F (66 degrees C), material surfaces.

1.5 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings:
 1. Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections, details of components, joint locations and configurations within system and between system and adjoining system.
 2. Show details of fabrication and installation of panels, battens and closures.
- D. Samples:
 1. Initial Color Selection: Submit manufacturer's standard color samples for each type of finish with Product Data and Shop Drawings.
 - a. When requested, submit samples for each exposed finish required, in same thickness and material indicated for the work and in the size indicated below.
 - 1) Sandwich panels: 7 inch x 12 inch unit.
 - 2) Factory finished aluminum: 3 inch long sections.
 2. Color Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics. Include notification to E/A if selection is not within specified price range.
 3. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components if requested by E/A.
- E. Quality Assurance/Control Submittals:
 1. Test Reports: Certified by independent testing organization for each type and class of panel system. Reports shall verify that the materials will meet all performance requirements of this specification. Test reports required include:
 - a. ASTM E84: Flame Spread and Smoke Development
 - b. ASTM D635: Burn Extent

- c. ASTM D2244: Color Difference
 - d. ASTM C297, ASTM D1002: Bond Strength
 - e. ASTM D1037: Accelerated Aging
 - f. ASTM E108: Class "A" Roof System
- F. Maintenance Manual: Provide to Owner maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.

1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide translucent insulated wall and skylight system units made of components of standard construction furnished by 1 manufacturer as coordinated assemblies.
- B. Qualifications:
- 1. Manufacturer:
 - a. Ten (10) years experience in the manufacture of translucent insulated wall and skylight system, with six (6) projects of similar size, scope and type of which three (3) have been in successful use for five (5) years or longer.
 - b. Panel system must be listed by an ANSI accredited evaluation service, which requires quality control inspections and fire, structural, and water infiltration testing of sandwich panel systems by an accredited agency.
 - c. Quality control inspections shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components, and production sandwich panels for conformance with AC 177 "Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems" as issued by the ICC-ES.
 - 2. Installer: Installation shall be by an experienced installer, with 7 years experience in the installation of translucent insulated wall and skylight systems in projects of similar types and sizes.
 - 3. Personnel: For actual installation of translucent insulated wall and skylight system, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Certifications: Provide to E/A, certification of installer from manufacturer of translucent insulated wall and skylight system.
- D. Field Samples: If requested, furnish sample of each type of translucent insulated wall and skylight system to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.
- E. Regulatory Requirements:
- 1. Insulated wall and skylight system must be listed by the ICC Evaluation Service (ICC-ES) which requires quality control inspections and fire, structural, and water infiltration testing of sandwich panel systems by an approved agency.
 - 2. Quality control inspections and required testing shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components, and production sandwich panels for conformance with "Acceptance Criteria for Sandwich Panels" as regulated by the ICC-ES.
 - 3. Skylight system shall pass Class A Roof Burning Brand Test by ASTM E108 or be UL listed as a Class A Roof by UL 790.
- F. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver panel system, components, and materials in manufacturer's standard protective packaging.
- B. Store panels according to manufacturer's recommendations.
- C. Store panels on long edge, several inches above the ground, blocked and under cover to prevent warping.

1.8 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.9 WARRANTY

- A. Provide manufacturer's 10-year limited warranty covering color stability, delamination, and fiber bloom.
- B. Installer shall warrant system against water leakage and weather tightness for 10 years.
- C. Warranties shall be provided in writing.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Standard of Quality: Design is based on products of Kalwall Corporation, Manchester, NH www.kalwall.com
- B. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - 1. Major Industries, Wausau, WI www.majorskylights.com
 - 2. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

- A. Face Sheets:
 - 1. Glass fiber reinforced thermoset resins by insulated panel system fabricator for architectural use.
 - 2. Thermoplastic polycarbonate or acrylic faces are not acceptable.
 - 3. The exterior face shall have a permanent glass erosion barrier to provide maximum long term resistance to reinforcing fiber exposure. Plastic film overlays or coatings are not acceptable
 - 4. The exterior face shall have a self-cleaning thermoset acrylic urethane surface molecularly bonded under factory controlled conditions, and fully field restorable if worn or damaged. Tedlar film is not acceptable.
 - 5. Flammability:
 - a. The interior face sheet shall have a flame spread rating no greater than 50 and smoke developed no greater than 250 when tested according to ASTM E84.
 - b. Burn extent by ASTM D635 shall be no greater than 1 inch.
 - c. Faces shall not deform, deflect or drip when subject to fire or flame.
 - 6. Weatherability: The full thickness of the exterior face shall not change color more than 3.0 Adams Units (Delta E by ASTM D2244) after 5 years outdoor South Florida weathering at 7 degrees facing south, determined by the average of at least 3 white samples without a protective film or coating to ensure maximum, long term stability.

7. Appearance:
 - a. Face sheets shall be uniform in color to prevent splotchy appearance.
 - b. Faces shall be completely free of ridges and wrinkles that prevent proper surface contact in bonding to the aluminum grid core.
 - c. Clusters of air bubbles/pinholes that collect dirt and moisture will not be acceptable.
 8. Strength: The exterior face sheet shall be uniform in strength and repel an impact equal to 70 foot pounds without fracture or tear according to SPI Shatter Resistance Test.
- B. Structural I-Beam Grid:
1. Thermally broken aluminum of 6063-T6 or 6005-T5 alloy.
 2. Provide for mechanical interlocking of muntin-mullion and perimeter to prevent high and low intersections which do not allow full bonding surface to contact with face material.
 3. Width: No less than 7/16 inch.
 4. Machined to tolerances of not greater than plus or minus 0.002 inch.
 5. Thermal Break: Minimum 1 inch.
- C. Battens and Perimeter Closure System:
1. Extruded 6063-T6 and 6063-T5 aluminum screw clamp-tight closure system.
 2. Curved closure system may be roll formed.
 3. Thermal break perimeter systems shall be factory prefabricated with perimeter closures factory sealed to panels.
 4. "U" = 0.50 or less.
 5. Fasteners: 300 series stainless steel screws (excluding final fasteners to the building).
 6. Flexible Sealing Tape: Manufacturer's standard pre-applied to closure system at the factory under controlled conditions.
- D. Laminate Adhesives:
1. Heat and pressure resin type engineered for structural sandwich panel use.
 2. Adhesive shall pass testing requirements specified by ICBO "Acceptance Criteria for Sandwich Panel Adhesive"
 3. Minimum Strength:
 - a. 750 PSI tensile strength by ASTM C297 after 2 exposures to 6 cycles each of the aging conditions prescribed by ASTM D1037.
 - b. 500 PSI shear strength average of 5 exposures per ASTM D1002:
 - 1) 50 percent relative humidity at 73 degrees F: 540 PSI.
 - 2) Accelerated aging by ASTM D1183 at room temperature: 800 PSI.
 - 3) 182 degrees F: 100 PSI.
 - 4) 500 hour oxygen bomb by ASTM D572: 1400 PSI.
- E. Condensation Drip Flashing:
1. Include manufacturer's condensation flashing at sill of translucent wall panel.
 2. Drain flashing to exterior.
 3. Color: As selected by E/A from manufacturer's standard range of colors.

- F. Other Materials: Other materials not specifically described but required for complete, proper installation of translucent insulated wall and skylight system, subject to acceptance of E/A.

2.3 FABRICATION

A. Panels:

1. Sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking thermally broken aluminum I-beams.
2. Adhesive bonding line to be straight, cover the entire width of the I-beam, and have a neat, sharp edge.
3. Thickness: 2-3/4 inches.
4. Insulation: U factor 0.23 thermally broken.
5. Light Transmission: 20 percent.
6. Shading Coefficient: 0.12.
7. Thermally Broken Panels:
 - a. Minimum Condensation Resistance Factor of 80 as measured by AAMA 1503 on the bond line.
 - b. Minimum CRF of 90 at center of grid cell.
8. Grid Pattern: Verti-Kal™, 10 inch nominal spacing.
9. To ensure bonding strength, white spots at intersections of muntins and mullions shall not exceed 4 for each 40 square feet of panel, nor shall they be more than 3/64 inch in width.

B. Aluminum Clamp-Tite Installation System:

1. Thermally broken-flat clamp-tite screw type closure system shall be of extruded aluminum alloy and temper as recommended by manufacturer.
2. Sealing tape: Manufacturer's standard, pre-applied to aluminum clamp-tite installation system at the factory under controlled conditions.
3. Fasteners: 300 series stainless steel screws for aluminum clamp-tite installation system, excluding final fasteners to the building.

2.4 FINISHES

- A. All exposed aluminum to be acrylic/ urethane-based copolymer corrosion resistant finish.
- B. Meet performance requirements of ANSI/AAMA 2604.
- C. Aluminum Clamp-Tite Installation System:
1. Factory applied finish meeting the performance requirements of AAMA 2604.
 2. Custom color as indicated on the Drawings.
- D. Face Sheets:
1. Uniform in appearance.
 2. Color:
 - a. Exterior face sheets: Ice Blue.
 - b. Interior face sheets: Crystal.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.

- B. Verification of Conditions: Verify that system may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies:
 - 1. Immediately notify E/A in writing.
 - 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 - 3. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.
- B. Metal Protection:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or apply sealant or tape recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturer.
 - 3. Where aluminum will contact pressure-treated wood, separate dissimilar materials by methods recommended by manufacturer.

3.3 INSTALLATION

- A. Install translucent panel system in strict accordance with approved Shop Drawings as supplied by manufacturer.
- B. Anchor component parts securely in place by permanent mechanical attachment system and to accommodate thermal and mechanical movements.
- C. Set sill and curb members in a full bed of sealant compound, or with joint fillers or gaskets to provide weather-tight construction.
- D. Install joint sealants at perimeter joints and within panel system according to manufacturer's installation instructions.
- E. Clean aluminum before sealants are applied.

3.4 FIELD QUALITY CONTROL

- A. Water Test: Test according to procedures in AAMA 501.
- B. After other trades have completed work on adjacent material, carefully inspect translucent panel installation and touch up marred finishes, but replace units that cannot be restored to factory-finished appearance.

3.5 ADJUSTING

- A. Make adjustments necessary to ensure proper installation and weather-tight conditions.

3.6 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from work of this section. Maintain premises in neat, orderly condition.
- B. System: Clean inside and outside of system surfaces using materials and methods recommended by manufacturer.

3.7 DEMONSTRATION

- A. Maintenance Instructions: Manufacturer's representative to schedule and attend meeting with Owner's representatives to explain:
 - 1. Maintenance and Care Instructions.
 - 2. Recommended Maintenance Program.
 - 3. Warranty Requirements.

END OF SECTION 08 45 00

SECTION 08 71 00 – Door Hardware

PART 1 – GENERAL

1.1 CONDITIONS

- A. Conditions of the contract (General and Supplementary Conditions) and Division 01 - General Requirements, govern the work of this section.
- B. This section includes all material, and related service necessary to furnish all finish hardware indicated on the drawings or specified herein.
- C. Furnish UL listed hardware for all labeled and 20 min. openings in conformance with the requirements for the class of opening scheduled. Underwriters' requirements shall have precedence over specification where conflicts exist.
- D. All work shall be according to all applicable state and local building codes. Code requirements shall have precedence over this specification where conflicts exist.

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 WORK INCLUDED

- A. This section includes the following:
 - 1. Furnish door hardware (for hollow metal, wood and aluminum doors) specified herein, listed in the hardware schedule, and/or required by the drawings.
 - 2. Cylinders for Aluminum Doors
 - 3. Thresholds and Weather-stripping (Aluminum frame seals to be provided by aluminum door supplier)
 - 4. Electro-Mechanical Devices
 - 5. Access Control components and or systems specified within this section.
- B. Where items of hardware are not definitely or correctly specified and is required for the intended service, such omission, error or other discrepancy should be directed to the Architect prior to the bid date for clarification by addendum. Otherwise furnish such items in the type and quantity established by this specification for the appropriate service intended.

1.4 RELATED WORK IN OTHER SECTIONS

- A. This section includes coordination with related work in the following sections:
 - 1. Division 06 Section "Finish Carpentry".
 - 2. Division 06 Section "Cabinet Hardware"
 - 3. Division 08 Section "Hollow Metal Doors and Frames".
 - 4. Division 08 Section "Wood Doors"
 - 5. Division 08 Section "Storm Doors"
 - 6. Division 08 Section "Aluminum Entrances and Storefronts"
 - 7. Division 26 Sections "Electrical"
 - 8. Division 28 Sections "Electronic Safety and Security".

1.5 REFERENCES

- A. Publications of agencies and organizations listed below form a part of this specification section to the extent referenced.
 - 1. DHI – Installation Guide for Doors and Hardware (2020).
 - 2. NFPA 80 - Standards for Fire Doors and Windows.
 - 3. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.
 - 4. UL - Building Material Directory.
 - 5. DHI - Door and Hardware Institute
 - 6. WHI - Warnock Hersey
 - 7. BHMA - Builders Hardware Manufacturers Association
 - 8. ANSI – American National Standards Institute
 - 9. BABAA – Build America Buy America Act
 - 10. IBC - International Building Code 2015 Edition (as adopted and amended by local building code)

1.6 SUBMITTALS

- A. Within ten days after award of contract, submit detailed hardware schedule in quantities as required by Division 01 - General Requirements.
- B. Schedule format shall be consistent with recommendations for a vertical format as set forth in the Door & Hardware Institute's (DHI) publication "Sequence and Format for the Hardware Schedule". Hardware sets shall be consolidated to group multiple door openings which share similar hardware requirements. Schedule shall include the following information:
 - 1. Door number, location, size, handing, and rating.
 - 2. Door and frame material, handing.
 - 3. Degree of swing.
 - 4. Manufacturer
 - 5. Product name and catalog number
 - 6. Function, type and style
 - 7. Size and finish of each item
 - 8. Mounting heights
 - 9. Explanation of abbreviations, symbols, etc.
 - 10. Numerical door index, indicating the hardware set/ group number for each door.
- C. When universal type door closers are to be provided, the schedule shall indicate the application method to be used for installation at each door: (regular arm, parallel arm, or top jamb).
- D. The schedule will be prepared under the direct supervision of a certified Architectural Hardware Consultant (AHC), or certified Door Hardware Consultant (DHC) employed by the hardware distributor. The hardware schedule shall be signed and embossed or stamped with the DHI certification seal of the supervising AHC or DHC. The supervising AHC or DHC shall attend any meetings related to the project when requested by the architect.
- E. Check the specified hardware for suitability and adaptability to the details and surrounding conditions.
- F. Review drawings from related trades as required to verify compatibility with specified hardware. Indicate unsuitable or incompatible items, and proposed substitutions in the hardware schedule.

- G. Provide documentation for all hardware to be furnished on labeled fire doors indicating compliance with positive pressure fire testing UL 10C.
- H. Furnish manufacturers' catalog data for each item of hardware in quantities as required by Division 01 - General Requirements.
- I. Submit a sample of each type of hardware requested by the architect. Samples shall be of the same finish, style, and function as specified herein. Tag each sample with its permanent location so that it may be used in the final work.
- J. Furnish with first submittal, a list of required lead times for all hardware items.
- K. After final approved schedule is returned, transmit corrected copies for distribution and field use in quantities as required by Division 01 - General Requirements.
- L. Furnish approved hardware schedules, template lists, and pertinent templates as requested by related trades.
- M. Furnish necessary diagrams, schematics, voltage and amperage requirements for all electro-mechanical devices or systems as required by related trades. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.
- N. After receipt of approved hardware schedule, Hardware supplier shall initiate a meeting including the owner's representative to determine keying requirements. Upon completion of initial key meeting, hardware supplier shall prepare a proposed key schedule with symbols and abbreviations as set forth in the door and hardware institute's publication "Keying Procedures, Systems, and Nomenclature". Submit copies of owner approved key schedule for review and field use in quantities as required by Division 01 - General Requirements. Wiring diagrams shall be included in final submittals transmitted for distribution of field use.

1.7 QUALITY ASSURANCE

- A. Manufacturers and model numbers listed are to establish a standard of function and quality. Similar items by approved manufacturers that are equal in design, function, and quality, may be considered for prior approval of the architect, provided the required data and physical samples are submitted for approval as set forth in Division 01 - General Requirements.
- B. Where indicated in this specification, products shall be independently certified by ANSI for compliance with relevant ANSI/BHMA standards A156.1 - A156.36 – Standards for Hardware and Specialties. All products shall meet or exceed certification requirements for the respective grade indicated within this specification. Supplier shall provide evidence of certification when requested by the architect.
- C. Obtain each type of hardware (hinges, latch and locksets, exit devices, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.
- D. Electrical drawings and electrical specifications are based on the specific electrified hardware components specified in hardware sets. When electronic hardware components other than those indicated in hardware sets are provided, the supplier shall be responsible for all costs incurred by the design team and their consultants to review and revise electrical drawings and electrical specifications. Supplier shall also be responsible for any additional costs associated with required changes in related equipment, materials, installation, or final hook up to ensure the system will operate and function as indicated in the construction documents, including hardware set operational / functional descriptions.
- E. All hardware items shall be manufactured no earlier than 6 months prior to delivery to site.
- F. Hardware supplier shall be factory trained and certified by the manufacture to provide and support all computer managed locks and system components.

- G. Installation of hardware shall be installed or directly supervised and inspected by a skilled installer certified by the manufacturer of locksets, door closers, and exit devices used on the project, or with not less than 3 years' experience in successful completion of projects similar in size and scope.
- H. Provide hardware for all labeled fire doors, which complies with positive pressure fire testing UL 10C.
- I. Comply with all applicable provisions of the standards referenced within section 1.4 of this specification.
- J. Hardware supplier shall participate when reasonably requested to meet with the contractor and or architect to inspect any claim for incorrect or non-functioning materials; following such inspection, the hardware supplier shall provide a written statement documenting the cause and proposed remedy of any unresolved items.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Hardware supplier shall deliver hardware to the job site unless otherwise specified.
- B. All hardware shall be delivered in manufacturers' original cartons and shall be clearly marked with set and door number.
- C. Coordinate with contractor prior to hardware delivery and recommend secure storage and protection against loss and damage at job site.
- D. Contractor shall receive all hardware and provide secure and proper protection of all hardware items to avoid delays caused by lost or damaged hardware. Contractor shall report shortages to the Architect and hardware supplier immediately after receipt of material at the job site.
- E. Coordinate with related trades under the direction of the contractor for delivery of hardware items necessary for factory installation.

1.9 PRE-INSTALLATION MEETING

- A. Schedule a hardware pre-installation meeting on site to review and discuss required door operating clearances and the installation of continuous hinges, locksets, door closers, exit devices, overhead stops, and electromechanical door hardware.
- B. Meeting attendees shall be notified 7 days in advance and shall include: Architect, Contractor, Door Hardware Installers (including low voltage hardware), Manufacturers representatives for above hardware items, and any other effected subcontractors or suppliers.
- C. All attendees shall be prepared to distribute installation manuals, hardware schedules, templates, and physical hardware samples.

1.10 WARRANTY

- A. All hardware items shall be warranted against defects in material and workmanship as set forth in Division 01 - General Requirements.
- B. Repair, replace, or otherwise correct deficient materials and workmanship without additional cost to owner.

PART 2 – PRODUCTS

2.1 FASTENERS

- A. All exposed fasteners shall be Phillips head or as otherwise specified and shall match the finish of the adjacent hardware. All fasteners ex-posed to the weather shall be non-ferrous or stainless steel. Furnish correct fasteners to accommodate surrounding conditions.
- B. Coordinate required reinforcements for doors and frames. Seek approval of the architect prior to furnishing through-bolts. Furnish through-bolts as required for materials not readily reinforced.

2.2 BUTT HINGES

A. Acceptable manufacturers and respective catalog numbers:

	<u>Hager</u>	<u>Prior Approved Equal (Compliance with BABAA)</u>
1. Standard Weight, Plain Bearing	****	
2. Standard Weight, Ball Bearing	BB1279	
3. Standard Weight, Ball Bearing, Non-Ferrous	BB1191	
4. Heavy Weight, Ball Bearing	BB1168	
5. Heavy Weight, Ball Bearing, Non-Ferrous	BB1199	

B. Hinges shall be independently certified by ANSI for compliance with ANSI A156.1 (2006). Hinges shall meet or exceed the following ANSI grade requirements as indicated below:

1. Standard Weight, Plain Bearing Hinges: Grade 3
2. Standard Weight, 2 Ball Bearing Hinges: Grade 2
3. Heavy Weight, 4 Ball Bearing Hinges: Grade 1

C. Unless otherwise specified, furnish the following hinge quantities for each door leaf.

1. 3 hinges for doors up to 90 inches.
2. 1 additional hinge for every 30 inches on doors over 90 inches.
3. 4 hinges for Dutch door applications.

D. Unless otherwise specified, top and bottom hinges shall be located as specified in Division 08 Section "Hollow Metal Doors and Frames". Intermediate hinges shall be located equidistant from others.

E. Unless otherwise specified, furnish hinge weight and type as follows:

1. Standard weight: plain bearing hinge 5PB1 or ball bearing hinge 5BB1 for interior openings through 36 inches wide without a door closer.
2. Standard weight: ball bearing hinge 5BB1 for interior opening over 36 through 40 inches wide without a door closer, and for interior openings through 40 inches wide with a door closer.
3. Heavyweight: 4 ball bearing hinge 5BB1HW for interior openings over 40 inches wide, and for all vestibule doors.
4. Heavyweight: 4 ball bearing hinge 5BB1HWss for exterior openings unless otherwise listed in groups.
5. Heavyweight: 4 ball bearing hinge 5BB1HWss 5" for all exterior doors or 4 ball bearing hinge 5BB1HW 5" for interior doors, that have an automatic operator.

F. At existing frames receiving new hinges, match existing hinge size and weight.

G. Unless otherwise specified, furnish hinges for exterior doors, fabricated from brass, bronze, or stainless steel. Unless otherwise specified, hinges for interior doors may be fabricated from steel.

H. Unless otherwise specified, furnish hinges in the following sizes:

1. 5" x 5" 2-1/4" thick doors
2. 4-1/2" x 4-1/2" 1-3/4" thick doors
3. 3-1/2" x 3-1/2" 1-3/8" thick doors

I. Furnish hinges with width to accommodate trim and allow for 180-degree swing.

J. Unless otherwise specified, furnish hinges with flat button tips with non-rising pins at interior doors, non-removable loose pins (NRP) at exterior, and out-swinging lockable interior doors.

K. Unless otherwise specified, furnish all hinges to template standards.

2.3 CONTINUOUS GEARED HINGES

A. Acceptable manufacturers and respective catalog numbers:

	<u>Ives</u>	<u>Prior Approved Equal</u> <u>(Compliance with BABAA)</u>
1. Full Mortise	112HD	

- A. Hinges shall be independently certified by ANSI for compliance with ANSI A156.26, Grade 1 (2012).
- B. Continuous hinges shall be geared type hinge providing full height door support up to 600 lbs.
- C. Hinge shall be non-handed with symmetrical template hole pattern and factory drilled.
- D. Hinge to be able to carry Warnock Hersey Int. or UL for fire rated doors and frames up to 90 minutes.
- E. Provide machine screws for doors which have been reinforced to accept machine screws.
- F. Note: Fire label for doors and frames should be placed on the header and top rail of fire rated doors and frames.

2.4 POWER TRANSFERS

A. Acceptable manufacturers and respective catalog numbers:

	<u>Von Duprin</u>	<u>Prior Approved Equal</u> <u>(Compliance with BABAA)</u>
1. Concealed Two Wire	EPT-2	
2. Concealed Ten Wire	EPT-10	

- B. Door cords shall be armored cable with screw on caps.
- C. Concealed power transfers shall be concealed in the door and frame when the door is closed.
- D. Concealed power transfers shall have a steel tube to protect wires from being cut.
- E. Concealed power transfers with spring tubes shall be rejected.
- F. Concealed power transfers shall be supplied with a mud box to house all terminations.

2.5 FLUSH BOLTS AND DUST PROOF STRIKES

A. Acceptable manufacturers and respective catalog numbers:

	<u>Ives</u>	<u>Prior Approved Equal</u> <u>(Compliance with BABAA)</u>
1. Constant Latching Bolt (Metal Door)	FB51P	
2. Constant Latching Bolt (Wood Door)	FB61P	

- B. Unless otherwise specified, provide 12" rods for manual flush bolts for door 7'6" or less, 24" top rods for doors over 7'6" to 8'6".
- C. Unless otherwise specified, provide doors over 8'6" with automatic top bolts.
- D. Provide automatic flush bolts where required to maintain fire door listing and or egress requirements on pairs of doors.
- E. All flush-bolt applications shall be UL listed to be installed with top flush-bolt only. Provide auxiliary fire bolt as required for fire rated openings where less bottom bolt has been specified.
- F. Provide all bottom flush bolts with non-locking dust proof strikes.

2.6 EXIT DEVICES

A. Acceptable manufacturers and respective catalog numbers:

Von Duprin

Prior Approved Equal (Compliance with BABAA)

1.	Wide Stile, Push Pad	99 Series
2.	Wide Stile, Electric Latch Retraction	QEL 99 Series
3.	Pull Trim	990

- B. Exit devices shall be independently certified by ANSI for compliance with ANSI A156.3, Grade 1 (2008).
- C. Obtain exit devices from a single manufacturer, although several may be indicated as offering products complying with requirements.
- D. All exit devices shall be equipped with a sound-dampening feature to reduce touch pad return noise.
- E. Quiet Electric Latch Retraction shall be accomplished using a motor driven assembly, and shall incorporate the following features:
1. Motor shall retract both the push pad assembly and latchbolt.
 2. Automatic calibration of latch throw and pull.
 3. Built-in time delay.
 4. On-board installation and troubleshooting diagnostics built into power supply and device.
 5. Retry mode if device does not pull on the first try.
- F. On full glass doors there shall be no exposed fasteners on the back of the mechanism visible through the glass.
- G. All exit devices shall be provided with flush end caps to reduce potential damage from impact.
- H. All exit devices shall be provided with dead-locking latch bolts to ensure security.
- I. All exit devices shall be U.L. listed for accident hazard. Exit device for use on fire doors shall also be U.L. listed for fire exit hardware.
- J. Provide optional strikes, special length rods, and adapter plates to accommodate door and frame conditions. Provide narrow style series devices in lieu of wide stile series devices where optional strikes will not accommodate door and frame conditions.
- K. Coordinate with related trades to ensure adequate clearance and reinforcement is provided in doors and frames. Provide through bolts as required.
- L. Refer to hardware groups for exit device applications utilizing the option of: "less bottom rod and floor strike" (LBR)
- M. All exit devices shall be provided with optional trim designs to match other lever and pull designs used on the project.
- N. Unless specific exit device dogging options are noted within hardware sets, provide dogging options as follows:
1. Fire Rated devices: Dogging not permitted.
 2. Non-Rated Exit Only functions not equipped with outside trim or pull: Less Dogging.
 3. Non-Rated Classroom functions: Less Dogging.

4. Non-Rated devices utilizing electric latch retraction or electrified outside trim: Less Dogging.
 5. All Other Non-Rated devices: Cylinder Dogging utilizing interchangeable core cylinders. Cylinder keyway shall match locksets furnished on this project.
- O. Provide glass bead kits as required to accommodate door conditions. Screws shall not be visible through full glass doors.
- P. Where specified, provide compatible keyed mullions with cylinder for pairs of doors.
- Q. Provide Von Duprin #154 or equivalent mullion/frame stabilizers at the following application(s):
1. Lockable exterior or vestibule paired openings with a fixed or removable hollow metal or aluminum mullion.
 2. Lockable exterior or vestibule single doors in aluminum frames.

2.7 LOCKS AND LATCHES

- A. Acceptable manufacturers and respective catalog numbers:
- | | <u>Schlage</u> | <u>Prior Approved Equal</u>
<u>(Compliance with BABAA)</u> |
|--------------------|----------------|---|
| 1. Grade 1 Mortise | L Series 03A | |
- B. Bored locks shall be independently certified by ANSI for compliance with ANSI A156.2 (2011). Interconnected locks shall be independently certified by ANSI for compliance with ANSI A156.12 (2013). Mortise locks shall be independently certified by ANSI for compliance with ANSI A156.13 (2012).
- C. Minimize transmission of heat to lock trim. Provide temperature control modules (TCM) on all electrified locks when cataloged by the lock manufacturer.
- D. Unless otherwise specified, all locks and latches to have:
1. 2-3/4" Backset
 2. 1/2" minimum throw latchbolt
 3. 1" throw deadbolt
 4. ANSI A115.2 strikes
- E. Provide guarded latch bolts for all locksets, and latch bolts with throw to maintain fire rating of both single and paired door assemblies.
- F. Provide strike with lip length adequate to clear surrounding trim.
- G. Provide wrought boxes for strikes at inactive doors, wood frames, and metal frames without integral mortar covers.
- H. Provide Von Duprin #154 or equivalent mullion/frame stabilizers at the following application(s) unless provided with deadbolt:
1. Lockable exterior or vestibule paired openings with a fixed or removable hollow metal or aluminum mullion.
 2. Lockable exterior or vestibule single doors in aluminum frames.

2.8 PULLS, PUSH BARS, PUSH/PULL PLATES

- A. Acceptable manufacturers and respective catalog numbers:
- | | <u>Ives</u> | <u>Prior Approved Equal</u>
<u>(Compliance with</u>
<u>BABAA)</u> |
|---|-----------------|---|
| 1. Push Plate (.050 6"X 16") | 8200 6" X 16" | |
| 2. Pull Plate (1" dia., 10" CTC - .050" X 4" X 16") | 8303-0 4" X 16" | |

- A. Adjust dimensions of push plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, push plates shall be factory drilled for cylinders or other mortised hardware. All push plates shall be beveled 4 sides and counter sunk.
- B. Where required on wide stile doors, install straight pull offset of cylinder to allow for access to cylinder.
- C. Where possible, provide back-to-back, and concealed mounting for pulls and push bars. Push bar length shall be 3" less door width, or center of stile to center of stile for stile and rail or full glass doors.

2.9 CLOSERS

- A. Acceptable manufacturers and respective catalog numbers:

<u>LCN</u>	<u>Prior Approved Equal (Compliance with BABAA)</u>
1. 4050A / 4050A EDA	
- B. Door closers shall be independently certified by ANSI for compliance with ANSI A156.4, Grade 1 (2013).
- C. Obtain door closers from a single manufacturer, although several may be indicated as offering products complying with requirements.
- D. Provide extra heavy-duty arm (EDA / HD) when closer is to be installed using parallel arm mounting.
- E. Hardware supplier shall coordinate with related trades to ensure aluminum frame profiles will accommodate specified door closers.
- F. Closers shall use aluminum cylinders.
- G. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with standards UL10C.
- H. Unless otherwise specified, all door closers shall have full covers and separate adjusting valves for sweeps, latch, and backcheck.
- I. Provide closers for all labeled doors. Provide closer series and type consistent with other closers for similar doors specified elsewhere on the project.
- J. Provide closers with adjustable spring power. Size closers to ensure exterior and fire rated doors will consistently close and latch doors under existing conditions. Size all other door closers to allow for reduced opening force not to exceed 5 lbs.
- K. Install closers on the room side of corridor doors, stair side of stairways and interior side of exterior doors.
- L. Closers shall be furnished complete with all mounting brackets and cover plates as required by door and frame conditions, and by adjacent hardware.
- M. Door closers shall be provided with a powder coat finish to provide superior protection against the effects of weathering. Powder coat finish shall successfully pass a 100-hour salt spray test.

2.10 LOW ENERGY ELECTRO-HYDRAULIC AUTOMATIC OPERATORS

- A. Acceptable manufacturers and respective catalog numbers:

<u>LCN</u>	<u>Prior Approved Equal</u> <u>(Compliance with BABAA)</u>
1. Electro-Hydraulic Operator 4640	
- B. Low energy operators shall be independently certified by ANSI for compliance with ANSI A156.19 (2002).
- C. Where low kinetic energy, as defined by ANSI/BHMA Standard A156.19, power operators are indicated for doors required to be accessible to the disabled, provide electrically powered operators complying with the ADA for opening force and time to close standards.

- D. The closing action shall be controlled by modern type cast iron door closer cylinder filled with a flat viscosity fluid, stable from +120F to -30F that would require no seasonal adjustments. The closer shall have field adjustable spring power; have two independent closing speed adjustment valves, and hydraulic back-check.
- E. Full closing force shall be provided when the power or assist cycle ends.
- F. All power operator systems shall include the following features and functions:
 - 1. Provisions for separate conduits to carry high and low voltage wiring in compliance with the National Electrical Code, section 725-31.
 - 2. The operator will be designed with an electronically controlled mechanical clutching mechanism to prevent damage to the operator if the system is actuated while the door is latched or if the door is forced closed during the opening cycle.
 - 3. All covers, mounting plates and arm systems shall be powder coated and successfully pass a minimum of 100 hours testing as outlined in ANSI/BHMA Standard A156.18.
 - 4. UL listed for use on labeled doors.
 - 5. All operators shall be non-handed with spring power over a range of at least four sizes; either 1 through 4 or 2 through 5.
 - 6. The power operator shall incorporate microprocessor controlled digital controls including factory default memory settings, on-board diagnostics, non-volatile memory, and integrated delay and relay for controlling door release devices.
 - 7. Provisions in the control box or module shall provide control {inputs and outputs} for; electric strike delay, auxiliary contacts, sequential operation, fire alarms systems, actuators, swing side sensors, and stop side sensors.
 - 8. Exterior switches shall be weather resistant and mount on a single gang electrical box furnished by Division 26.
- G. All electrically powered operators shall include the following features or functions:
 - 1. When an obstruction or resistance to the opening swing is encountered, the operator will pause at that point, then attempt to continue opening the door. If the obstruction or resistance remains, the operator will again pause the door.
 - 2. Easily accessible main power and maintain hold open switches will be provided on the operator.
 - 3. An electronically controlled clutch to provide adjustable opening force.
 - 4. A microprocessor to control all motor and clutch functions.
 - 5. An on-board power supply capable of delivering both 12V and 24V outputs up to a maximum of 1.0 ampere combined load.
 - 6. All input and output power wiring shall be protected by slow blow fuses. These fuses shall be easily replaceable without special tools or component replacement.
 - 7. If electrical failure occurs, the unit shall operate as a standard door closer.
- H. Power Operators shall be warranted by the manufacture to be free from defects in material and workmanship for a period of two years.

2.11 KICK PLATES AND MOP PLATES

- A. Furnish protective plates as specified in hardware groups.
- B. Where specified, provide 10" kick plates, 34" armor plates, and 4" mop plates. Unless otherwise specified, metal protective plates shall be .050" thick; plastic plates shall be 1/8" thick.
- C. Protective plates shall be 2" less door width, or 1" less door width at pairs. All protective plates shall be beveled 4 sides and counter sunk.

- D. Protection plates over 16" shall not be provided for labeled doors unless specifically approved by door manufacturers listing. When protection plates over 16" are provided for labeled doors, the plate shall be labeled.
- E. Where specified, provide surface mounted door edges. Edges shall butt to protective plates. Provide edges with cutouts as required adjacent hardware.
- F. Adjust dimensions of protection plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, protection plates shall be factory drilled for cylinders or other mortised hardware.

2.12 OVERHEAD STOPS

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Glynn-Johnson</u>	<u>Prior Approved Equal</u> <u>(Compliance with BABAA)</u>
1. Heavy Duty Surface Mount	GJ900 Series	
2. Heavy Duty Concealed Mount	GJ100 Series	
- B. Unless otherwise specified, furnish GJ900 series overhead stop for hollow metal or 1-3/4" solid core doors equipped with regular arm surface type closers that swing more than 140 degrees before striking a wall, for hollow metal or 1-3/4" solid core doors that open against equipment, casework, sidelights, or other objects that would make wall bumpers inappropriate, and as specified in hardware groups.
- C. Furnish sex bolt attachments for wood and mineral core doors unless doors are supplied with proper reinforcing blocks.
- D. Provide special stop only ("SE" suffix) overhead stops when used in conjunction with electronic hold open closers.
- E. Do not provide holder function for labeled doors.

2.13 WALL STOPS AND HOLDERS

- A. Furnish a stop or holder for all doors.
- B. Provide concave style wall stop at all adjacent integral push button locks; provide convex style wall stop at all other locations.
- C. Where wall stops are not applicable, furnish overhead stops.
- D. Furnish floor stops or hinge pin stops only where specified in hardware sets.
- E. Do not provide holder function for labeled doors.

2.14 WEATHERSTRIP, GASKETING

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Zero</u>	<u>NGP</u>	<u>Prior Approved Equal (Compliance with BABAA)</u>
1. Weatherstrip	****	700NA	
2. Adhesive Gasket	188	5050	
3. Sweep w/ drip	8198	C627	
4. Drip Cap	142	16	
- B. Weatherstrip and gasketing shall be independently certified by ANSI for compliance with ANSI A156.22 (2005).
- C. Where specified in the hardware groups, furnish the above products unless otherwise detailed in groups.
- D. Provide weatherstripping all exterior doors and where specified.
- E. Provide intumescent and other required edge sealing systems as required by individual fire door listings to comply with positive pressure standards UL 10C.
- F. Provide Zero 188 smoke gaskets at all fire rated doors and smoke and draft control assemblies.

- G. Provide gasketing for all meeting edges on pairs of fire doors. Gasketing shall be compatible with astragal design provided by door supplier as required for specific fire door listings.

2.15 THRESHOLDS

- A. Acceptable manufacturers and respective catalog numbers:

	<u>NGP</u>	<u>Prior Approved Equal (Compliance with BABAA)</u>
1. Saddle Thresholds	425	

- A. Thresholds shall be independently certified by ANSI for compliance with ANSI A156.21 (2001).
- B. Hardware supplier shall verify all finish floor conditions and coordinate proper threshold as required to ensure a smooth transition between threshold and interior floor finish.
- C. Threshold Types:
- Unless otherwise specified, provide saddle threshold similar to Zero 8655 for all exterior openings with an interior floor finish less than or equal to 1/4" in height.
 - Unless otherwise specified, provide half saddle threshold similar to Zero 1674 for all exterior openings with an interior floor finish greater than 1/4" in height. Threshold height shall match thickness of interior floor finish.

2.16 ELECTRIC STRIKES

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Von Duprin</u>	<u>Prior Approved Equal (Compliance with BABAA)</u>
1. Type 1	6200 Series	

- B. Provide electric strikes compatible with the type of locks shown at each opening where specified.
- C. Electric strikes shall be UL listed as Burglary-Resistant Electric Door Strikes and where required shall be UL listed as Electric Strike for Fire Doors.
- D. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.17 FINISHES AND BASE MATERIALS

- A. Unless otherwise indicated in the hardware groups or herein, hardware finishes shall be applied over base metals as specified in the following finish schedule:

	<u>HARDWARE ITEM</u>	<u>BHMA FINISH AND BASE MATERIAL</u>
1.	Butt Hinges: Exterior, or Non-Ferrous	630 (US32D - Satin Stainless Steel)
2.	Butt Hinges: Interior	652 (US26D - Satin Chromium)
3.	Continuous Hinges	630 (US32D - Satin Stainless Steel)
4.	Flush Bolts	626 (US26D - Satin Chromium)
5.	Exit Devices	626 (US26D - Satin Chromium)
6.	Locks and Latches	626 (US26D - Satin Chromium)
7.	Pulls and Push Plates/Bars	630 (US32D - Satin Stainless Steel)
8.	Closers	689 (Powder Coat Aluminum)
9.	Protective Plates	630 (US32D - Satin Stainless Steel)
10.	Overhead Stops	630 (US32D - Satin Stainless Steel)
11.	Wall Stops and Holders	630 (US32D - Satin Stainless Steel)
12.	Thresholds	719 (Mill Aluminum)
13.	Weather-strip, Sweeps Drip Caps	Aluminum Anodized
14.	Miscellaneous	626 (US26D - Satin Chromium)

2.18 KEYING

- A. Acceptable manufacturers and respective catalog numbers:
 - Schlage Prior Approved Equal (Compliance with BABAA)
- 1. Everest 29
- B. Provide all locks and cylinders utilizing a patented keyway to prevent manufacturing and distribution of aftermarket key blanks by anyone other than factory authorized dealers.
- C. All locks under this section shall be keyed as directed by the owner to a new Patented Master Key System.
- D. Keying shall be by lock manufacturer where permanent records shall be kept.
- E. Furnish a total of 2 keys per cylinder. Actual cut keys to be determined by owner.
- F. Furnish a total of 10 construction keys. Furnish a total of 2 construction control keys.
- G. Furnish a minimum of 2 permanent control keys. Actual number to be determined by owner during keying meeting.
- H. Master keys, control keys to be delivered by registered mail to the owner. Change keys shall be delivered in a set up key cabinet. Construction keys shall be delivered to the contractor.

2.19 FIRE DEPARTMENT ACCESS BOX

- A. Acceptable manufacturers, subject to compliance with specified requirements, acceptable manufacturers and products are:
 - 1. Dama, S3 (surface-mount)
 - 2. Dama, R3 (recessed mount)
 - 3. Knox-Box, 3200 Series
 - 4. Tru-Lock (recessed mount), Eau Claire, WI
- B. Verify manufacturer is acceptable to local Fire Department.
- C. Requirements:
 - 1. Coordinate keying requirements with the authority having jurisdiction.
 - 2. Verify surface or flush mount box with E/A.
 - 3. Finish: Corrosion resistant.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Prior to installation of hardware, installer shall examine door frame installation to ensure frames have been set square and plumb. Installer shall examine doors, door frames, and adjacent wall, floor, and ceiling for conditions, which would adversely affect proper operation and function of door assemblies. Do not proceed with hardware installation until such deficiencies have been corrected.

3.2 INSTALLATION

- A. Before hardware installation, general contractor/construction manager shall coordinate a hardware installation seminar with a 1 week notice to all parties involved. The seminar is to be conducted on the installation of hardware, specifically of locksets, closers, exit devices, continuous hinges and overhead stops. Manufacturer's representative of the above products to present seminar. Seminar to be held at the job site and attended by installers of hardware (including low voltage hardware) for aluminum, hollow metal and wood doors. Training to include use of installation manuals, hardware schedule, templates and physical products samples.
- B. Shim doors as required to maintain proper operating clearance between door and frame.

- C. Install all hardware according to the approved hardware schedule and manufacturer's instructions for installation and adjustment.
- D. Set units level, plumb and true to the line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Provide blocking or reinforcement for all hardware mounted to drywall construction, including wall mounted door stops and holders.
- F. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accord with industry standards.
- G. Drill appropriate size pilot holes for all hardware attached to wood doors and frames.
- H. Unless otherwise specified, locate all hardware according to the recommended locations for builders hardware for standard doors and frames as published by the Door and Hardware Institute (TDH-007-20).
- I. Use only fasteners supplied by or approved by the manufacturer for each respective item of hardware.
- J. Mortise and cut to close tolerance and conceal evidence of cutting in the finished work.
- K. Conceal push and pull bar fasteners where possible. Do not install through bolts through push plates.
- L. Install hardware on UL labeled openings according to manufacturer's requirements to maintain the label.
- M. Apply self-adhesive gasketing on frame stop at head and latch side and on rabbet of frame at hinge side.
- N. Install hardware according to supplemental "S" label instructions on all fire rated openings.
- O. Install wall stops to contact lever handles or pulls. Do not mount wall stops on casework, or equipment.
- P. Where necessary, adjust doors and hardware as required to eliminate binding between strike and latchbolt. Doors should not rattle.
- Q. Overhead stops used in conjunction with electrified hold open closers shall be templated and installed to coincide with engagement of closer hold open position.
- R. Install door closers on corridor side of lobby doors, room side of corridor doors, and stair side of stairways.
- S. Adjust spring power of door closers to the minimum force required to ensure exterior and fire rated doors will consistently close and latch doors under existing conditions. Adjust all other door closers to ensure opening force does not to exceed 5 lbs.
- T. Adjust "sweep", "latch", and "back check" valves on all door closers to properly control door throughout the opening and closing cycle. Adjust total closing speed as required to comply with all applicable state and local building codes.
- U. Install "hardware compatible" (bar stock) type weatherstripping continuously for an uninterrupted seal. Adjust templating for parallel arm door closers, exit devices, etc., as required to accommodate weatherstripping.
- V. Unless otherwise specified or detailed, install thresholds with the bevel in vertical alignment with the outside door face. Notch and closely fit thresholds to frame profile. Set thresholds in full bed of sealant.
- W. Compress sweep during installation as recommended by sweep manufacturer to facilitate a water-resistant seal.
- X. Deliver to the owner 1 complete set of installation and adjustment instructions, and tools as furnished with the hardware.

3.3 FIELD QUALITY CONTROL

- A. After installation has been completed, the hardware supplier and manufacturers representative for locksets, door closers, exit devices, and overhead stops shall check the project and verify compliance with installation instructions, adjustment of all hardware items, and proper application according to the approved hardware schedule. Hardware supplier shall submit a list of all hardware that has not been installed correctly.
- B. After installation has been completed, the hardware supplier and manufacturers representative shall meet with the owner to explain the functions, uses, adjustment, and maintenance of each item of hardware. Hardware supplier shall provide the owner with a copy of all wiring diagrams. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.

3.4 ADJUSTMENT AND CLEANING

- A. At final completion, and when H.V.A.C. equipment is in operation, installer shall make final adjustments to and verify proper operation of all door closers and other items of hardware. Lubricate moving parts with type lubrication recommended by the manufacturer.
- B. All hardware shall be left clean and in good operation. Hardware found to be disfigured, defective, or inoperative shall be repaired or replaced.

3.5 HARDWARE SCHEDULE

- A. The following schedule of hardware groups are intended to describe opening function. The hardware supplier is cautioned to refer to the preamble of this specification for a complete description of all materials and services to be furnished under this section.

HW SET: 01

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	PASSAGE SET	L9010	SCH
1	EA	WALL STOP	(AS REQUIRED)	IVE

FUNCTION: L9010 (F01) PASSAGE LATCH

LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HW SET: 02

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	OFFICE/ENTRY LOCK	L9050	SCH
1	EA	WALL STOP	(AS REQUIRED)	IVE

FUNCTION: L9050 (F04) OFFICE AND INNER ENTRY LOCK

LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE UNLESS OUTSIDE IS MADE INOPERATIVE BY KEY OUTSIDE OR BY TURNING INSIDE THUMBTURN. WHEN OUTSIDE IS LOCKED, LATCHBOLT IS RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER REMAINS LOCKED UNTIL THUMBTURN IS RETURNED TO VERTICAL OR UNLOCKED BY KEY. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 03

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	OFFICE/ENTRY LOCK	L9050	SCH
1	EA	OH STOP	90S	GLY

FUNCTION: L9050 (F04) OFFICE AND INNER ENTRY LOCK

LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE UNLESS OUTSIDE IS MADE INOPERATIVE BY KEY OUTSIDE OR BY TURNING INSIDE THUMBTURN. WHEN OUTSIDE IS LOCKED, LATCHBOLT IS RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER REMAINS LOCKED UNTIL THUMBTURN IS RETURNED TO VERTICAL OR UNLOCKED BY KEY. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 04

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	CONST LATCHING BOLT	FB51T / FB61T	IVE
			(TOP BOLT)	
1	EA	STOREROOM LOCK	L9080	SCH
1	EA	OH STOP & HOLDER	90H	GLY
			(ACTIVE LEAF)	
1	EA	OH STOP	90S	GLY
			(INACTIVE LEAF)	
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	OVERLAP ASTRAGAL	(BY DOOR SUPPLIER)	

FUNCTION: L9080 (F07) STOREROOM LOCK

LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 05

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	CONST LATCHING BOLT	FB51T / FB61T	IVE
			(TOP BOLT)	
1	EA	STOREROOM LOCK	L9080	SCH
2	EA	OH STOP	90S	GLY
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	OVERLAP ASTRAGAL	(BY DOOR SUPPLIER)	

FUNCTION: L9080 (F07) STOREROOM LOCK

LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 06

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	CLASSROOM LOCK	L9070	SCH
1	EA	WALL STOP	(AS REQUIRED)	IVE

FUNCTION: L9070 (F05) CLASSROOM LOCK

LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE UNLESS OUTSIDE IS LOCKED BY KEY. UNLOCKED FROM OUTSIDE BY KEY. INSIDE LEVER ALWAYS FREE FOR IMMEDIATE EXIT. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 07

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	CLASSROOM LOCK	L9070	SCH
1	EA	OH STOP	90S	GLY

FUNCTION: L9070 (F05) CLASSROOM LOCK

LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE UNLESS OUTSIDE IS LOCKED BY KEY. UNLOCKED FROM OUTSIDE BY KEY. INSIDE LEVER ALWAYS FREE FOR IMMEDIATE EXIT. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 08

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM LOCK	L9080	SCH
1	EA	WALL STOP	(AS REQUIRED)	IVE

FUNCTION: L9080 (F07) STOREROOM LOCK

LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 09

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	CONST LATCHING BOLT	FB51T / FB61T	IVE
1	EA	STOREROOM LOCK	L9080	SCH
2	EA	OH STOP	90S	GLY
1	EA	OVERLAP ASTRAGAL (BY DOOR SUPPLIER)		

FUNCTION: L9080 (F07) Storeroom Lock

LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 10 – NOT USED**HW SET: 10A**

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	PANIC HARDWARE	LD-9927-EO-LBR	VON
1	EA	PANIC HARDWARE	LD-9927-L-NL-LBR	VON
1	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
1	EA	SURFACE CLOSER	4050A SCUSH	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER.

FUNCTION: (EO) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD. NO EXTERIOR TRIM.

HW SET: 11

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	PASSAGE SET	L9010	SCH
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	(AS REQUIRED)	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: L9010 (F01) PASSAGE LATCH

LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HW SET: 12

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	CLASSROOM LOCK	L9070	SCH
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	(AS REQUIRED)	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: L9070 (F05) CLASSROOM LOCK

LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE UNLESS OUTSIDE IS LOCKED BY KEY. UNLOCKED FROM OUTSIDE BY KEY. INSIDE LEVER ALWAYS FREE FOR IMMEDIATE EXIT. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 13

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	CLASSROOM LOCK	L9070	SCH
1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4050A EDA	LCN

FUNCTION: L9070 (F05) CLASSROOM LOCK

LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE UNLESS OUTSIDE IS LOCKED BY KEY. UNLOCKED FROM OUTSIDE BY KEY. INSIDE LEVER ALWAYS FREE FOR IMMEDIATE EXIT. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 14

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	CLASSROOM LOCK	L9070	SCH
1	EA	SURFACE CLOSER	4050A SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: L9070 (F05) CLASSROOM LOCK

LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE UNLESS OUTSIDE IS LOCKED BY KEY. UNLOCKED FROM OUTSIDE BY KEY. INSIDE LEVER ALWAYS FREE FOR IMMEDIATE EXIT. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 15

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM LOCK	L9080	SCH
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	(AS REQUIRED)	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: L9080 (F07) STOREROOM LOCK

LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 16

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	INSTITUTION LOCK	L9082	SCH
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	(AS REQUIRED)	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: L9082 INSTITUTION LOCK

LATCHBOLT RETRACTED BY KEY FROM EITHER SIDE. LEVER ON BOTH SIDES ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 17 – NOT USED

HW SET: 17A

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	EXIT LOCK	L9025	SCH
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CVX	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: L9025 EXIT LOCK

BLANK PLATE OUTSIDE. INSIDE LEVER ALWAYS UNLOCKED.

HW SET: 18

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM LOCK	L9080	SCH
1	EA	OH STOP	90S	GLY
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROLS DRS ONLY)	ZER

FUNCTION: L9080 (F07) STOREROOM LOCK

LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 18A

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	PANIC HARDWARE	LD-99-NL	VON
1	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CVX	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER.

HW SET: 19

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM W/DEADBOLT	L9480	SCH
1	EA	SURFACE CLOSER	4050A SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	SET	SEALS	700NA	NGP
1	EA	DOOR SWEEP W/DRIP	8198	ZER
1	EA	CAST THRESHOLD 1/2" X 5"	425HD	NGP

FUNCTION: L9480 STOREROOM LOCK WITH DEADBOLT

LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER OR KNOB INSIDE. OUTSIDE LEVER ALWAYS FIXED. DEADBOLT THROWN OR RETRACTED BY KEY OUTSIDE OR THUMBTURN INSIDE. TURNING INSIDE LEVER SIMULTANEOUSLY RETRACTS BOTH DEADBOLT AND LATCHBOLT. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 20 – NOT USED**HW SET: 21**

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM LOCK	L9080	SCH
1	EA	SURFACE CLOSER	4050A SHCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: L9080 (F07) STOREROOM LOCK

LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HW SET: 22 – NOT USED**HW SET: 23**

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	PRIVACY LOCK	L9456N L283-722	
		(FULL ESUTCHEON)	SCH	
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	(AS REQUIRED)	IVE
1	EA	SEALS	188S	ZER

FUNCTION: L9456 PRIVACY WITH OCCUPIED INDICATOR LEVER RETRACTS LATCHBOLT FROM EITHER SIDE. DEADBOLT THROWN OR RETRACTED BY KEY OUTSIDE (RETRACTION BY KEY REQUIRED IN THE EVENT OF AN EMERGENCY) OR INSIDE THUMBTURN. THROWING DEADBOLT LOCKS OUTSIDE LEVER AND DISPLAYS OCCUPIED PLATE. ROTATING INSIDE LEVER SIMULTANEOUSLY RETRACTS BOTH DEADBOLT AND LATCHBOLT AND UNLOCKS OUTSIDE LEVER.

HW SET: 24

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM LOCK	L9080	SCH
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	OH STOP	90S	GLY
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER
1	EA	CREDENTIAL READER	(BY SECURITY SUPPLIER	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: L9080 (F07) STOREROOM LOCK LATCH BOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCH BOLT WHEN DOOR IS CLOSED.

A VALID CREDENTIAL RELEASES ELECTRIC STRIKE.

HW SET: 24A

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	INSTITUTION LOCK	L9082	SCH
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	OH STOP	90S	GLY
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER
1	EA	CREDENTIAL READER	(BY SECURITY SUPPLIER (BOTH SIDES OF OPENING)	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: L9082 INSTITUTION LOCK

LATCHBOLT RETRACTED BY KEY FROM EITHER SIDE. LEVER ON BOTH SIDES ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

A VALID CREDENTIAL FROM EITHER DIRECITON RELEASES ELECTRIC STRIKE.I

HW SET: 24B

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	INSTITUTION LOCK	L9082	SCH
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CVX	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONROL DRS ONLY)	ZER
1	EA	CREDENTIAL READER	(BY SECURITY SUPPLIER (BOTH SIDES OF OPENING)	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: L9082 INSTITUTION LOCK

LATCHBOLT RETRACTED BY KEY FROM EITHER SIDE. LEVER ON BOTH SIDES ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

A VALID CREDENTIAL FROM EITHER DIRECITON RELEASES ELECTRIC STRIKE.I

HW SET: 25

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM LOCK	L9080	SCH
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	(AS REQUIRED)	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER
1	EA	CREDENTIAL READER	(BY SECURITY SUPPLIER	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT	
			(BY HARDWARE SUPPLIER)	

FUNCTION: L9080 (F07) STOREROOM LOCK LATCH BOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCH BOLT WHEN DOOR IS CLOSED.

A VALID CREDENTIAL RELEASES ELECTRIC STRIKE.

HW SET: 25A

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM LOCK	L9080	SCH
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	SURFACE CLOSER	4050A SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER
1	EA	CREDENTIAL READER	(BY SECURITY SUPPLIER	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT	
			(BY HARDWARE SUPPLIER)	

FUNCTION: L9080 (F07) STOREROOM LOCK LATCH BOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCH BOLT WHEN DOOR IS CLOSED.

A VALID CREDENTIAL RELEASES ELECTRIC STRIKE.

HW SET: 26

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM LOCK	L9080	SCH
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	LOCK GUARD	LG1	IVE
1	EA	SURFACE CLOSER	4050A SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER

1	SET	SEALS	700NA	NGP
1	EA	DOOR SWEEP W/DRIP	8198	ZER
1	EA	CAST THRESHOLD 1/2" X 5"	425HD	NGP
1	EA	CREDENTIAL READER	(BY SECURITY SUPPLIER	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT	
			(BY HARDWARE SUPPLIER)	

FUNCTION: L9080 (F07) STOREROOM LOCK LATCH BOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCH BOLT WHEN DOOR IS CLOSED.

A VALID CREDENTIAL RELEASES ELECTRIC STRIKE.

HW SET: 27

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	PANIC HARDWARE	LD-99-EO	VON
1	EA	SURFACE CLOSER	4050A SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	SET	SEALS	700NA	NGP
1	EA	DOOR SWEEP W/DRIP	8198	ZER
1	EA	CAST THRESHOLD 1/2" X 5"	425HD	NGP

FUNCTION: (EO) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD. NO EXTERIOR TRIM.

HW SET: 28

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	FIRE EXIT HARDWARE	99-L-BE-F X 499F	VON
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	(AS REQUIRED)	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER

FUNCTION: (L-BE) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD, EXTERIOR BY LEVER. LEVER DOES NOT LOCK.

HW SET: 29

1	EA	CONT. HINGE	112HD	IVE
1	EA	DUMMY PUSH BAR	330-DT-990	VON
1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4050A EDA	LCN

FUNCTION: PUSH/PULL.

HW SET: 30

2	EA	CONT. HINGE	112HD	IVE
2	EA	DUMMY PUSH BAR	330-DT-990	VON
2	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4050A EDA	LCN
1	EA	SURF. AUTO OPERATOR	4642	LCN
2	EA	ACTUATOR	8310-853 / 8310-818	LCN

FUNCTION: PUSH/PULL.

THIS DOOR HAS A POWER OPERATOR. BOTH ACTUATORS ALWAYS ACTIVE TO OPEN THE DOOR.

HW SET: 31

1	EA	CONT. HINGE	112HD EPT	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	ELEC PANIC HARDWARE	QEL-99-NL	VON
1	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4050A EDA	LCN
1	EA	RAIN DRIP	142	ZER
	EA	WEATHERSTRIP	(BY DR/FR SUPPLIER)	
1	EA	DOOR SWEEP W/DRIP	8198	ZER
1	EA	CAST THRESHOLD 1/2" X 5"	425HD	NGP
1	EA	CREDENTIAL READER	(BY SECURITY SUPPLIER	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT	
			(BY HARDWARE SUPPLIER)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. A VALID CREDENTIAL WILL UNLOCK THE DOOR.

HW SET: 32

1	EA	CONT. HINGE	112HD	IVE
1	EA	CONT. HINGE	112HD EPT	IVE
2	EA	POWER TRANSFER	EPT10	VON
1	EA	KEYED REMOVABLE MULLION	KR-4954 STAB	VON
1	EA	PANIC HARDWARE	LD-99-EO	VON
1	EA	ELEC PANIC HARDWARE	QEL-99-NL	VON
2	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
2	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4050A EDA	LCN
1	EA	SURF. AUTO OPERATOR	4642	LCN
2	EA	ACTUATOR	8310-853 / 8310-818	LCN

1	EA	RAIN DRIP	142	ZER
	EA	WEATHERSTRIP	(BY DR/FR SUPPLIER)	
2	EA	DOOR SWEEP W/DRIP	8198	ZER
1	EA	CAST THRESHOLD 1/2" X 5"	425HD	NGP
1	EA	MULLION SEAL	8780	ZER
1	EA	CREDENTIAL READER	(BY SECURITY SUPPLIER)	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED.

THIS DOOR HAS A POWER OPERATOR. INTERIOR ACTUATOR ALWAYS ACTIVE TO UNLOCK AND OPEN THE DOOR. A VALID CREDENTIAL WILL UNLOCK DOOR AND MAKE THE EXTERIOR ACTUATOR ACTIVE.

FUNCTION: (EO) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD. NO EXTERIOR TRIM.

HW SET 32A

2	EA	CONT. HINGE	112HD EPT	IVE
2	EA	POWER TRANSFER	EPT10	VON
1	EA	KEYED REMOVABLE MULLION	KR-4954 STAB	VON
1	EA	ELEC PANIC HARDWARE	QEL-99-DT	VON
1	EA	ELEC PANIC HARDWARE	QEL-99-NL	VON
2	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
2	EA	OH STOP	100S	GLY
2	EA	SURFACE CLOSER	4050A EDA	LCN
1	EA	MULLION SEAL	8780	ZER
1	EA	CREDENTIAL READER	(BY SECURITY SUPPLIER)	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED.

FUNCTION: (DT) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD. ACCESS FROM EXTERIOR WHEN EXIT DEVICE PUSH PAD IS DOGGED DOWN.

HW SET 32B

2	EA	CONT. HINGE	112HD	IVE
1	EA	KEYED REMOVABLE MULLION	KR-4954 STAB	VON
1	EA	PANIC HARDWARE	99-DT	VON
1	EA	PANIC HARDWARE	99-NL	VON
2	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH

2	EA	OH STOP	100S	GLY
2	EA	SURFACE CLOSER	4050A EDA	LCN
1	EA	RAIN DRIP	142	ZER
1	EA	WEATHERSTRIP	(BY DR/FR SUPPLIER)	
2	EA	DOOR SWEEP W/DRIP	8198	ZER
1	EA	CAST THRESHOLD 1/2" X 5"	425HD	NGP
1	EA	MULLION SEAL	8780	ZER
1	EA	CREDENTIAL READER	(BY SECURITY SUPPLIER	
1	EA	POWER SUPPLY	(BY SECURITY SUPPLIER)	
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. ACCESS FROM EXTERIOR WHEN EXIT DEVICE PUSH PAD IS DOGGED DOWN.
FUNCTION: (DT) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD. ACCESS FROM EXTERIOR WHEN EXIT DEVICE PUSH PAD IS DOGGED DOWN.

HW SET: 33

1	EA	CONT. HINGE	112HD	IVE
1	EA	PANIC DEVICE	CD-99-NL	VON
2	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4050A EDA	LCN
1	EA	RAIN DRIP	142	ZER
	EA	WEATHERSTRIP	(BY DR/FR SUPPLIER)	
1	EA	DOOR SWEEP W/DRIP	8198	ZER
1	EA	CAST THRESHOLD 1/2" X 5"	425HD	NGP

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. ACCESS FROM EXTERIOR WHEN EXIT DEVICE PUSH PAD IS DOGGED DOWN.

HW SET: 34

ALL HARDWARE BY DOOR SUPPLIER.

HW SET: 35

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	PUSH PLATE	8200 6" X 16"	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"	IVE
1	EA	SURFACE CLOSER	4050A / 4050A EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	(AS REQUIRED)	IVE

FUNCTION: PUSH/PULL

HW SET: 35A

	EA	SPRING HINGE	(AS REQUIRED)	IVE
	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	DUTCH DOOR BOLT	054	IVE
1	EA	CYL X TURN DEAD LOCK	L460	SCH
2	EA	WALL STOP	WS406/407CVX	IVE

FUNCTION: L460 E06071 CYLINDER X THUMBTURN LOCK

DEADBOLT THROWN OR RETRACTED BY KEY OUTSIDE OR THUMBTURN INSIDE.

END OF SECTION 08 71 00

SECTION 08 80 00 – Glazing

PART 1 – GENERAL

1.1 SUMMARY

A. Provide:

1. Glass and glazing units for the following products and applications, and glazing requirements referenced by other sections:
 - a. Windows.
 - b. Doors.
 - c. Interior borrowed lites.
 - d. Glazed entrances.
 - e. Storefront framing.
 - f. Glazed curtain walls.
 - g. Skylights.
2. Glass and glazing accessories.

B. The following is not included in this section:

1. Restroom Mirrors (Section 10 28 13).

C. Related Sections:

1. Section 08 11 13 - Hollow Metal Doors and Frames (Commercial)
2. Section 08 14 00 - Wood Doors
3. Section 08 16 00 - Corrosion Resistant Doors and Frames
4. Section 08 41 13 - Aluminum Entrance Doors
5. Section 08 43 13 - Aluminum-Framed Storefront
6. Section 08 44 13 - Glazed Aluminum Curtain Wall

1.2 FEDERAL BIDDING REQUIREMENTS

A. Buy America:

1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.

B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

A. American Architectural Manufacturers Association (AAMA): AAMA 800 - Voluntary Specifications and Test Methods for Sealants.

B. American Society for Testing and Materials (ASTM):

1. C509 - Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
2. C864 - Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
3. C920 - Specification for Elastomeric Joint Sealants.
4. C1036 - Standard Specification for Flat Glass.
5. C1048 - Standard Specification for Heat-Treated Flat Glass.
6. C1087 - Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.

7. C1115 - Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.
 8. C1172 - Standard Specification for Laminated Architectural Flat Glass.
 9. C1281 - Specification for Preformed Tape Sealants for Glazing Applications.
 10. C 1330 - Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
 11. C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
 12. E774 - Specification for the Classification of the Durability of Sealed Insulating Glass Units.
 13. E1300 - Practice for Determining Load Resistance of Glass in Buildings.
 14. E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation.
- C. American National Standards Institute (ANSI): Z97.1
- D. Code of Federal Regulations: 16 CFR 1201 – Safety Standard for Architectural Glazing Materials.
- E. Glass Association of North America (GANA):
1. Glazing Manual.
 2. Laminated Glass Design Guide.
 3. Engineering Standards Manual.
- F. The Insulating Glass Manufacturers Alliance (IGMA):
1. IGMA TB-3001 – Sloped Glazing Guidelines.
 2. IGMA TB-3000 – Glazing Guidelines for Sealed Insulating Glass Units.
- G. Lawrence Berkely National Laboratory; Environmental Energy Technologies Division; Building Technologies Department; Windows & Daylighting Group, windows.lbl.gov/software:
1. LBNL Window 5.0 (or higher) - A PC Program for Analyzing Window Thermal and Optical Performance.
- H. National Fenestration Rating Council (NFRC):
1. NFRC 100 – Procedure for Determining Fenestration Product Thermal Properties.
 2. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Normal Incidence.
 3. NFRC 300 - Procedures for Determining Solar Optical Properties of Simple Fenestration Products.
- I. National Fire Protection Association (NFPA):
1. NFPA 80 – Fire Doors and Windows.
 2. NFPA 252 – Fire Tests of Door Assemblies.
 3. NFPA 257 – Fire Test for Window and Glass Block Assemblies.

1.4 DEFINITIONS

- A. Lites: Interior glazed openings.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating glass unit that contains dehydrated air or other specified gas.

- D. Sealed Insulating Glass Unit Surface Designations:
1. Surface 1 - Exterior surface of the outer glass lite.
 2. Surface 2 - Interspace surface of the outer glass lite.
 3. Surface 3 - Interspace surface of the inner glass lite.
 4. Surface 4 - Interior surface of the inner glass lite.

1.5 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide glazing systems capable of withstanding thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following:
 - a. Defective manufacture, fabrication, and installation.
 - b. Failure of sealants or gaskets to remain watertight and airtight.
 - c. Deterioration of glazing materials.
 - d. Other defects in construction.
 - e. Where fire rated glass is required, provide fire rating as indicated on the Drawings.

B. Performance Requirements:

1. General: Provide glazing systems that will withstand indicated loads and normal thermal movement without failure, including loss or glass breakage resulting from defective manufacture, fabrication, or installation; failure of glazing systems to remain watertight and airtight; or deterioration of glazing materials.
2. Glass Design: Glass thicknesses indicated are minimums. Select actual glass lite thicknesses by analyzing loads and conditions. Provide glass lites in the thicknesses and in strengths required to meet or exceed the following criteria:
 - a. Glass Thicknesses: Comply with ASTM E 1300, as follows:
 - 1) Specified Design Wind and Snow Loads: As indicated on the Drawings.
 - 2) Probability of Breakage for Vertical Glazing: 8 lites per 1000, for lites set within 15 degrees of vertical and under wind load for a load duration of 3 seconds.
 - 3) Probability of Breakage for Sloped Glazing: 1 lite per 1000, for lites set more than 15 degrees off vertical and under wind and snow loads for a duration of 30 days.
 - 4) Thickness of Tinted Glass: Provide the same thickness for each tint color for all applications.
3. Thermal Movements: Allow for thermal movements of glazing components and glass framing members resulting from a temperature change range of 120 deg F ambient and 180 deg F material surfaces.
4. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
 - a. For monolithic-glass lites, properties are based on units with lites of thickness indicated; if not indicated, 1 inch thick for exterior glazing and 1/4" thick for interior glazing.
 - b. For laminated-glass lites, properties are based on products of construction indicated.
 - c. For frosted glass lites, properties are based on the products of construction indicated.

- d. For insulating-glass units (all tinted glass), properties are based on units with lites 6.0 mm thick and a nominal 1/2-inch-wide interspace.
- e. Provide glass meeting specified performance properties, based on manufacturer's published test data for units of thickness indicated, and the following:
 - 1) Center-of-glass values: Based on using LBNL WINDOW 5.0 (or higher) analysis, as follows:
 - a) U-factors: NFRC 100 expressed as Btu/square foot times height times degree F.
 - b) Solar heat gain coefficient: NFRC 200.
 - c) Solar Optical Properties: NFRC 300.

1.6 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings: Submit Shop Drawings for each type of glass showing system fabrication, installation drawings, including plans, elevations, sections, details of components, joint locations and configurations within system and between system and adjoining system.
 - 1. Use same designations indicated on the Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- D. Samples: Submit manufacturer's standard color samples with Product Data and Shop Drawings.
- E. Certifications: Provide manufacturer's signed product certificate that products furnished comply with requirements.
- F. Test Reports:
 - 1. Preconstruction Adhesion and Compatibility Test Report: Provide from glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.
- G. Qualification Information: For Installer firm and Installer's manufacturer/fabricator-trained field supervisor.
- H. Warranties: Submit sample meeting warranties requirements of this section.

1.7 QUALITY ASSURANCE

- A. One Source Responsibility: Provide glass and glazing units made of components of standard construction furnished by one manufacturer as coordinated assemblies.
 - 1. For glass sputter-coated with solar-control low-e coatings, obtain glass products in fabricated units from a manufacturer/fabricator certified by the primary glass manufacturer.
- B. Qualifications:
 - 1. Manufacturer: 10 years experience in the manufacture of glass and glazing.
 - 2. Installer: 5 years experience in the successful installation of glass and glazing, approved by glass product manufacturer/fabricator.
 - 3. Personnel: For actual installation of glass and glazing, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of Work.

- C. Testing:
 - 1. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
 - 2. Preconstruction Adhesion and Compatibility Testing: Submit glass units, glazing materials, and glass-framing members with applicable finish to elastomeric glazing sealant manufacturer for determination of sealant compatibility, priming, and preparation requirements for optimum adhesion and performance.
 - D. Glazing for Fire-Rated Door and Window Assemblies: Glazing tested per NFPA 252 and NFPA 257, as applicable, for assemblies complying with NFPA 80 and listed and labeled per requirements of authorities having jurisdiction.
 - E. Glazing Industry Publications: Comply with glass product manufacturers' recommendations and the following:
 - 1. GANA Publications: GANA Laminated Division's 'Laminated Glass Design Guide' and GANA's 'Glazing Manual.'
 - 2. IGMA Publication for Insulating Glass: IGMA TM-3000, 'Glazing Guidelines for Sealed Insulating Glass Units.'
 - F. Insulating-Glass Certification Program: Indicate compliance with requirements of Insulating Glass Certification Council on applicable glazing products.
 - G. Mockups: Prior to installing glazing, build mockups to demonstrate materials and workmanship. Coordinate with mockup requirements of related sections.
 - H. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Protect glazing materials during shipping, handling, and storage to prevent breakage, scratching, damage to seals, or other visible damage. Deliver, unload, store, and erect glazing materials without exposing panels to damage from construction operations.
 - 1. Comply with manufacturer's venting and sealing recommendations for shipping and handling of insulating glass units exposed to substantial altitude change.
- 1.9 PROJECT CONDITIONS
- A. Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet.
 - B. Do not install liquid glazing sealants when ambient and substrate temperature conditions are below 40 degrees F.
- 1.10 WARRANTY
- A. Provide 10-year written warranty, beginning at date of substantial completion, covering labor, materials for replacement of spontaneous failure of all tempered glass used on Project.
 - B. For any glass requiring replacement under this warranty, provide a new minimum 5 year warranty commencing at date of acceptance of replacement glass by Owner and E/A.
 - C. Hermetically sealed insulating glass: Submit written warranty agreeing to replace units which fail to maintain hermetic seal of air space, deteriorate, or otherwise fail to perform as required within 10 years after date of Substantial Completion as a result of failure of materials or workmanship.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Glass:

1. Standard of Quality: Unless indicated otherwise, design is based on products of Vitro Architectural Glass, Cheswick, PA www.vitroglazings.com
 - a. 6 mm Optigray® Solarban® 60 #2, 12.7mm Argon Spacer, 6mm Clear.
2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable fabricators and products are:
 - a. Cardinal Glass, Northfield, MN www.cardinalcorp.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

B. One-Way Mirror Glass:

1. Basis of Design: Unless indicated otherwise, design is based on products of Pilkington, Burnsville, MN www.pilkington.com
2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable fabricators and products are:
 - a. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

A. Primary Glass Products:

1. Annealed Float Glass:
 - a. ASTM C1036, Type I (transparent glass, flat).
 - b. Quality Q3 (glazing select).
 - c. Class: See schedules in Part 3.
2. Tinted/Reflective Float Glass (exterior windows):
 - a. Type I, (transparent glass flat).
 - b. ASTM C1048, Class 2 (tint heat absorbing and light reducing), Condition C
 - c. Quality Q3 (glazing select).

B. Heat-Treated Glass Products:

1. ASTM C1048; Type I (transparent flat glass).
2. Quality Q3 (glazing select).
3. Class, Kind and Conditions: See schedule in Part 3.
4. Tempered Glass: Provide tempered float glass required by safety of CPSC 16 CFR 1201, other codes and regulations, where safety glass is indicated and all locations within 8'-0" of a walking surface, including ground and floors.
5. Heat Strengthened Glass: Categories 1 and 2 and ANSI 297.1-1984.

C. Sealed Insulating Glass:

1. Double Glazed Tinted Solar Control Insulating Glass Unit.
 - a. Insulating Glass Units:
 - 1) Factory assembled units consisting of dual-sealed lites of glass separated by a dehydrated interspace, with manufacturer's standard spacer material and construction, per ASTM E 2190.
2. See Schedule in Part 3.

3. Outdoor Lite Glazing Type: Low-E Tinted Insulating zaSSGlass.
 - a. Conformance: ASTM C1036, Type 1, Class 2, Quality q3.
 - b. Glass thickness: 1/4 inch.
 - c. Magnetic Sputter Vacuum Deposition Coating (MSVD): ASTM C1376.
 - d. Heat-Treatment:
 - 1) Heat-strengthened, ASTM C1048, Kind HS or Tempered.
 - 2) ASTM C1048, Kind FT.
 - 3) Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201.
 4. Interspace Content: Air (10%) / Argon (90%) Mix. 1/2 inch thick.
 5. Indoor Lite Glazing Type: Clear float glass.
 - a. Conformance: ASTM C1036, Type 1, Class 1, Quality q3.
 - b. Glass thickness: 1/4 inch.
 - c. Heat-Treatment:
 - 1) Heat-strengthened, ASTM C1048, Kind HS or Tempered.
 - 2) ASTM C1048, Kind FT.
 - 3) Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201
 6. Performance Values:
 - a. Visible Light Transmission (VLT): Minimum 50 percent.
 - b. Solar Heat Gain Coefficient (SHGC): 0.29.
 - c. Shading Coefficient: 0.34.
 - d. Exterior reflectance: 8%.
 - e. U-value winter: 0.29 maximum.
 - 1) U-value winter: 0.24 90% Argon + 10% Air, or as required to meet thermal codes.
 - f. U-value summer: 0.27 maximum.
 7. Organic sealed edges.
 8. Float glass each side of similar thickness, laminated safety or tempered glass where codes prohibit use of float glass and where shown on Drawings.
- D. Spandrel Glass:
1. Double Glazed Tinted Solar Control Spandrel Insulating Glass Unit.
 - a. Insulating Glass Units:
 - 1) Factory assembled units consisting of dual-sealed lites of glass separated by a dehydrated interspace, with manufacturer's standard spacer material and construction, per ASTM E 2190.
 2. See Schedule in Part 3.
 3. Outdoor Lite Glazing Type: Low-E Tinted Insulating Glass.
 - a. Conformance: ASTM C1036, Type 1, Class 2, Quality q3.
 - b. Glass thickness: 1/4 inch.
 - c. Magnetic Sputter Vacuum Deposition Coating (MSVD): ASTM C1376.
 - d. Heat-Treatment:
 - 1) Heat-strengthened, ASTM C1048, Kind HS or Tempered.
 - 2) ASTM C1048, Kind FT.

- 3) Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201.
4. Interspace Content: Air (10%) / Argon (90%) mix. 1/2 inch.
5. Indoor Lite Glazing Type: Clear float glass.
 - a. Conformance: ASTM C1036, Type 1, Class 1, Quality q3.
 - b. Glass thickness: 1/4 inch.
 - c. Heat-Treatment:
 - 1) Heat-strengthened, ASTM C1048, Kind HS or Tempered.
 - 2) ASTM C1048, Kind FT.
 - 3) Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201
 - d. Coating: Ceramic Frit, 100 percent coverage. Color: Warm Gray.
 - e. Insulation: 2 inches high density insulation board taped to the backside of the glazing. frame. Maintain 1 inch air gap between insulation and glass.
6. Performance requirements:
 - a. Visible Light Transmittance (VLT): 3 percent minimum.
 - b. Solar Heat Gain Coefficient: 0.22 maximum.
 - c. Shading Coefficient: 0.26 maximum.
 - d. Outdoor Visible Light Reflectance: 13 percent maximum.
 - e. U-value winter: 0.24 maximum.
 - 1) U-value winter: 0.24 90% Argon + 10% Air, or as required to meet thermal codes.
 - f. U-value summer: 0.22 maximum.
- E. One-Way Mirror Glass:
 1. One-way vision glass which creates an opaque mirror-like visual barrier between subjects while allowing observers to see through the glass.
 2. Glass Type: Mirropane on Grey Glass.
 3. Visible Light Transmittance (VLT): 11 percent.
 4. Reflectance Coated Side: 68 percent.
 5. Visible Reflectance Glass Side: 16 percent.
 6. Thickness: 1/4 inch (6 mm).
- F. Accessories: Glazing accessories, other material not specifically called for, to be new, first quality of respective kinds, subject to approval of E/A.
 1. Sealant:
 - a. Acid-curing silicone.
 - b. Compatible with other sealants and other materials they will contact.
 2. Glazing Tape:
 - a. AAMA 800.
 - b. 1/8 inch at interior lites in hollow metal frames or as recommended by glazing manufacturer.
 - c. Nonstaining and nonmigrating in contact with nonporous surfaces.
 3. Glazing Gaskets:
 - a. ASTM C864 and C509.
 - b. Neoprene glazing gaskets of profiles indicated.

- c. Manufactured from virgin neoprene compounded to meet physical properties of ASTM C542.
 - d. Provide gaskets and zipper lock strips with premolded corners (cut strips of gasket material not acceptable).
- 4. Aluminum Extrusions:
 - a. 6063-T5 alloy aluminum extrusions for glazing gasket frame sections.
 - b. Finish architectural Class I anodic coating AA-M12 C22 A42 – verify color with E/A.
- 5. Setting Blocks:
 - a. ASTM C864.
 - b. Neoprene with Shore, Type A hardness of 80 to 90 durometer.
 - c. Not less than 3 inches long nor more than 8 inches long; length such that loading is 15 psi.
 - d. Height required for glazing method, pane weight, and pane area.
 - e. Full width of rabbet where possible.
- 6. Spacer Shims:
 - a. ASTM C864
 - b. Neoprene with Shore, Type A hardness of 50 to 60 durometer.
 - c. Not less than 3 inches, one half height of glazing stop.
 - d. Thickness as required for application.
 - e. One face self-adhesive.
- 7. Edge Blocks:
 - a. Elastomeric material of hardness required to limit glass lateral movement (side walking).
- 8. Glazing Sealants:
 - a. ASTM C920
 - b. Type recommended by glazing manufacturer for application indicated.
 - c. Comply with requirements of Section 07 92 00 Joint Sealants.
- 9. Other Materials: Other materials not specifically described but required for complete, proper installation of glass and glazing, subject to acceptance of E/A.

2.3 FABRICATION

- A. Fabricate glass to sizes required for glazing openings, with edge clearances and tolerances complying with glass manufacturer's recommendations.
- B. Provide thickness indicated or, if not indicated, as recommended by glass manufacturer for application indicated.
- C. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.
- D. Grind smooth and polish exposed glass edges and corners.

2.4 FINISHES

- A. Colors of glazing materials exposed to view in finished work shall be selected from manufacturer's standard colors.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that Work is complete to point where this installation may properly commence.
- B. Verification of Conditions:
 - 1. Verify that glazing may be done according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
 - 2. Examine for compliance:
 - a. Manufacturing and installation tolerances, including those for size, squareness, and offsets and corners.
 - b. Presence and functioning of weep system.
 - c. Minimum required face or edge clearances.
 - d. Effective sealing between joints of glass-framing members.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved.

3.2 PREPARATION

- A. Protect installed work and materials of other trades.
- B. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- C. Confirm that minimum required face and edge clearances will be maintained. Do not proceed with glazing until unsatisfactory conditions have been corrected.
- D. Examine glazing units prior to setting. Reject units that display edge or face damage that may impede performance of unit or that will be visible when installed.
- E. Clean glazing channels with manufacturer's recommended solvent and wipe dry. Apply primers to joint surfaces to ensure adhesion of sealants, unless preconstruction sealant-substrate testing indicates no primer is required.
- F. Protect glass edges from damage during handling and installation. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

3.3 INSTALLATION

- A. Glazing:
 - 1. General: Install glass and glazing materials according to instructions of manufacturers and requirements of GANA Glazing Manual.
 - a. Install setting blocks of size and in location required by glass manufacturer. Set blocks in bed of approved sealant.
 - b. Provide spacers for glass lites as recommended, based upon size of glass unit.
 - c. Comply with glass manufacturer's limits on edge pressures.
 - d. Ensure that glazing units are set with proper and consistent orientation of glass units toward interior and exterior.
 - e. Provide edge blocking where recommended.
 - f. Install sealants according to requirements of Division 07 Section 'Joint Sealants.'
 - 2. Set glass in true plane, tight, straight, with proper, adequate clearance.
 - 3. Install glazing from interior only. No exterior glazing permitted.
 - 4. Locate setting blocks at quarter points of sill; set in sealant if heel or toe bead is required.

5. Install aluminum gasket frames in bed of acoustic sealant.
6. Install spacers inside and out except where pre-shimmed tape or glazing gaskets are to be used.
7. Firmly anchor to prevent rattling and looseness.
8. Cleanly cut edges, do not nip or seam.
9. Do not leave voids in glazing channels except as specifically indicated or recommended by glass manufacturer.
 - a. Force sealant into channel to eliminate voids.
 - b. Tool exposed surfaces to slightly wash away from joint.
 - c. Trim and clean promptly.
 - d. Do not allow sealant to close weeps of aluminum framing.

3.4 CLEANING AND PROTECTION

A. Site:

1. Do not allow accumulation of scraps, debris arising from Work of this Section.
2. Maintain premises in neat, orderly condition.
3. Separate and recycle float glass, tempered glass, plastic materials, and corrugated cardboard.

B. Glass and Glazing:

1. Correct imperfections and replace glass damaged during construction period.
2. Leave labels on glass until it has been inspected and approved. Remove non-permanent labels immediately thereafter.
3. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass.
4. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter.
5. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction for buildup of dirt, scum, alkaline deposits, or stains. Remove as recommended by glass manufacturer.
6. Wash glass on both exposed surfaces not more than 4 days before date scheduled for Substantial Completion inspection. Wash glass as recommended by glass manufacturer.

3.5 SCHEDULE

G1 – 1" Insulated Glass Unit - Gray

¼" Solarban 60® on Optigray® Tinted Float Glass, with solar control (sputtered) on second surface (#2)

½" Air Space with 90% Argon + 10% Air

¼" Clear Float Glass

G1T – 1" Insulated Glass Unit Tempered - Gray

¼" Solarban 60® on Optigray® Tinted Float Glass - Tempered, with solar control (sputtered) on second surface (#2)

½" Air Space with 90% Argon + 10% Air

¼" Clear Float Glass - Tempered

G2 – 1/4" One-Way Mirror Glass

G2T – 1/4" Tempered One-Way Mirror Glass

G3 – 1/4" Tempered Clear

G4 – 3/8" Laminated Clear

SP1 – 1" Insulated Glass Unit Spandrel - Gray

1/4" Solarban 60® on Optigray® Tinted Float Glass, with solar control (sputtered) on second surface (#2)

1/2" Air Space with 90% Argon + 10% Air

1/4" Clear Float Glass with 100% Warm Gray Frit on fourth surface (#4)

END OF SECTION 08 80 00

SECTION 08 90 00 – Louvers and Vents

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Linear bar grilles.
- B. Related Sections:
 - 1. Section 06 61 00 - Cast Polymer Fabrications (Quartz)
 - 2. Section 07 92 00 - Joint Sealants
 - 3. Section 12 30 00 - Manufactured Casework
 - 4. Division 23 - Heating, Ventilating, and Air Conditioning

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASHRAE:
 - 1. 55 - Thermal Environmental Conditions for Human Occupancy.
 - 2. 70 - Method of Testing the Performance of Air Outlets and Air Inlets.
- B. ASTM:
 - 1. D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces.
 - 2. D714 - Standard Test Method for Evaluating Degree of Blistering of Paints.
 - 3. D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
 - 4. D4752 - Standard Practice for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub.
- C. NFPA:
 - 1. 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

1.4 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including elevations, sections details of components, within system and between system and adjoining system.
- D. Color Samples: Submit manufacturer's standard color samples with Product Data and Shop Drawings.
- E. Maintenance Manual: Provide to Owner, maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide linear bar grille units made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
 - 1. Manufacturer: 10 years experience in the manufacture of linear bar grilles.
- C. Field Samples: If requested, furnish sample of each type of louver to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.
- D. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.6 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.7 WARRANTY

- A. Provide manufacturer's standard written warranty for materials and workmanship.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Standard of Quality: Design is based on products of Price Industries, Suwanee, GA www.priceindustries.com
- B. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - 1. Architectural Grille, Brooklyn, NY www.archgrille.com
 - 2. Advanced Architectural Grilleworks, New Hyde Park, NY www.aagrilles.com
 - 3. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 LINEAR BAR GRILLES

- A. Furnish and install linear bar grilles of sizes and mounting types indicated on the Drawings.
- B. Product: Model LBP.
- C. Construction:
 - 1. The grilles shall have fixed deflection blades spaced 1/4 inch on center. The blades shall run parallel to the long dimension of the grille.
 - 2. The grille blades, border, and mullions material shall be heavy extruded aluminum construction.
 - 3. Units wider than 18 inches shall be supplied in multiple sections with mounting channels. The maximum section length shall be 72 inches.
 - 4. The core shall be supplied with 3/32 inch bars.
- D. Finish:
 - 1. All components shall have a baked-on powder coat finish.
 - a. The paint finish must demonstrate no degradation when tested according to ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
 - b. The paint film thickness shall be a minimum of 2.0 mils.
 - c. The finish shall have a hardness of 2H.

- d. The finish shall withstand a minimum salt spray exposure of 1000 hours with no measurable creep according to ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.
 - e. The finish shall have an impact resistance of 80 inch-pounds.
- E. Options:
 - 1. End Conditions:
 - a. The grille shall be supplied with the following end conditions:
 - 1. Both ends mitered (XX).
 - 2. Opposed Blade Damper:
 - a. The grille shall be supplied with an opposed blade damper and shall be operable from the grille face.
 - b. The damper shall be coated heavy duty 18 gauge cold rolled steel construction, and shall be supplied with a face accessible screw type blade locking mechanism.
 - 3. Border Style:
 - a. The grille shall be suitable for surface mounting, complete with a border in the following style:
 - 1) 1/2 inch border with mounting frame and spring clip fastening.
 - 4. Fastening:
 - a. The grille shall be supplied with the following fastening method:
 - 1) Spring clip.
 - 5. Mitered Corner Module:
 - a. The grille shall be supplied with a mitered corner module fixed at 135 degrees.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing Work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that louvers may be installed according to original design, pertinent codes, regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A in writing. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 INSTALLATION

- A. Interface with Other Work: Communicate and coordinate with mechanical installer.
- B. Louver Units:
 - 1. Install according to manufacturer's approved Shop Drawings.
 - 2. Install plumb, level, in proper alignment with adjacent work.
 - 3. Form tight joints. Anchor firmly.

3.3 REPAIR/RESTORATION

- A. Touch up marred finishes but replace units that cannot be restored to factory-finished appearance. Use materials, procedures recommended or furnished by manufacturer.

3.4 ADJUSTING AND PROTECTION

- A. Protect from damage during remainder of construction period.

3.5 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from work of this section. Maintain premises in neat, orderly condition.
- B. System:
 - 1. Clean exposed surfaces of louvers to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
 - 2. Before final inspection, clean exposed surfaces using materials and methods recommended by manufacturer.

END OF SECTION 08 90 00

END OF DIVISION 08 - OPENINGS

DIVISION 09 – FINISHES

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09 66 16	Precast Epoxy Terrazzo
09 67 00	Fluid Applied Flooring
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09 77 00	Fiberglass Reinforced Plastic (FRP) Panels
09 91 00	Painting
END OF INDEX	

SECTION 09 22 00 – Non-Structural Metal Framing

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide non-load-bearing steel framing members for the following applications:
 - 1. Interior Framing Systems (supports for partition walls, frames soffits, furring, etc.):
 - a. Studs (1'-4" on center unless otherwise noted).
 - b. Runners.
 - c. Light gauge reinforcement.
 - d. Furring channels (2 feet on center unless otherwise noted).
 - e. Resilient channels (2 feet on center unless otherwise noted).
- B. Related Sections:
 - 1. Section 05 40 00 - Cold-Formed Metal Framing
 - 2. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 3. Section 07 21 00 - Thermal Insulation
 - 4. Section 09 29 00 - Gypsum Board
 - 5. Section 09 51 13 - Acoustical Panel Ceilings

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy

America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

A. ASTM:

1. A641 - Standard for Zinc-Coated Carbon Steel Wire
2. C645 - Standard for Non-Structural Steel Framing
3. C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
4. C841 - Installation of Interior Lathing and Furring
5. C840 - Application and Finishing of Gypsum Board
6. D226 - Asphalt Saturated Organic Felt
7. E90 - Test for Airborne Sound Transmission
8. E119 - Fire Tests of Building Construction Materials
9. E413 - Rating Sound Insulation

1.4 DEFINITIONS

A. UL: Underwriters Laboratories.

1.5 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections details of components, joint locations and configurations within system and between system and adjoining system.
- D. Quality Assurance/Control Submittals:
 1. Test Reports: UL reports indicating approval for use in fire rated assemblies.

1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide metal support system units made of components of standard construction furnished by 1 manufacturer as coordinated assemblies.
- B. Qualifications:
 1. Manufacturer: 5 years experience in the manufacture of metal support systems.
 2. Contractor: 3 years experience in the installation of metal support systems.
 3. Personnel: For actual installation of metal support systems, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- D. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
- E. Field Samples: If requested, furnish sample of each type of metal support systems to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.

1.7 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.8 SEQUENCING

- A. Carefully coordinate requirements for support backing of items to be mounted on finished walls and ceilings.
- B. Carefully coordinate requirements for pipes, ducts, cabling, other services in soffits, plenums, other items designed to be housed within partition, wall, or soffit system.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - 1. Steel Studs and Furring Materials:
 - a. ClarkDietrich Industries, Inc., Pittsburgh, PA www.clarkdietrich.com
 - b. Custom Steelcraft, Lakeville, MN www.customsteelcraft.com
 - c. SCAFCO Steel Stud Company, Spokane, WA www.scacfo.com
 - d. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
 - 2. Fire Rated Expansion System Slip Head Channel:
 - a. Fire Track Corporation, Kimball, MN www.firetrak.com
 - b. ClarkDietrich Industries, Inc., Pittsburgh, PA www.clarkdietrich.com
 - c. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 COMPONENTS

- A. Steel Studs and Furring Materials:
 - 1. Studs and Runners:
 - a. Main runners: Steel channels with rust inhibitive paint finish, hot or cold rolled.
 - b. Screw type, drywall studs formed of galvanized steel, conforming to ASTM C645.
 - c. Size:
 - 1) 20-gauge nominal, 3-5/8-inch studs, except as indicated on Drawings; with cut-outs for pipe and conduit.
 - 2) 20-gauge nominal studs at 12 inches on center at mortar (tile) backer board.
 - 3) 20-gauge nominal studs at 16 inches on center at cement backer board at exterior soffit system.
 - 4) 20-gauge behind large wall-hung cabinets.
 - 5) 16-gauge at each side of door jambs.
 - 2. Slip Head Channel: System compatible with enough depth to allow for required deflection.
 - a. Single long-leg runner system:
 - 1) Top runner with 2-inch-deep flanges in thickness not less than indicated for studs.

- 2) Install with studs friction-fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
- b. Double-runner system:
 - 1) Top runners, inside runner with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs.
 - 2) Outer runner sized to friction fit inside runner.
- c. Deflection track:
 - 1) Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above.
 - 2) In thickness not less than indicated for studs and in width to accommodate depth of studs.
- d. Firestop track: UL Approved.
3. Carrying Channels: Cold-rolled, commercial-steel sheet with base-metal thickness of 0.0538-inch and minimum 1/2-inch-wide flanges.
4. Furring Channels:
 - a. Cold-rolled channels: 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges, 3/4-inch-deep.
 - b. Steel studs: ASTM C645.
 - c. Hat-shaped, rigid furring channels: ASTM C645, 7/8-inch-deep.
 - d. Resilient furring channels:
 - 1) 1/2-inch-deep.
 - 2) Place 24 inches on center.
 - 3) Designed to reduce sound transmission.
 - 4) Hat-shaped, RAN Vertical.
- B. Radius Members:
 1. Location: walls, soffits, ceilings.
 2. Shop form radius by bending member without cutting or splicing.
 3. Maintain member strength and rigidity after bending.
- C. Accessories:
 1. Clips, Screws, and Other Accessories: Manufacturer's standard type for intended use.
 2. Acoustical Sealant: Non-hardening, flexible, latex acrylic.
 3. Isolation Strip at Exterior Walls:
 - a. Asphalt-saturated organic felt, ASTM D226, Type 1, nonperforated.
 4. Other Materials: Not specifically described but required for complete and proper installation, to be new, first quality of respective kinds, subject to acceptance of E/A.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.

- B. Verification of Conditions:
 - 1. With Installer present, examine areas and substrates, including welded hollow-metal frames, cast-in anchors, and structural framing for compliance with requirements and other conditions affecting performance.
 - 2. Verify that metal support systems may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies:
 - 1. Immediately notify E/A.
 - 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 - 3. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Suspended Assemblies:
 - 1. Coordinate installation with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 2. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION

- A. Installation Standards:
 - 1. All Work of This Section: Comply with ASTM C754.
 - 2. Gypsum Plaster Assemblies: Comply with ASTM C841.
 - 3. Portland Cement Plaster Assemblies: Comply with ASTM C1063.
 - 4. Gypsum Veneer Plaster Assemblies: Comply with ASTM C844.
 - 5. Gypsum Board Assemblies: Comply with ASTM C840.
- B. Steel Studs and Furring Members:
 - 1. Extend steel stud partitions to structure above where indicated on Drawings
 - 2. Securely attach floor runners with concrete stud nails or powder-driven anchors spaced not over 24 inches on center.
 - 3. Set runners in two 1/4-inch beads of specified acoustical sealant.
 - 4. Attach runners to structure above with connection allowing for structure movement.
 - 5. Do not bridge building expansion joints.
 - 6. Studs:
 - a. Anchor studs to runner channels with screws or other positive fasteners; double studs at hollow metal frames.
 - b. Securely anchor to jamb and head anchor clips at hollow metal frames with screws or bolts.
 - c. Install runner track with web and flanges bent down at each end across head of hollow metal frames.
 - d. Screw each flange to vertical studs.
 - e. Install jack studs above frame.
 - f. Install supplementary framing, blocking and bracing at terminations in the work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings and similar construction.

- e. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
- 5. Grillage:
 - a. Where hanger spacing and spans exceed specified spans, use hangers with larger capacity, larger main runners, or additional reinforcing members, hangers, stiffening, or bracing as necessary to support loads without exceeding specified deflection.
 - b. Make provision for control, expansion joints as indicated or otherwise required to avoid damage to gypsum board ceilings.
- 6. Auxiliary Framing: Install at termination of ceiling and at openings for light fixtures and similar work, as required for support of both gypsum base and other work indicated for support.
- D. Grid Suspension Systems:
 - 1. Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces.
 - 2. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- E. Installation Tolerance: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.4 INSTALLATION OF FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
- C. Install tracks (runners) at floors and overhead supports.
- D. Extend framing to full height to structural supports or substrates above suspended ceilings, up to metal building structural / roof systems.
- E. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-type head joints: Where framing extends to overhead structural supports, install to product joints at tops of framing systems that prevent axial loading of finished assemblies.
- F. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames.
 - 1. Install runner track section (for cripple studs) at head and secure to jamb studs.
 - 2. Install 2 studs at each jamb, unless otherwise indicated.
 - 3. Install cripple studs at head adjacent to each jamb stud, with minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - 4. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
- G. Other Framed Openings:
 - 1. Frame same as door openings, unless otherwise indicated.
 - 2. Install framing below sills of openings to match framing required above door heads.
- H. Fire-resistance-rated Partitions:
 - 1. Install framing to comply with assembly indicated and support closures.
 - 2. Make partitions continuous from floor to underside of solid structure.
 - 3. Install firestop track where indicated, to maintain continuity of fire-resistance-rated assembly.

- I. Sound-rated Partitions: Install framing to comply with sound-rated assembly indicated.
- J. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 MISCELLANEOUS CONSTRUCTION

A. Special Situations:

1. Chase Walls:

- a. Construct with double studs.
- b. Brace double studs with 12-inch-high, 1/2-inch thick gypsum board braces spaced not over 48 inches on center, screwed to studs with not less than three screws on each side of wall.
- c. Or brace with 2-1/2-inch studs spaced not over 48 inches on center.

2. Where Ceilings Return to Higher Ceiling:

- a. Form vertical surfaces with metal studs suspended from structure above.
- b. Space studs not over 24 inches on center.
- c. Brace studs with diagonal bracing spaced not over four feet on center as required.

B. Interface with Other Work:

- 1. Where main runners, cross runners are interrupted by light fixtures, grilles, registers or other openings: Install additional runners to frame openings.
- 2. Reinforce grillage as necessary to support light fixtures, grilles, registers, other items mounted in ceiling.

C. Site Tolerances:

- 1. Vertically: 1 in 500.
- 2. Horizontally: 1 in 200.
- 3. Ceilings: Maximum allowable deflection of 1/360 of span.

END OF SECTION 09 22 00

SECTION 09 29 00 – Gypsum Board

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Gypsum drywall:
 - a. Gypsum board.
 - b. Tile backerboard.
 - c. Fire-rated gypsum board.
 - 2. Corner beads and trim.
 - a. Metal
 - 3. Joint treatment.
 - 4. Drywall accessories including, but not limited to:
 - a. Acoustical compound and sealant.
 - b. Felt building paper.
 - c. Fasteners.
 - d. Adhesives.
 - e. Primer surfacer.
 - f. Texture (orange peel).
- B. Related Sections:
 - 1. Section 04 20 00 - Unit Masonry Assemblies
 - 2. Section 06 10 53 - Rough Carpentry
 - 3. Section 08 31 13 - Access Doors and Frames
 - 4. Section 09 22 00 - Non-Structural Metal Framing
 - 5. Section 09 91 00 - Painting

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. C423 - Sound Absorption
 - 2. C557 - Standards for Adhesives for Fastening Wallboard to Wood Framing
 - 3. C840 - Application and Finishing of Gypsum Board
 - 4. C1002 - Standard for Steel Self-Piercing Tapping Screws for Application of Gypsum Panels
 - 5. C1396 - Standard for Gypsum Board
 - 6. D3273 - Test for Resistance to Growth of Mold on the Surface of Interior Coatings

- 7. E84 - Surface Burning Characteristics of Building Materials
 - 8. E119 - Fire Tests of Building Construction Materials
 - B. Gypsum Association - Levels of Gypsum Board Finish (GA 214-Latest Edition)
- 1.4 SUBMITTALS
- A. Refer to Section 01 33 00.
 - B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
 - C. Samples:
 - 1. Trim Accessories: Provide full size sample in 12-inch-long length for each trim accessory.
 - 2. Textured Finish: Provide manufacturer's standard size for each finish indicated and on same backing indicated for work.
- 1.5 QUALITY ASSURANCE
- A. Single Source Responsibility: Provide drywall systems units made of components of standard construction furnished by one manufacturer as coordinated assemblies.
 - B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of drywall systems.
 - 2. Contractor: 3 years experience in the installation of drywall systems.
 - 3. Personnel: For actual installation of drywall systems, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
 - C. Regulatory Requirements:
 - 1. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
 - D. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.
- 1.6 STORAGE AND HANDLING
- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes.
 - B. Stack panels flat to prevent sagging.
- 1.7 PROJECT CONDITIONS
- A. Environmental Conditions:
 - 1. Joint Treatment: Control heating, ventilating during finishing operations to ensure maintenance of 55 degrees F minimum temperature.
 - 2. Comply with ASTM C840 or manufacturer's recommendations, whichever are more stringent.
 - 3. Existing Conditions: Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.
 - B. Do not install panels that are wet, show moisture damage, or are mold damaged.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Gypsum Drywall:
 - 1. Standard of Quality: Design is based on products of United States Gypsum Company (USG), Chicago, IL www.usg.com
 - 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Georgia-Pacific (G-P), Atlanta, GA www.gp.com/gypsum
 - b. National Gypsum Company, Charlotte, NC www.nationalgypsum.com
 - c. Manufacturer of comparable products submitted in compliance with Section 01 25 13.
- B. Primer Surfer: Subject to compliance with requirements, acceptable manufacturers are:
 - 1. USG, Tuff-Hide.
 - 2. Sherwin Williams, PrepRite High Build
 - 3. Manufacturer of comparable products submitted in compliance with Section 01 25 13.
- C. Texture Finishes: Subject to compliance with requirements, acceptable manufacturers are:
 - 1. USG, Sheetrock Ceiling Spray Texture, QT
 - 2. G-P, Regency Ceiling Textures/Polystyrene
 - 3. National Gypsum Company, Perfect Spray
 - 4. Sherwin Williams
 - 5. Manufacturer of comparable products submitted in compliance with Section 01 25 13.
- D. Corner Beads and Trim:
 - 1. Metal design is based on Sheetrock brand products of USG www.usg.com
 - 2. Subject to compliance with requirements, acceptable manufacturers are:
 - a. ClarkDietrich Industries, Inc., Pittsburgh, PA www.clarkdietrich.com
 - b. Manufacturer of comparable products submitted in compliance with Section 01 25 13.
- E. Acoustical Sealant:
 - 1. Green Glue, Green Glue Soundproofing Compound and Sealant

2.2 MATERIALS

- A. Panels, General:
 - 1. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- B. Typical Interior Gypsum Drywall (Unless Noted/Scheduled Otherwise):
 - 1. USG Sheetrock Brand
 - 2. Gypsum Board:
 - a. 5/8-inch-thick for new walls, typical.
- C. Abuse Resistant Gypsum Drywall: (Where Noted on Plans/Details)
 - 1. USG Fiberock Brand Aqua-Tough AR Interior Panels Type X
 - 2. Fire-rated Gypsum Board:
 - a. 5/8-inch-thick.

- D. Typical Tile Backerboard (Unless Noted/Scheduled Otherwise):
 - 1. USG Fiberock Brand
 - 2. Fiber-reinforced Gypsum Board:
 - a. 5/8-inch-thick for new walls, typical.
- E. Typical Fire Rated Interior Gypsum Drywall (Unless Noted/Scheduled Otherwise):
 - 1. USG Sheetrock Brand Ultralight Panels Mold Tough Firecode X or C
 - 2. Fire-rated Gypsum Board:
 - a. 5/8-inch-thick.
 - b. Horizontal applications: Type C core.
 - c. Vertical applications: Type X core.
 - d. Regular: Firecode Sheetrock.
- F. Metal Corner Beads and Trim:
 - 1. Fire rated.
 - 2. Paper faced.
 - 3. Rust resistant.
 - 4. Corner Bead: USG Dur-A-Bead.
 - 5. Control Joint: USG 093.
 - 6. Flex Corner Bead: USG 800.
 - 7. "J" Bead: USG 200-A.
- G. Joint Tape:
 - 1. Interior Gypsum Wallboard:
 - a. Paper tape.
 - b. Do not use in wet areas.
 - c. Recycled content paper.
- H. Joint Compound:
 - 1. Interior Gypsum Panels: USG ready-to-use joint compound (taping, topping, general purpose).
 - 2. Do not use all-purpose joint compound in wet areas.
 - 3. Verify formulation is compatible with other compounds applied on previous or for successive coats.
 - 4. Exterior Glass-mat Gypsum Sheathing: As recommended by sheathing board manufacturer.
 - 5. Tile Backing Panels:
 - a. As recommended by backer manufacturer.
 - b. Setting type joint compound.
 - c. Abuse resistant.
 - 6. Setting Type Mix:
 - a. Abuse resistant.
 - b. Non shrink.
 - c. Rapid setting.
 - d. Cement based.

- e. Mold and moisture resistant.
 - f. Meets ASTM D3272 and 3274.
- I. Drywall Accessories:
 - 1. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
 - 2. Resilient Furring Channel:
 - a. Metal studs: See Section 09 22 00.
 - 3. Building Paper: ASTM D6757, Type I; asphalt saturated felt, non-perforated, 15 pound type.
 - 4. Access Panels:
 - a. Coordinate size of drywall access panels with affected trades.
 - b. Product: Style "DW" manufactured by Milco, Inc., or equal product of other manufacturers accepted in advance by E/A.
 - 5. Fasteners:
 - a. Comply with ASTM C1002.
 - b. Metal Studs, Furring Strips: USG Type S bugle head screws of lengths required.
 - c. Cementitious Backer Board: Screws specifically designed and recommended by manufacturer for application of cementitious backer board.
 - d. Other Fasteners: Screws, clips, fasteners specifically designed for application of gypsum drywall panels.
 - 6. Drywall Stops:
 - a. Galvanized steel (high recycled content) or 100 percent recycled HDPE with minimum 25 percent post-consumer recycled content.
 - b. Reduce risk of drywall cracking from expansion/contraction; install at locations prone to cracking
 - 7. Primer-Surfacer:
 - a. Spray application prime coat in thicknesses recommended by manufacturer.
 - b. Use in lieu of skim coat and primer coat in Level 5 finish.
 - c. Hides minor surface defects.
 - d. Smoother finished walls.
 - e. Product: Sheetrock Brand Primer Surfacers by USG.
 - 8. Adhesives:
 - a. Non-bituminous base adhesive recommended by gypsum board manufacturer for type of installation and material to receive gypsum wallboard.
 - b. Conform to ASTM C557.
 - 9. Other Materials, including drywall expansion joints per industry standards: Not specifically described but required for complete, proper installation of gypsum drywall, to be selected by installer subject to acceptance of E/A.

2.3 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.

- B. Aggregate Finish:
 - 1. Water-based, field mixed, aggregated, drying-type texture finish for spray application.
 - 2. Texture: Light spatter – light orange peel direction (all office and conference areas, including corridors; confirm locations with E/A).

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades:
 - 1. Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
 - 2. Examine areas and substrates, with installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Verification of Conditions: Verify that gypsum drywall may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Examine panels before installation. Do not install panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications of damage include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications of mold damage include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
- D. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.

3.3 INSTALLATION

- A. Gypsum Drywall:
 - 1. Comply with ASTM C840.
 - 2. Lay out panels to minimize waste; reuse cutoffs whenever feasible.
 - 3. Use full-length boards where possible.
 - 4. Install with true, even surfaces, straight sharp corners, face out.
 - 5. Do not force into place.
 - 6. In general, install gypsum board on ceilings before walls.
 - 7. Cutting:
 - a. Score and break or saw, working from face side.
 - b. Smooth cut ends, edges of panels as necessary to obtain smooth joint.
 - c. Make cut-outs in panels for pipes, fixtures, other small openings by sawing or other method to not fracture core or tear covering, so that plates, escutcheons, trim will cover edges.
 - 8. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling.
 - 9. Install flat panels plumb, level, with vertical joints on bearing.
 - 10. Loosely butt joints to be taped; firmly butt joints to be left untreated.

11. Stagger end joints, joints between panels to achieve maximum of bridging, minimum of continued joints.
12. Stagger vertical joints on opposite sides of partitions.
13. Do not make joints other than control joints at corners of framed openings.
14. Form control and expansion joints with space between edges of adjoining gypsum panels, where indicated on Drawings or, if not indicated, no more than 20 feet on center.
15. Install sound attenuation blankets where indicated on Drawings.
16. Attachment:
 - a. Screw to framing.
 - b. For walls with gypsum board applied vertically, space screws 8 inches on center along edges, 12 inches on center.
 - c. For walls with gypsum board applied horizontally and ceiling construction, space screws 12 inches on center.
 - d. Space screws according to rated design for fire-resistive partitions, ceilings.
 - e. Fasten gypsum board beginning at center, work towards outer edges. Hold board firmly against supports while fastening.
 - f. Locate fasteners opposite each other on adjacent ends and edges; locate at edges of boards 3/8 inch to 1/2 inch from edge.
17. Sealing:
 - a. Seal partition perimeter joints with acoustical sealant where indicated on Drawings.
 - b. Seal joints in backer board occurring behind control joints.
 - c. Seal around pipes, ducts, conduit, other items extending through gypsum board partitions or ceilings.
 - d. Seal backs, sides of electrical boxes.
 - e. Seal joints, cut edges, nail and screw heads, punctures in water-resistant gypsum backing board with waterproofing sealant recommended by gypsum board manufacturer.

B. Adhesive Installation of Gypsum Drywall:

1. Where indicated on Drawings, install gypsum board directly on concrete or masonry using adhesive.
2. Before installation, verify that concrete and masonry surfaces are thoroughly cured, clean, dry, reasonably smooth, free of fins and projections which would prevent proper bonding of gypsum board, free of release agents (from oil).
3. Apply adhesive according to manufacturer's instructions.
4. Apply gypsum board vertically with joints neatly fitted.
5. Temporarily support gypsum board as recommended by manufacturer.
6. Allow at least 24 hours after installation before treating joints.

C. Trim:

1. Drawings are not intended to show all trim required. Carefully inspect Drawings and verify with E/A precise locations, types of trim to be used.
2. Installation:
 - a. Follow manufacturer's installation instructions to validate lifetime warranty and replacement costs.

- b. Install corner reinforcing at external corners, install casing beads where gypsum board abuts other materials.
 - c. Control joints:
 - 1) Comply with ASTM C840.
 - 2) Install where indicated on Drawings.
 - 3) Where not indicated, locate in walls, partitions not over 30 feet on center.
 - 4) Locate above door frames where possible; construct one control joint above each jamb of door.
 - d. Install trim plumb, level, true to line, with firm attachment to supporting members.
- D. Access Panels: Install in ceilings, soffits, walls where directed by E/A, in strict accordance with manufacturer's recommendations.

3.4 TAPING AND FINISHING

- A. General:
- 1. Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.
 - 2. Promptly remove residual joint compound from adjacent surfaces.
 - 3. Prefill open joints, rounded or beveled edges, and damaged surface areas.
 - 4. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- B. Finish:
- 1. Tool joints as smoothly as possible to minimize sanding and dust.
 - 2. Protect workers, building occupants, and HVAC systems from gypsum dust.
 - 3. Level 3 with Primer Surfacer, as specified by GA-214-90.
 - a. First coat:
 - 1) Spread compound evenly over joints, using suitable tools designed for purpose. Fill joint recesses, metal trim.
 - 2) Center reinforcing tape on joint, press into fresh compound, wiping down with sufficient pressure to remove excess compound but leaving sufficient compound under tape for proper bond.
 - 3) Feather edges, leave surface free from blisters, tape wrinkles.
 - 4) Apply compound to fastener recesses, leaving flush with adjacent surfaces.
 - 5) Fold reinforcing tape along its centerline, apply to interior angles, following same procedure as for joints.
 - b. Second coat:
 - 1) Apply coat to joints, feathering approximately 3 inch beyond edges of tape. Apply to fastener recesses; allow to dry.
 - c. Third coat:
 - 1) Apply coat, feathering approximately 2 inches beyond second coat.
 - 2) Coat fastener recesses, metal trim, interior angles; allow to dry.
 - 3) Carefully sand to uniformly smooth surface completely free from irregularities visible to unaided eye at distance of 5 feet.

- d. Primer surfacer.
 - 1) Airless spray application only.
 - 2) Do not thin or intermix with any other products.
 - 3) Apply to minimum WFT of 15-20 mils.
 - 4) DFT: 9-12.
- e. Provide fourth coat if requested by A/E at no additional cost.

3.5 CLEANING AND PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
- C. Do not allow accumulation of scraps and debris arising from Work of this Section.
- D. Maintain premises in neat, orderly condition.
- E. In event of spilling or splashing compound or finish material onto other surfaces, immediately remove spilled or splashed material and all trace of residue, to acceptance of E/A.

END OF SECTION 09 29 00

SECTION 09 30 00 – Porcelain Tile

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Glazed porcelain tile.
 - 2. Metal Trim and Accessories.
 - 3. Setting Materials, including but not limited to:
 - a. Self-leveling underlayment.
 - b. Mortar.
 - c. Grout.
 - d. Caulk.
 - e. Sealant.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 04 22 00 - Concrete Unit Masonry
 - 3. Section 09 39 00 - Gypsum Board
 - 4. Section 07 92 00 - Joint Sealants

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI A108.1A - Specifications for Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar.
 - 2. ANSI A108.1B - Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar.
 - 3. ANSI A108.1C - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar -or- Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar.
 - 4. ANSI A108.4 - Specifications for Ceramic Tile Installed with Organic Adhesives or Water-Cleanable Tile Setting Epoxy Adhesive.
 - 5. ANSI A108.5 - Specifications for Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
 - 6. ANSI A108.6 - Specifications for Ceramic Tile Installed with Chemical-Resistant, Water-Cleanable Tile-Setting and -Grouting Epoxy.
 - 7. ANSI A108.8 - Specifications for Ceramic Tile Installed with Chemical-Resistant Furan Mortar and Grout.
 - 8. ANSI A108.9 - Specifications for Ceramic Tile Installed with Modified Epoxy Emulsion Mortar/Grout.

9. ANSI A108.10 - Specifications for Installation of Grout in Tilework.
 10. ANSI A118.1 - Standard Specification for Dry-Set Portland Cement Mortar.
 11. ANSI A118.3 - Chemical-Resistant, Water-Cleanable, Tile-Setting and -Grouting Epoxy and Water-Cleanable Tile-Setting Epoxy Adhesive.
 12. ANSI A118.4 - Latex-Portland Cement Mortar.
 13. ANSI A118.5 - Chemical-Resistant Furan Mortar and Grout.
 14. ANSI A118.6 - Standard Ceramic Tile Grouts.
 15. ANSI A118.7 - Polymer Modified Cement Grouts
 16. ANSI A118.8 - Modified Epoxy Emulsion Mortar/Grout.
 17. ANSI A118.9 - Test Methods and Specifications for Cementitious Backer Units
 18. ANSI A137.1 - Specifications for Ceramic Tile.
- B. ASTM International (ASTM):
1. ASTM C 50 - Standard Practice for Sampling, Sample Preparation, Packaging, and Marking of Lime and Limestone Products.
 2. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.
 3. ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 4. ASTM C 241 - Standard Test Method For Abrasion Resistance of Stone Subjected to Foot Traffic.
 5. ASTM C 1028 - Standard Test method for Determining the Static Coefficient of Friction or Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull meter Method.
 6. ASTM F 2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes
 7. ASTM D 4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
- C. Tile Council of North America (TCNA): TCNA Handbook for Ceramic Tile Installation, 2023.

1.4 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: Tile on walkway surfaces shall be provided with the following values as determined by testing in conformance with ASTM C 1028.
1. Level Surfaces: Minimum of 0.6 (Wet).
 2. Step Treads: Minimum of 0.6 (Wet).
 3. Ramp Surfaces: Minimum of 0.8 (Wet).

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 - Submittal Procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Selection Samples: Samples of actual tiles, grout, and metal trim for selection. Selections to be from a manufacturer's full range of colors and patterns.

- E. Test Reports:
 - 1. Provide certified test reports showing concrete slab substrate meets porcelain tile and setting material manufacturer's requirements.
 - 2. Submit two copies of supplier's/manufacturer's written certification that flooring system meets or exceeds required properties.
- F. Manufacturer's Certificate:
 - 1. Certify that products meet or exceed specified requirements.
 - 2. For each shipment, type and composition of tile provide a Master Grade Certificate signed by the manufacturer and the installer certifying that products meet or exceed the specified requirements of ANSI A137.1.
- G. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.
- H. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.
- I. Field-Erected Mockups:
 - 1. Before installing tile, erect mock-up for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution.
 - 2. Build mock-up to comply with the following requirements, using materials indicated for final unit of work.
 - 3. Location: Locate mock-up on site in location and size indicated or, if not indicated, directed by E/A.
 - 4. Scope: Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Acceptance: Obtain Owner's acceptance of mock-up before start of final unit of work.
 - 6. Maintenance: Retain and maintain mock-up during construction in undisturbed condition as a standard for judging completed unit of work.
 - 7. Accepted mock-up in undisturbed condition at time of Substantial Completion may become part of completed unit of work.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum two years' experience.
- B. Single Source Responsibility: Obtain each type and color of tile from a single source. Obtain each type and color of mortar, adhesive and grout from the same source.
- C. Prior to installation of concrete floor slabs and concrete toppings, advise General Contractor of all manufacturer's requirements of the concrete substrate including finish, levelness, imperfection tolerances, and curing. The General Contractor is required to coordinate any special concrete floor slab and concrete topping requirements with the concrete floor mix designs prior to placement.
- D. Testing: The General Contractor shall be responsible for hiring an independent testing service to test the concrete floor slabs and concrete toppings for relative humidity, temperature, moisture vapor emission, and pH level as required by the tile manufacturer. Refer to Section 01 45 10 Quality Control for Building Construction for more information.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging until ready for installation.
- B. Protect adhesives and liquid additives from freezing or overheating according to manufacturer's instructions.

- C. Store tile and setting materials on elevated platforms, under cover and in a dry location and protect from contamination, dampness, freezing or overheating.

1.8 PROJECT CONDITIONS

- A. Environmental Requirements: Refer to manufacturer's instructions and strictly follow.
- B. Existing Conditions: Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.
- C. Concrete Substrate:
 - 1. Concrete shall have cured for at least 28 days, and be free of water for at least 7 days.
- D. Prior to installation of porcelain floor tile, verify with the General Contractor that concrete substrate meets manufacturer's requirements for relative humidity, temperature, moisture vapor emission, and pH level.
- E. General Contractor is responsible for ensuring concrete substrate meets the flooring manufacturer's installation requirements and performing required mitigation. Means and methods of mitigation are the General Contractor's responsibility.
- F. Do not install adhesives in an unventilated environment.
- G. Maintain ambient and substrate temperature of 50 degrees F (10 degrees C) during tiling and for a minimum of 7 days after completion.

1.9 WARRANTY

- A. Provide manufacturer's standard warranty.

1.10 EXTRA MATERIALS

- A. Provide for Owner's use a minimum of three (3) percent of the primary sizes and colors of tile specified, boxed and clearly labeled.

PART 2 – PRODUCTS

2.1 TILE

- A. Manufacturers:
 - 1. Standard of Quality: Design is based on products of Daltile Corporation, Dallas, TX <https://www.daltile.com>
 - 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. American Olean, Dallas, TX www.americanolean.com
 - b. Arizona Tile, Tempe, AZ www.arizonatile.com
 - c. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.
- B. General:
 - 1. Provide tile that complies with ANSI A137.1 for types, compositions and other characteristics indicated.
 - 2. Provide tile in the locations and of the types, colors, and pattern indicated on the Drawings. Tile shall also be provided according to the following:
 - a. Factory Blending: For tile exhibiting color variations within the ranges selected under Submittal of samples, blend tile in the factory and package so tile taken from one package shows the same range of colors as those taken from other packages.
 - b. Mounting: For factory mounted tile, provide back or edge mounted tile assemblies as standard with the manufacturer, unless otherwise specified.

- c. Factory Applied Temporary Protective Coatings: Protect exposed surfaces of tile against adherence of mortar and grout by pre-coating with a continuous film of petroleum paraffin wax applied hot. Do not coat unexposed tile surfaces.

C. Glazed Porcelain Tile:

- 1. Product: Daltile Volume 1.0.
- 2. Thickness: 6.4 mm (1/4 inch).
- 3. Dynamic Coefficient of Friction: Not less than 0.42.
- 4. Trim Units: Matching bullnose, bullnose corner, cove/inside finger cove, radius cap, sink rail, sink rail in corner/outcorner, cove base, outside cove corner shapes in sizes coordinated with field tile shapes.
- 5. Size and Shape: As selected by Architect from chosen series. Architect may choose tiles from up to 3 series each for walls and 3 series for floors. Tile selection as indicated on the Drawings.
- 6. Surface Finish: As selected by Architect from chosen series, and indicated on the Drawings.
- 7. Colors: To be selected from manufacturer's standard range. Architect may choose up three colors each from each series chosen for walls and up to three colors each from each series chosen for floors. Refer to the Drawings for patterns and color layouts.

2.2 TRIM AND ACCESSORIES

A. Manufacturer:

- 1. Standard of quality: Design is based on products of Schluter Systems, Plattsburg, NY www.schluter.com
- 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Blanke Corporation, Norcross, GA www.blankecorp.com
 - b. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.

B. Metal Trim:

- 1. Finishing and edge-protection metal trim in profiles, materials, and dimensions to suit application, for setting and using with tile mortar or adhesive.
- 2. Material: Color-coated aluminum.
- 3. Color: As indicated on the Drawings.
- 4. Locations: As indicated on the Drawings and:
 - a. Open edges of floor tile.
 - b. Transition between floor finishes of different heights.
 - c. Thresholds at door openings.
 - d. Expansion and control joints, floor and wall.
 - e. Wall tile edging.
 - f. Wall tile outside corners.

2.3 SETTING MATERIALS

A. Manufacturers:

- 1. Standard of quality: Design is based on products of Ardex, Aliquippa, PA www.ardexamericas.com

2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Maipai, Deerfield Beach, FL www.mapei.com
 - b. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.
- B. Floors - Cement-based self-leveling underlayment:
1. Performance and Physical Properties: Meet or exceed the following values for material cured at 73° F+/-3°F (23° C+/-3°C) and 50% +/-5% relative humidity:
 - a. Application: Barrel Mix or Pump.
 - b. Flow Time: 10 minutes.
 - c. Initial Set: Approx. 30 minutes.
 - d. Final Set: Approx. 90 minutes.
 - e. Compressive Strength: 4000 psi at 28 days, ASTM C109M.
 - f. Flexural Strength: 1000 psi at 28 days, ASTM C78.
 - g. VOC: 0 g/l
 2. Product: Ardex TL-1400™ Self-Leveling Underlayment.
- C. Walls - Pre-Tile Smoothing and Ramping Mortar:
1. Performance and Physical Properties: Meet or exceed the following values for material cured at 70° F+/-3°F (21° C+/-3°C) and 50% +/-5% relative humidity:
 - a. Application: Trowel.
 - b. Open Time: 10 minutes.
 - c. Pot Life: 30-45 minutes.
 - d. Working Time: 30 minutes.
 2. Product: Ardex AM100™ Rapid Set Pre-Tile Smoothing and Ramping Mortar.
- D. Mortar:
1. Performance and Physical Properties: Meet or exceed the following values for material cured at 70° F+/-3°F (21° C+/-3°C) and 50% +/-5% relative humidity:
 - a. Open Time: Up to 10 - 15 minutes.
 - b. Pot Life: Approx. 3 hours.
 - c. ISO 13007: C2 TE P1.
 - d. Thin Set: Meets or Exceeds ANSI A-118.15, ANSI A-118.11 and ANSI A-118.4.
 2. Product: Ardex X-5™ Flexible and Versatile Tile and Stone Mortar.
- E. Epoxy Grout:
1. Performance and Physical Properties: Meet or exceed the following values for material cured at 70° F+/-3°F (21° C+/-3°C) and 50% +/-5% relative humidity:
 - a. Pot Life: 40 minutes.
 - b. Working Time: 60 minutes.
 - c. Open to Traffic: 12 hours (light foot traffic).
 2. Use in toilet rooms, janitor closets, and other wet locations.
 3. Product: Ardex WA™ High Performance Epoxy Grout and Adhesive.

- F. Sanded Grout:
 - 1. Performance and Physical Properties: Meet or exceed the following values for material cured at 70° F +/-3°F (21° C +/-3°C) and 50% +/-5% relative humidity:
 - a. Pot Life: Approx. 30 minutes.
 - b. Working Time: Approx. 30 minutes.
 - c. Open to Traffic: 90 minutes.
 - 2. Product: Ardex FL™ Rapid Set, Flexible, Sanded Grout.
- G. Sealant
 - 1. 100% acrylic grout colorant and sealer.
 - 2. Product: Ardex GCS Grout Colorant and Sealer.
- H. Caulk
 - 1. Product: Ardex SX™ 100% silicone caulk.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that wall surfaces are free of substances which would impair bonding of setting materials, smooth and flat within tolerances specified in ANSI A137.1, and are ready to receive tile.
- B. Verify that sub-floor surfaces are dry, dust-free, and free of substances which would impair bonding of setting materials to sub-floor surfaces, and are smooth and flat within tolerances specified in ANSI A137.1.
- C. Do not begin preparation or installation until satisfactory substrate results are achieved. The General Contractor is responsible for providing manufacturer's recommended moisture vapor control coating if required.
- D. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Remove any curing compounds or other contaminants.
- C. Vacuum clean surfaces and damp clean.
- D. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- E. Install cementitious backer board according to ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of dry-set mortar to a feather edge.
- F. Prepare substrate surfaces for adhesive installation according to adhesive manufacturer's instructions.

3.3 INSTALLATION - GENERAL

- A. Install tile and grout according to applicable requirements of ANSI A108.1 through A108.13, manufacturer's instructions, and TCNA Handbook recommendations.
- B. Lay tile to pattern indicated. Arrange pattern so that a full tile or joint is centered on each wall and that no tile less than 1/2 width is used. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.

- E. Form internal angles square and external angles bullnosed.
- F. Install non-ceramic trim according to manufacturer's instructions.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- I. Allow tile to set for a minimum of 48 hours prior to grouting.
- J. Grout tile joints. Use standard grout unless otherwise indicated.
- K. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.4 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install according to TCNA Handbook Method F113, dry-set or latex-portland cement bond coat, with standard grout, unless otherwise indicated.
 - 1. Where waterproofing membrane is indicated, install according to TCNA Handbook Method F122, with latex-portland cement grout.
 - 2. Where epoxy bond coat and grout are indicated, install according to TCNA Handbook Method F131.

3.5 INSTALLATION - WALL TILE

- A. Over cementitious backer units on studs, install according to TCNA Handbook Method W244, using membrane at toilet rooms.
- B. Over gypsum wallboard on wood or metal studs, install according to TCNA Handbook Method W243, thin-set with dry-set or latex-portland cement bond coat, unless otherwise indicated.
 - 1. Where mortar bed is indicated, install according to TCNA Handbook Method W222, one coat method.
 - 2. Where waterproofing membrane is indicated other than at showers and bathtub walls, install according to TCNA Handbook Method W222, one coat method.
- C. Over interior concrete and masonry install according to TCNA Handbook Method W202, thin-set with dry-set or latex-portland cement bond coat.
- D. Over metal studs without backer install according to TCNA Handbook Method W241, mortar bed, with membrane where indicated.

3.6 CLEANING

- A. Clean tile and grout surfaces.

3.7 PROTECTION OF FINISHED WORK

- A. Do not permit traffic over finished floor surface for 72 hours after installation.
- B. Cover floors with kraft paper and protect from dirt and residue from other trades.
- C. Where floor will be exposed for prolonged periods cover with plywood or other similar type walkways.

3.8 SCHEDULE

- A. Refer to plans for layouts.

END OF SECTION 09 30 00

SECTION 09 51 13 – Acoustical Panel Ceilings

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide exposed ceiling suspension system:
 - 1. Acoustical ceiling panels.
 - 2. Linear veneered wood ceiling panels.
 - 3. Metal suspension system.
 - 4. Accessories for installation of complete system.
- B. The following is not included in this section:
 - 1. Acoustical insulation (Section 07 21 00).
- C. Related Sections:
 - 1. Section 09 22 00 - Non-Structural Metal Framing
 - 2. Section 09 29 00 - Gypsum Board

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. A641 - Zinc-Coated Carbon Steel Wire
 - 2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot- Dip Process
 - 3. ASTM A 1008 Standard Specification for Steel, Sheet, and Cold Rolled Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
 - 4. B164 - Nickel-Copper Alloy Rod, Bar, Wire
 - 5. C423 - Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - 6. C635 and C636 - Manufacture of Metal Suspension Systems and Installation of Suspended Ceilings
 - 7. C834 - Latex Sealants
 - 8. E84 - Surface Burning Characteristics of Building Materials
 - 9. E119 - Fire Tests of Building Construction and Materials
 - 10. E1111 - Interzone Attenuation of Open Office Compartments
 - 11. E1264 - Classification for Acoustical Ceiling Products
 - 12. E1414 - Airborne Sound Attenuation Between Rooms with Common Ceiling Plenums
 - 13. E1477 - Luminous Reflectance Factor of Acoustical Materials
 - 14. F593 - Stainless Steel Bolts, Hex Cap Screws, Studs
 - 15. F594 - Stainless Steel Nuts

B. CISCA Ceiling Systems Installation Handbook

1.4 DEFINITIONS

A. CAC: Ceiling Attenuation Class.

B. LR: Light Reflectance coefficient.

C. NRC: Noise Reduction Coefficient.

1.5 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Meet or exceed the following acoustical ratings:
 - a. NRC (Noise Reduction Coefficient), ASTM C423: Minimum 0.50.
 - b. AC (Articulation Class), ASTM E1111: Minimum 150.
 - c. CAC: (Ceiling Attenuation Class), ASTM E1414: Minimum 35.
2. Withstand maximum of 104 degree, 100 percent relative humidity, without visible sagging, warping, or shrinking.
3. LR (light reflectance), ASTM E1477: Meet or exceed minimum of 0.80.
4. UL certification for compliance with ASTM C635 load compliance.
5. Recycled content: Minimum 25 percent.
6. Fire resistance characteristics per ASTM E119, UL, or agency having jurisdiction.
7. Surface burning characteristics per ASTM E1264 for Class A materials.

1.6 SUBMITTALS

A. Refer to the Division 1 Specifications.

B. Product Data:

1. Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
2. Provide a cut sheet or material safety data sheet for every sealant used within the building with VOC levels highlighted.

C. Shop Drawings:

1. Show system fabrication, installation drawings, including plans, elevations, section details of components, joint locations and configurations within system and between system and adjoining system.
2. Show ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Samples:

1. Color samples: Submit manufacturer's standard color samples with Product Data and Shop Drawings.
2. Product samples: One 12 inch by 12 inch sample of each type of acoustical ceiling tile.

E. Quality Assurance/Control Submittals: Provide letter from manufacturer stating panels contain biogards or microbial agents.

1.7 QUALITY ASSURANCE

A. Source Limitations: Provide acoustical ceiling panel system units made of components of standard construction furnished by one manufacturer as coordinated assemblies.

B. Qualifications:

1. Manufacturer: 5 years experience in the manufacture of acoustical ceiling panel system.

2. Contractor: 3 years experience in the installation of acoustical ceiling panel system.
3. Personnel: For actual installation of acoustical ceiling panel system, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
4. Testing Agency: NVLAP accredited laboratory.
- C. Regulatory Requirements: Comply with pertinent codes and regulations, and recommendations published by the ceiling and interior systems contracting associations.
- D. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.
 1. Surface Burning Characteristics: As follows, tested per ASTM E-84 and complying with ASTM E 1264 for Class A products.
 2. HPVA (Hardwood Plywood and Veneer Association) certification and audit program per ASTM E-84 tunnel test.
- E. Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.
- F. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Provide short as possible storage time at jobsite.
- B. Provide environmental conditions as close as possible to occupancy during storage and installation.
 1. Enclosed with windows and exterior doors in place and glazed.
 2. Roof watertight.
 3. Temperature between 60 and 85 degrees.
 4. Maximum relative humidity of 75 percent.
- C. Each carton of acoustical tile must carry UL certification for AC, CAC, and NRC.
- D. Handle acoustical tiles carefully to avoid chipping edges or damaging units.
- E. Do not allow tiles to become damp.
- F. Do not store panels near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, adhesives, etc.

1.9 COORDINATION

- A. Coordinate layout and installation with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.10 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.
- B. Linear Veneered Wood Ceiling Panels:
 1. Wood ceiling materials should be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation. (Remove plastic wrap to allow panels to climatize).
 2. The wood panels should not be installed in spaces where the temperature or humidity conditions vary from the temperatures and conditions that will be normal in the occupied space.

3. As interior finish products, the veneered panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed, and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

1.11 WARRANTY

- A. Grid System: Manufacturer's warranty on rusting and manufacturing defects: 10 year limited warranty.
- B. Acoustical panels: Manufacturer's warranty on sagging or warping: 30 year limited warranty.
- C. Linear Veneered Wood Ceiling Panels:
 1. Veneered Wood Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to:
 - a. Veneered Wood Panels: Defects in materials or factory workmanship.
 - b. Grid System: Rusting and manufacturing defects.
 2. Warranty Period:
 - a. Veneered Wood panels: One (1) year from date of installation.
 - b. Grid: Ten years from date of installation.
 3. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the contractor under the requirements of the Contract Documents.

1.12 MAINTENANCE

- A. Extra Materials: Provide for maintenance purposes, quantity equal to 2 percent of each type of material installed. Package and mark to identify building and material type and color. Store as directed after completion of work.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Acoustical Ceiling Panels:
 1. Standard of Quality: Design is based on products of Armstrong World Industries, Butler, PA www.armstrong.com
 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. USG Interiors, Inc., Chicago, IL www.usg.com
 - b. Certaineed, Malvern, PA www.certainteed.com
 - c. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.
- B. Linear Veneered Wood Ceiling Panels:
 1. Standard of Quality: Design is based on products of Armstrong World Industries, Butler, PA www.armstrong.com
 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Certaineed, Malvern, PA www.certainteed.com
 - b. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.

- C. Metal Suspension Systems:
1. Standard of Quality: Design is based on products of Armstrong World Industries, Butler, PA www.armstrong.com
 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Chicago Metallic www.rockfon.com
 - b. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.

2.2 MATERIALS

- A. Acoustical Ceiling Panels, ASTM E1264:
1. Types:
 - a. All Types may not be included in the project; refer to Room Finish Schedule.
 - b. Type ACT-01: Painted mineral fiber – Ultima.
 - 1) Edge detail: Beveled Tegular 15/16".
 - 2) Thickness: 3/4 inch.
 - 3) Texture: Fine.
 - 4) NRC: 0.75.
 - 5) CAC: 35.
 - 6) Light Reflectance: 87%.
 - c. Type ACT-02: Painted mineral fiber and ceramic composite – Ceramaguard.
 - 1) Edge detail: Square Lay-in 15/16".
 - 2) Thickness: 5/8 inch.
 - 3) Texture: Medium.
 - 4) NRC: 0.55.
 - 5) CAC: 38.
 - 6) Light Reflectance: 86%.
 - d. Type ACT-03: Painted mineral base; #1732 Fine Fissured with Humiguard Plus.
 - 1) Edge detail: Angled Tegular 15/16"
 - 2) Thickness: 5/8" inch.
 - 3) Texture: Medium.
 - 4) NRC: 0.55
 - 5) CAC: 35
 - 6) Light Reflectance: 82%
 2. Size: 24 inches by 24 inches.
 3. Fire Rating: Nonrated
 4. Flame spread/smoke developed: 25 or less, Class A.
 5. Include antimicrobial agent.

- B. Linear Veneered Wood Ceiling Panels:
 - 1. Type WCP-01: WoodWorks Linear Veneered Panels 6690F02W1.
 - a. Surface Texture: Smooth.
 - b. Composition: Real wood veneer on fire rated particle board.
 - c. Plank Width: 6" plank module nominal width (5.75" actual).
 - d. Panel Width: 24" panel nominal width (23.75" actual).
 - e. Panel Length: 96" panel nominal length (95.75 actual), with 1/4 inch reveal panel to panel at length and width.
 - f. Flame Spread:
 - 1) Class A: ASTM E84 surface burning characteristics. Flame Spread Index 25 or less. Smoke Developed Index 50 or less.
 - 2) CAN/ULC S102 surface burning characteristics. Flame Spread Rating 25 or less. Smoke Developed Classification 50 or less.
 - g. Finish: As indicated on the Drawings from the manufacturer's full range.
- C. Metal Suspension Systems:
 - 1. General: Standard type, finish, structural classification, to comply with applicable ASTM C635 requirements.
 - 2. Armstrong Prelude XL 15/16" Exposed Tee.
 - 3. Double web steel suspension system:
 - a. Manufacturer's standard system roll-formed from prefinished cold-rolled electrogalvanized steel sheet.
 - b. Fire-rated where required.
 - c. Direct-hung.
 - d. Intermediate-duty system.
- D. Accessories:
 - 1. Attachment Devices:
 - a. Sized for 5 times design load indicated in ASTM C635, Table 1, Direct Hung.
 - b. Corrosion Protection: Stainless steel components complying with ASTM F593 and ASTM F594, Group 1 Alloy 304 or 316 for bolts and anchors at locations indicated.
 - 2. Concrete Inserts: Formed from hot-dipped galvanized sheet steel, designed for attachment to concrete forms, for embedment in concrete, with holes or loops for attachment at hanger wires.
 - 3. Hanger Wire:
 - a. Galvanized carbon steel wire, ASTM A641, soft temper, prestretched, Class 1 coating, sized so stress at 3 times hanger design load (ASTM C635, Table 1, Direct Hung), will be less than yield stress of wire; provide not less than 12 gauge.
 - b. Corrosion Protection: Nickel-copper alloy wire; ASTM B164 nickel copper alloy UNS N04400 at locations indicated.
 - 4. Edge Moldings, Trim: Metal or extruded plastic of types and profiles indicated or, if not indicated, manufacturer's standard molding for edges, penetrations of ceiling which fits with type of edge detail, suspension system indicated.
 - a. For lay-in panels with reveal edge details: Stepped edge molding which forms reveal of same depth, width as formed between edge of panel and flange at exposed suspension member, unless indicated otherwise.

- b. For circular penetrations of ceiling: Edge moldings factory-fabricated to diameter required to fit penetration exactly.
 - c. Trim: 4-inch wide face, 9/16-inch horizontal legs with hems formed for attachment to mounting clip; commercial cold-rolled 24-gauge steel with factory finish.
- E. Other Materials: Other materials not specifically described but required for complete, proper installation of acoustical ceiling panel system, subject to acceptance of E/A.

2.3 FINISHES

- A. General: Manufacturer's standard factory-applied flat finish for type of system indicated. Color as selected by the E/A from manufacturer's full range of colors.
- B. High Humidity Finish: Comply with ASTM C635 requirements for "Coating Classification for Severe Environment Performance" where high humidity finishes are indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing, to which acoustical tile ceilings attach or abut, with installer present, for compliance with requirements specified that affect ceiling installation and anchorage, and with requirements for installation tolerances and other conditions affecting performance of acoustical tile ceilings.
- B. Field Dimensions: Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of work. Field verify dimensions and assume full responsibility for their accuracy.
- C. Verification of Conditions: Verify that acoustical ceiling panel system may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- D. Discrepancies:
 - 1. Immediately notify E/A.
 - 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 - 3. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection:
 - 1. Protect installed work and materials of other trades.
 - 2. Light fixtures and other recessed equipment within all fire-rated ceiling areas to be protected as required to comply with codes.
- B. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical tile ceiling installation.
- C. Testing Substrate: Test and verify moisture level is below tile manufacturer's recommended limits before installing adhesively applied tiles on wet-placed substrates.

3.3 INSTALLATION

- A. Comply with ASTM C636 and manufacturer's instructions.
- B. Acoustical Panels:
 - 1. All 4 edges of each board to be in firm contact with and supported by flanges of the runner sections.
 - 2. Check level of system during installation; maintain level and true plane.
 - 3. Lay out to minimize waste. Reuse cutoffs whenever feasible.

C. Metal Suspension Systems:

1. Pattern:
 - a. Lay out according to reflected ceiling plans.
 - b. Where not otherwise indicated, lay out so margins on opposite sides of rooms are equal and greater than 1/2 tile wide.
2. Main Runners:
 - a. Suspend with not less than 12 gauge galvanized, soft annealed steel wire.
 - b. Securely attach hanger wires to structure above.
 - c. Hang wires vertically with no kinks or bends.
 - d. Remove and replace dented, bent, or kinked members.
 - e. Space hangers along main runners according to manufacturer's recommendations and code requirements.
3. Reinforcement: Reinforce suspension system as necessary to adequately support suspension system, acoustical material, light fixtures, grilles, registers, other mechanical equipment to be supported by system with maximum hanger spacing 4 feet on center.
4. Supports:
 - a. Do not support from electrical conduit, mechanical ducts, pipes, or equipment.
 - b. Where spans exceed recommended or specified spans, furnish larger main runner channels or additional reinforcing members, hangers, stiffening, or bracing as necessary to support loads without exceeding specified allowable deflection.
 - c. Swing hangers are not permitted.
 - d. Install fire rated assemblies according to the appropriate UL fire rated assemblies.
5. Edge Moldings: Install at walls and vertical projections through ceiling.

3.4 CLEANING

- A. Following installation, clean dirt, finger marks, other discolored spots from exposed surfaces in manner and with materials recommended by manufacturer.
- B. Replace dirty, discolored, damaged, and improperly applied units.

3.5 CONSTRUCTION WASTE

- A. Conform with the Division 1 Specifications.
- B. Check with manufacturer for recycling options.

3.6 SCHEDULE

- A. Acoustical Panel Ceiling Types:

Type	Edge	Size	Rating	Base	Finish
ACT-01	Beveled Tegralar	2'x2'	None	Mineral	Painted
ACT-02	Square	2'x2'	None	Mineral/Ceramic	Painted
ACT-03	Angled Tegralar	2'x2'	None	Mineral	Painted
WCP-01	Reveal	2'x8'	None	Particle Board	Stained

END OF SECTION 09 51 13

SECTION 09 65 13 – Resilient Wall Base and Accessories

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Rubber Base.
 - 2. Molding accessories.
 - 3. Installation accessories.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 09 29 00 - Gypsum Board
 - 3. Section 09 68 00 - Carpeting
 - 4. Section 09 91 00 - Painting

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. F1861 - Standard for Resilient Wall Base
- B. UL 779

1.4 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Provide for each type of product indicated.
- C. Provide manufacturer's product data for adhesives, including printed statement of VOC content.
- D. Samples:
 - 1. Initial selection: For each type of product.
 - 2. Verification: For each type of product indicated, in manufacturer's standard-size, showing product color, texture, and pattern required.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide resilient base units and accessories made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of resilient products.
 - 2. Contractor: 3 years experience in the installation of resilient base.
 - 3. Personnel: For actual installation of resilient base and accessories, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.

- C. Regulatory Requirements:
 - 1. Meet ADA requirements.
 - 2. Fire-Test-Response Characteristics: Provide resilient stair accessories with a critical radiant flux classification of Class 1, not less than 0.45 W/sq. cm, as determined by testing identical products per ASTM E648 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Store in dry space, protected from weather, at temperatures between 50 degrees and 90 degrees F.
- 1.7 PROJECT CONDITIONS
 - A. Environmental Requirements:
 - 1. Maintain temperature of spaces to receive resilient products at least 70 degrees F for 48 hours.
 - 2. Store materials in these spaces at this temperature for 24 to 48 hours before installation is begun.
 - 3. Maintain 70 degrees F temperature during and after installation.
 - B. Install resilient products after other finishing operations, including painting, have been completed.
 - C. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.
- 1.8 WARRANTY
 - A. Replacement or repair to E/A's satisfaction for materials and labor for a period of one (1) year from Final Completion.
- 1.9 MAINTENANCE
 - A. Extra Materials:
 - 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 2. Furnish not less than 10 linear feet for every 200 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Resilient Base:
 - 1. Standard of Quality: Design is based on products of Johnsonite, Chagrin Falls, OH www.commercial.tarkett.com
 - 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Armstrong, Lancaster, PA www.armstrong.com
 - b. Roppe Corporation, Fostoria, OH www.roppe.com
 - c. VPI Floor Products, Sheboygan, WI www.vpicorp.com
 - d. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

A. Wall Base:

1. Type: Rubber.
2. Style: Coved base.
3. Surface: Smooth.
4. Thickness: 0.125-inch-thick base.
5. Height: 4 inches.
6. Length: 120 foot continuous roll.
7. Outside Corners: Premolded (outside corners with less than 12 inches on each leg must be premolded).
8. Inside Corners: Premolded.
9. Options:
 - a. Removable application.
 - b. Recyclable product.
 - c. Contoured.

B. Accessories:

1. Reducer Strips:
 - a. Use between carpet and exposed concrete floors.
 - b. 1 1/2 inch (minimum) wide beveled rubber or vinyl strips suitable for use in bridging adjacent materials as indicated on the Room Finish Schedule.
 - c. As may be indicated on Drawings.
2. Nosing for Carpet: Vinyl.

C. Installation Materials:

1. Trowelable leveling and patching compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated.
2. Adhesives:
 - a. As recommended by manufacturer to suit resilient products and substrate conditions.
 - b. Water-resistant.
 - c. Comply with following VOC limits:
 - 1) Cove base adhesives: 50 g/L.
3. Conductive Adhesive: As recommended by manufacturer for each specific material, location, use; include grounding foil at rate recommended.
4. Adhesive Tape System for Stairs: Johnsonite Power Tape.
5. Other Materials: Other materials not specifically described but required for complete, proper installation of resilient products, subject to acceptance of E/A.

2.3 FINISH

- ### A. Colors for Rubber Base:
- Colors selected by E/A from manufacturer's full color range for selected pattern. Owner reserves the right to pick up to 3 different colors.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Protect installed work and materials of other trades.
- B. Surface Preparation:
 - 1. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone; using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Prime concrete according to adhesive manufacturer's recommendations.
 - 4. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.2 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, foreign deposits, curing compounds, sealers, and hardeners that might interfere with adhesion of resilient products.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.3 INSTALLATION

- A. Base:
 - 1. Provide base from same factory color run in each room or as directed by the Architect.
 - 2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 3. Install base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
 - 4. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
 - 5. Do not stretch base during installation.
 - 6. On masonry surfaces or other irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.
 - 7. Premolded corners: Install before straight pieces.
 - 8. Job-formed Corners:
 - a. Outside:
 - 1) Use straight pieces of maximum lengths possible.
 - 2) Form without producing discoloration (whitening) at bends.
 - 3) Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.

- b. Inside:
 - 1) Use straight pieces of maximum lengths possible.
 - 2) Form by cutting an inverted V shaped notch in toe of wall base at the point where corner is formed.
 - 3) Shave back of base where necessary to product a snug fit to substrate.

B. Miscellaneous Accessories:

- 1. Butt mold accessories to adjacent materials and tightly adhere to substrates throughout length of each piece.
- 2. Install reducer strips at edges of floor coverings that would otherwise be exposed.

3.4 CLEANING

A. Site: Do not allow accumulation of scraps, debris arising from work of this section. Maintain premises in neat, orderly condition.

B. Resilient Products:

- 1. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance.
- 2. Thoroughly clean resilient products after installation to remove excess adhesive, dirt, and other foreign substances.
 - a. Use materials, procedures recommended or furnished by manufacturer.
 - b. Remove adhesive and other blemishes from exposed surfaces.
 - c. Sweep and vacuum surfaces thoroughly.
 - d. Damp-mop surfaces to remove marks and soil.
 - e. Do not wash surfaces until after time period recommended by manufacturer.

3.5 PROTECTION

- A. Close space to traffic for 24 hours after installation.
- B. Protect from mars, marks, indentations, and other damage from construction operations during remainder of construction period.
- C. Use protection methods recommended in writing by manufacturer.
- D. Do not move heavy and sharp objects directly over surfaces. Slide or roll objects over protective panels placed over tile.

3.6 WASTE MANAGEMENT

- A. Close and seal tightly all partly used adhesive containers and store protected in well-ventilated, fire-safe area at moderate temperature.

3.7 SCHEDULE

- A. Base (colors for each room shall be determined by Owner prior to installation), up to, and including three (3) colors.

END OF SECTION 09 65 13

SECTION 09 65 19 – Resilient Wall Base and Accessories

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Resilient Tile Flooring.
 - 2. Accessories including, but not limited to:
 - a. Adhesives.
 - b. Leveling Underlayment.
 - c. Transition/Edge moldings.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 09 65 13 - Resilient Wall Base and Accessories

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 DEFINITIONS

- A. Resilient Tile Flooring specified under this section is referenced on the Drawings as "Luxury Vinyl Tile (LVT)."

1.4 REFERENCES

- A. ASTM International:
 - 1. ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
 - 2. ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
 - 3. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
 - 4. ASTM F 1482, Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring
 - 5. ASTM F 1700 Standard Specification for Solid Vinyl Tile
 - 6. ASTM F 1861 Standard Specification for Resilient Wall Base
 - 7. ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
 - 8. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes

1.5 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide flooring which has been manufactured, fabricated, and installed to performance criteria certified by manufacturer without defects, damage, or failure.

- B. Administrative Requirements:
 - 1. Pre-installation Meeting: Conduct an on-site pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.
 - 2. Pre-installation Testing: Conduct pre-installation testing as described in this specification.
- C. Test Installations/ Mock-ups:
 - 1. Install at the project site a job mock-up using acceptable products and manufacturer approved installation methods, including concrete substrate testing. Obtain Owner's and Consultant's acceptance of finish color, texture and pattern, and workmanship standards.
 - 2. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
 - 3. Incorporation: Mock-up may be incorporated into the final construction with Owner's approval.
- D. Sequencing and Scheduling
 - 1. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring.
 - 2. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, according to the manufacturer's recommended bond, moisture tests and pH test.

1.6 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections details of components, seaming plan, coving details, and configurations within system and between system and adjoining system.
- D. Test Reports:
 - 1. Provide certified test reports showing concrete slab substrate meets resilient tile flooring manufacturer's maximum moisture level requirements.
 - 2. Submit two copies of supplier's/manufacturer's written certification that flooring system meets or exceeds required properties.
- E. Samples: Submit finish color samples for selection in manufacturer's standard colors.
- F. Closeout Submittals: Submit the following:
 - 1. Operation and Maintenance Data: Operation and maintenance data for installed products according to Division 1. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
 - 2. Warranty: Warranty documents specified herein.

1.7 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide types of flooring and accessories supplied by one manufacturer, including moisture mitigation systems, primers, leveling and patching compounds, and adhesives.

- B. Prior to installation of concrete floor slabs and concrete toppings, advise General Contractor of all manufacturer's requirements of the concrete substrate including finish, levelness, imperfection tolerances, and curing. The General Contractor is required to coordinate any special concrete floor slab and concrete topping requirements with the concrete floor mix designs prior to placement.
- C. Testing: The General Contractor shall be responsible for hiring an independent testing service to test the concrete floor slabs and concrete toppings for relative humidity, temperature, moisture vapor emission, and pH level, as required by floor covering manufacturer. Refer to Section 01 45 10 Quality Control for Building Construction for more information.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- B. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives, and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

1.9 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.
- B. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65°F (18°C) and a maximum temperature of 85°F (29°C) for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55°F (13°C) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances. Refer to the manufacturer's instructions for a complete guide on project conditions.
- C. Concrete Substrate:
 - 1. Concrete shall have cured for at least 28 days, and be free of water for at least 7 days.
 - 2. Prior to installation of resilient tile flooring, verify with the General Contractor that concrete substrate meets manufacturer's requirements for relative humidity, temperature, moisture vapor emission, and pH level.
 - 3. General Contractor is responsible for ensuring concrete substrate meets the flooring manufacturer's installation requirements and performing required mitigation. Means and methods of mitigation are the General Contractor's responsibility.

1.10 WARRANTY

- A. Provide manufacturer's standard twenty (20) year warranty.

1.11 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials from same production run as products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - 1. Quantity: Furnish quantity of flooring units equal to 5% of amount installed.
 - 2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage, and protection of extra material.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Resilient Tile Flooring:
 - 1. Standard of Quality: Design is based on products of Armstrong Flooring, Lancaster, PA armstrongflooring.com/commercial.
 - 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Shaw Contract, Cartersville, GA www.shawcontract.com
 - b. Tarkett, Solon, OH www.tarkett.com
 - c. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

- A. Resilient Tile Flooring:
 - 1. A layered construction consisting of a tough, clear, rigid vinyl wear layer protecting a high-fidelity print layer on a solid vinyl backing.
 - 2. Protected by a diamond-infused UV-cured polyurethane finish, the wear surface is embossed with different textures to enhance each of the printed visuals. Colors are insoluble in water and resistant to cleaning agents and light.
 - 3. ASTM F 1700, "Standard Specification for Solid Vinyl Tile", Class III, Type B – Embossed Surface. Meets requirements for size, squareness, thickness, thickness of wear layer, residual indentation, resistance to chemicals, resistance to light and resistance to heat.
 - 4. Pattern and Color: As selected by E/A or as indicated on the Drawings.
 - 5. Size: As selected by E/A, or as indicated on the Drawings.
 - 6. Wear layer thickness: 0.020 in. (0.5 mm).
 - 7. Thickness: 0.100 in. (2.5 mm).
- B. Adhesives:
 - 1. Provide adhesive under the flooring as recommended by the flooring manufacturer.

2.3 ACCESSORIES

- A. For patching, smoothing, and leveling monolithic subfloors, provide underlayment and embossing leveler as recommended by the flooring manufacturer.
- B. For priming porous and non-porous substrates, provide primers as recommended by the flooring manufacturer.
- C. Provide transition/reducing strips tapered to meet abutting materials.
- D. Provide threshold of thickness and width as shown on the drawings.
- E. Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl, or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.
- F. Provide metal edge strips of width shown on the drawings and of required thickness to protect exposed edges of the flooring. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage or overlap-type metal edge strips for exposed anchorage. Unless otherwise shown, provide strips made of extruded aluminum with a mill finish.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation according to manufacturer's instructions (i.e., moisture tests, bond test, pH test, etc.).
- C. Testing of Concrete Substrate:
 - 1. The General Contractor shall perform the following tests to determine in-situ relative humidity and temperature, moisture vapor emission, and pH level of concrete substrate:
 - a. Type of test and number of tests as required by ASTM F2170 or as recommended by manufacturer and installer.
 - b. ASTM F2170 - In-situ Probe Test: As required by the resilient tile flooring manufacturer.
 - c. PH Level: As required by the resilient tile flooring manufacturer.
 - 2. Notify E/A if test results are not within recommended limits and obtain instructions from flooring manufacturer.
- D. Do not begin preparation or installation until satisfactory concrete substrate test results are achieved. The General Contractor is responsible for providing manufacturer's required substrate conditions.
- E. Visually inspect flooring materials, adhesives, and accessories prior to installation. Flooring material with visual defects shall not be installed and shall not be considered as a legitimate claim.
- F. Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.
- G. Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
- H. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protect installed work and materials of other trades.
- B. Subfloor Preparation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects as recommended by the flooring manufacturer.
- C. Subfloor Cleaning:
 - 1. The surface shall be free of dust, solvents, varnish, paint, wax, oil, grease, sealers, release agents, curing compounds, residual adhesive, adhesive removers, and other foreign materials that might affect the adhesion of resilient flooring to the concrete or cause a discoloration of the flooring from below.
 - 2. Remove residual adhesives as recommended by the flooring manufacturer.
 - 3. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring.
 - 4. Avoid organic solvents.

5. Spray paints, permanent markers and other indelible ink markers must not be used to write on the back of the flooring material or used to mark the concrete slab as they could bleed through, telegraphing up to the surface and permanently staining the flooring material.
6. If these contaminants are present on the substrate, they must be mechanically removed prior to the installation of the flooring material.

3.3 INSTALLATION OF FLOORING

- A. Install according to the latest manufacturer's instructions.
- B. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.
- C. If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the subfloor around covers and to covers.
- D. Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.
- E. Roll with a 100-lb. roller in the field areas. Refer to specific rolling instructions of the flooring manufacturer.
- F. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.

3.4 INSTALLATION OF ACCESSORIES

- A. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.
- B. Apply metal edge strips where shown on the drawings. Secure units to the substrate, complying with the edge strip manufacturer's recommendations.

3.5 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from work of this section. Maintain premises in neat, orderly condition.
- B. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance.

3.6 PROTECTION

- A. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings.

END OF SECTION 09 65 19

SECTION 09 66 16 – Precast Epoxy Terrazzo

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Precast Epoxy Terrazzo:
 - a. Stair treads.
 - b. Stair risers.
 - c. Stair landings.
 - d. Transition strips.
 - 2. Accessories, including but not limited to:
 - a. Thin-set epoxy tile adhesive.
 - b. Epoxy grout.
 - c. Caulk.
 - d. Sealants.
- B. The following is not included in this section:
 - 1. Installation of steel stairs and landings to receive precast epoxy terrazzo treads, risers and landings.
- C. Related Sections:
 - 1. Section 03 33 00 - Cast-in-Place Concrete
 - 2. Section 03 41 00 - Plant-Precast Structural Concrete
 - 3. Section 05 50 00 - Metal Fabrications

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. C33 - Standard Specification for Concrete Aggregates
 - 2. C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
 - 3. C150 - Standard Specification for Portland Cement
 - 4. C293 - Standard Test Method for Flexural Strength of Concrete
- B. National Terrazzo and Mosaic Association Inc. (NTMA)
- C. Federal Register Part III
 - 1. 28 CFR Part 36

1.4 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.

- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections details of components, joint locations and configurations within system and between system and adjoining system. Details shall show all reinforcing and special hardware for fastening.
- D. Samples:
 - 1. Initial Color Selection: Submit manufacturer's standard color samples for each type of finish with Product Data and Shop Drawings.
 - 2. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components if requested by E/A.
- E. Maintenance Manual: Provide to Owner maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide precast epoxy terrazzo stair products made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of precast epoxy terrazzo stairs.
 - 2. Contractor: 3 years experience in the installation of precast epoxy terrazzo stairs.
 - 3. Personnel: For actual installation of precast epoxy terrazzo stairs, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of Work.
- C. Field Samples: If requested, furnish sample of each type of precast terrazzo tile and accessories to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.
- D. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.6 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Precast terrazzo to be palletized and shrink wrapped, delivered in original, unopened packaging with legible manufacturer identification, including size, piece number, quantities, manufacturer date and inspector initials.
- B. Store precast terrazzo indoors, in a climate-controlled environment, sheltered from moisture in original packaging. Protect from damage by other trades.
- C. Report all damage due to shipment immediately. Contractor is required to sign the Bill of Lading slip noting damaged product. Picture proof is required.

1.8 WARRANTY

- A. Manufacturer/Installer shall warrant installed system for a period of one (1) year from date of substantial completion against failure of workmanship and materials.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Precast Epoxy Terrazzo:
 - 1. Standard of Quality: Unless otherwise indicated, design is based on products of Wausau Tile, Inc., Wausau, WI www.wausautile.com

2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Precast Terrazzo Enterprises, Raleigh, NC www.precastterrazzo.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
- B. Thin-Set Epoxy Tile Adhesive:
1. Standard of Quality: Unless otherwise indicated, design is based on products of Custom Building Products, Santa Fe Springs, CA www.custombuildingproducts.com
 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Laticrete, North Bethany, CT www.laticrete.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
- C. Epoxy Grout:
1. Standard of Quality: Unless otherwise indicated, design is based on products of Custom Building Products, Santa Fe Springs, CA www.custombuildingproducts.com
 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Laticrete, North Bethany, CT www.laticrete.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

- A. Epoxy Resin
- B. Aggregates: All aggregates to meet ASTM C33 specifications, cleaned and properly graded to size. Aggregate shall be blended to meet individual project requirements.
- C. Marble chips: Size to conform with NTMA gradation standards.
- D. Abrasive Inserts: Shall consist of silica carbide and black epoxy. Number and size of inserts as indicated on the Drawings.
- E. Setting Materials:
 1. Thin-Set Epoxy Adhesive:
 - a. Comply with ASNI A118.3.
 - b. Chemical resistant, water-cleanable, non-sag, and non-slump.
 - c. Product: EBM-Lite Epoxy Bonding Mortar.
 - d. Color as indicated on the Drawings.
 2. Epoxy Grout:
 - a. Comply with ANSI A118.3.
 - b. Stain and chemical resistant, non-sag.
 - c. Product: CEG-Lite 100% Solids Commercial Epoxy Grout.
 - d. Color as indicated on the Drawings.
- F. Caulk and Sealants:
 1. Urethane or Polyurethane sealant.
 2. Color as selected by E/A from manufacturer's standard color pallet.

- G. Cleaner: Liquid neutral chemical cleaner, with pH factor between 7 and 8, of formulation recommended by sealer manufacturer for type of precast terrazzo used and complying with NTMA requirements.
- H. Sealer: Colorless, slip and stain-resistant penetrating sealer with pH factor between 7 and 8, that does not affect color or physical properties of precast terrazzo surface. Flash point (ASTM D56): 80 degrees F, minimum.

2.3 MANUFACTURED UNITS

- A. Sizing Tolerances: All units to conform to shop drawings with a 1/16" tolerance in dimension.
- B. Precast Surfaces and Edges:
 - 1. All exposed edges to be ground and polished with a minimum of 1/16" bevel.
 - 2. All finished surfaces to be ground and polished, free of holes and to have overall uniformity in matrix and aggregate.
 - 3. All precast epoxy terrazzo finished surfaces to be sealed with a sealer approved by manufacturer.
- C. Other Materials: Other materials not specifically described but required for complete, proper installation of precast epoxy terrazzo, subject to acceptance of E/A.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that precast terrazzo may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Examine areas to receive precast terrazzo for defects in existing work, and deviations beyond allowable tolerances for the substrate.
- D. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.
- B. Cleaning:
 - 1. Clean substrates of dust, dirt, grease, mildew, loose mill scale, and other foreign substances that could impair the bond of the setting material, according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 2. Surface shall be free of all visible rust.

3.3 INSTALLATION

- A. General Requirements:
 - 1. Install plumb, true, square in neat, rigid, substantial manner.
- B. Setting:
 - 1. Set accurately as shown on the approved shop drawings. Comply with setting material manufacturer's requirements to ensure proper bonding of all materials.
 - 2. All thin-set materials, whether cement or epoxy based, will require a full setting bed be applied to all appropriate surfaces of the precast terrazzo, vertical and horizontal, where contact is made with the substrate or structural base.
 - 3. Alignment of precast terrazzo should be straight and true to all dimensions. It may not vary more than 1/8" in length, height, or width.

4. Install anchors as shown on details, if required.
5. Fill joints between manufacturer-approved caulk or as specified.

3.4 ADJUSTING AND CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from Work of this Section. Maintain premises in neat, orderly condition.
- B. Clean exposed surfaces using materials and methods recommended by manufacturer.
- C. When work is completed, remove unused materials, containers, equipment, and debris.

3.5 PROTECTION

- A. Upon completion, the work shall be ready for final inspection and acceptance by E/A.
- B. General Contractor shall protect the finished work from the time the terrazzo contractor completes the work.

3.6 FINISH

- A. All precast epoxy terrazzo finished surfaces to be sealed with a sealer approved by manufacturer.

END OF SECTION 09 66 16

SECTION 09 67 00 – Fluid Applied Flooring

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Epoxy resin coating.
 - 2. Epoxy resin coating with chips.
 - 3. Integral epoxy resin cove base.
 - 4. Flooring accessories including, but not limited to:
 - a. Joint, edge and termination strips.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 07 92 00 - Joint Sealants

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 DEFINITIONS

- A. Epoxy Resin Flooring specified under this section is referenced on the Drawings as "Fluid Applied Flooring (FAF)."

1.4 REFERENCES

- A. ASTM:
 - 1. ASTM C 413 - Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - 2. ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
 - 3. ASTM D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.
 - 4. ASTM D1475 - Standard Test Method For Density of Liquid Coatings, Inks, and Related Products.
 - 5. ASTM D 2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
 - 6. ASTM D 2240 - Standard Test Method for Rubber Property—Durometer Hardness.
 - 7. ASTM D 2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
 - 8. ASTM D2369 - Standard Test Method for Volatile Content of Coatings.
 - 9. ASTM D 2370 - Standard Test Method for Tensile Properties of Organic Coatings.
 - 10. ASTM D 3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.
 - 11. ASTM D 4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

12. ASTM D 4366 - Standard Test Methods for Hardness of Organic Coatings by Pendulum Damping Tests.
 13. ASTM D5441 - Standard Test Method for Analysis of Methyl Tert-Butyl Ether (MTBE) by Gas Chromatography.
 14. ASTM D 7234 - Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
 15. ASTM F 1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 16. ASTM F 2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes
 17. ASTM G 154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials.
- B. National Floor Safety Institute (NFSI):
1. ANSI/NFSI B101.1 - Test Method for Measuring Wet SCOF of Common Hard-Surface Floor Materials.

1.5 SYSTEM DESCRIPTION

- A. Heavy duty, three component epoxy resin floor coating system, consisting of 1/8 inch textured epoxy surfacing with broadcast aggregate to form a skid resistant surface. Surface finish shall be a two component, chemical resistant epoxy.

1.6 SUBMITTALS

- A. Refer to Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including:
1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
 4. Provide a cut sheet or material safety data sheet for every sealant used within the building with VOC levels highlighted.
 5. Operation and maintenance data.
- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, details of components and configurations within system and between system and adjoining system.
- D. Test Reports:
1. Provide certified test reports showing concrete slab substrate meets epoxy resin coating manufacturer's maximum moisture level requirements.
 2. Submit two copies of supplier's/manufacturer's written certification that flooring system meets or exceeds required properties.
- E. Samples:
1. Initial Selection: Submit manufacturer's standard color samples for each type of finish with Product Data and Shop Drawings. Samples to be 6 inch by 6 inch cured format, indicating color combining and non-skid properties.
 2. Approved samples will be used during installation for product match.
- F. Maintenance Manual: Provide to Owner maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.

1.7 QUALITY ASSURANCE

- A. Provide special flooring, including primers, colorants, slip-retardant aggregates, resins, hardening agents, and finish coats from a single manufacturer.

- B. Prior to installation of concrete floor slabs and concrete toppings, advise General Contractor of all manufacturer's requirements of the concrete substrate including finish, levelness, imperfection tolerances, and curing. The General Contractor is required to coordinate any special concrete floor slab and concrete topping requirements with the concrete floor mix designs prior to placement.
- C. Testing: The General Contractor shall be responsible for hiring an independent testing service to test the concrete floor slabs and concrete toppings for relative humidity, temperature, moisture vapor emission, and pH level, as required by floor covering and coating manufacturer. Refer to Section 01 45 10 Quality Control for Building Construction for more information.
- D. Qualifications:
 - 1. Manufacturer: 10 years experience in the manufacture of specified flooring.
 - 2. Contractor: 5 years experience in the installation of specified flooring.
 - 3. Personnel: For actual installation of special flooring, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- E. Manufacturer Certifications:
 - 1. Provide to E/A, certification of the installer from the manufacturer of special flooring, that the installer is approved by the manufacturer.
- F. Installer to verify locations of all flexible joints required by the manufacturer.
- G. Field-Erected Mockups:
 - 1. Before installing special flooring, erect mock-up for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution.
 - 2. Build mock-up to comply with the following requirements, using materials indicated for final unit of work.
 - 3. Location: Locate mock-up on site in location and size indicated or, if not indicated, directed by E/A.
 - 4. Scope: Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Acceptance: Obtain E/A and Owner's acceptance of mock-up before start of final unit of work.
 - 6. Maintenance: Retain and maintain mock-up during construction in undisturbed condition as a standard for judging completed unit of work.
 - 7. Accepted mock-up in undisturbed condition at time of Substantial Completion may become part of completed unit of work.
- H. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying:
 - a. Coating or material name.
 - b. Manufacturer.
 - c. Color name and number.
 - d. Batch or lot number.
 - e. Date of manufacture.
 - f. Mixing and thinning instructions.

- B. Storage:
1. Store in a clean, dry, temperature-controlled environment (65 degrees F to 80 degrees F) and out of direct sunlight.
 2. Keep resins, hardeners, and solvents separated from each other and away from sources of ignition.
 3. Follow manufacturer's instructions for further storage and handling requirements.
 4. Keep materials in manufacturer's original, unopened containers and packaging until application.
 5. Handle to prevent damage or contamination.
 6. Keep materials from freezing.
 7. Do not use materials beyond manufacturer's shelf life limits.
- C. Replace damaged, outdated, unacceptable material prior to acceptance at no additional cost to Owner.

1.9 PROJECT CONDITIONS

- A. Environmental Requirements: Refer to manufacturer's instructions; strictly follow.
- B. Existing Conditions: Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.
- C. Lighting: Permanent lighting will be in place and working before installation of floor coating.
- D. Dust and Contaminants:
1. Schedule coating work to avoid excessive dust and airborne contaminants.
 2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.
- E. Apply flooring system under the following ambient conditions:
1. Ambient and Concrete Floor Temperatures: Between 65 and 85 degrees F.
 2. Material Temperature: Between 65 and 85 degrees F.
 3. Relative Humidity: Maximum 80 percent.
 4. Dew Point: Floor temperature more than 5 degrees above dew point.
- F. Concrete Substrate:
1. Concrete shall have cured for at least 28 days, and be free of water for at least 7 days.
 2. Prior to installation of floor coating system, verify with the General Contractor that concrete substrate meets manufacturer's requirements for relative humidity, temperature, moisture vapor emission, and pH level.
 3. General Contractor is responsible for ensuring concrete substrate meets the flooring manufacturer's installation requirements and performing required mitigation. Means and methods of mitigation are the General Contractor's responsibility.

1.10 WARRANTY

- A. Manufacturer shall warranty the installation of the product.
1. Warranty shall include warranty against delamination, adhesion defects, or deterioration due to normal wear, not including Owner neglect.
 2. Warranty shall be in effect for a period of 1 year from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Epoxy Resin Floor Coating System:
 - 1. Standard of Quality is based on products by Key Resin Company, Batavia, OH www.keyresin.com
 - 2. Other acceptable manufacturers, subject to compliance with specified requirements, are:
 - a. Sherwin-Williams, Cleveland, OH, www.sherwin-williams.com
 - b. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.

2.2 MATERIALS

- A. Epoxy Resin Floor Coating System:
 - 1. Product: Key Mortar SLT.
 - a. Prime Coat: Two component penetrating damp-proof epoxy, Key #502.
 - b. First Binder Coat with full broadcast quartz silica.
 - c. Second Binder Coat with full broadcast quartz silica.
 - d. Grout and Sealer Topcoat:
 - 1) Grout: Two component epoxy, Key #510, pigmented.
 - 2) Topcoat: Key #450 pigmented urethane with 46 grit aluminum oxide.
 - e. Broadcast Aggregates:
 - 1) Blended aggregate for base.
 - 2) Broadcast silica with a minimum Mohs hardness of six (6).
- B. Integral Cove:
 - 1. Product: Key #510.
 - 2. Color to match floor.
- C. Color: Refer to the Drawings.

2.3 ACCESSORIES

- A. Transition strips and termination strips as recommended by the manufacturer.
- B. Special Flooring Accessories: Other materials not specifically described but required for complete, proper installation subject to acceptance of E/A.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that special flooring may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Verify with concrete contractor that neither curing compound nor sealer was used on slab. Ensure concrete substrate has cured a minimum of 28 days.
- D. Testing of Concrete Substrate:
 - 1. The General Contractor shall perform at least one of the following two tests to determine in-situ relative humidity and temperature, and moisture vapor emission in concrete.

- a. Type of test and number of tests as required by ASTM F2170 or as recommended by manufacturer and installer.
 - b. ASTM F1869 - Calcium Chloride Test:
 - 1) The maximum allowed moisture vapor emission rate is 3 pounds per 1,000 square feet per 24 hours, or as required by the floor coating manufacturer.
 - c. ASTM F2170 - In-situ Probe Test:
 - 1) Application of flooring system shall start only if test results are below 80 percent relative concrete humidity, or as required by the floor coating manufacturer.
 - 2. If test results are above limits, notify E/A and floor coating manufacturer in writing.
- E. Do not begin preparation or installation until satisfactory concrete test results are achieved. The General Contractor is responsible for providing floor coating manufacturer's recommended moisture vapor control coating if required.
- F. Discrepancies:
 - 1. Immediately notify E/A.
 - 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 - 3. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Protection: Protect installed work and materials of other trades.
- C. Surface Preparation:
 - 1. Prepare concrete surfaces according to manufacturer's instructions.
 - 2. Provide concrete testing required by coating manufacturer.
 - 3. Surface should be checked for soundness and any "hollow" area should be removed.
 - 4. Fill depressions and spalled areas and cracks with manufacturer's approved product.
 - 5. Repair damaged and deteriorated concrete to acceptable condition, leaving surface free of dust, dirt, laitance, and efflorescence.
 - 6. Route out all cracks larger than 1/32 inch width and fill with rigid epoxy. Apply flexible epoxy across the crack a minimum width of 24 inches at a spread rate of 50 square feet per gallon to achieve 25-30 mils dry over the crack and allow to cure. Apply primer to cured membrane. Embed fiberglass mesh into wet primer and saturate with additional primer.
 - 7. Remove dirt, dust, debris, oil, grease, curing agents, bond breakers, paint, coatings, sealers, silicones, and other surface contaminants which could adversely affect application of flooring system.
 - 8. Steel shot blast or rough grind area to receive coating according to manufacturer's recommendations.
 - 9. Key-cut termination points with 1/4 inch by 1/4 inch cut.
 - 10. Fill joints according to manufacturer's instructions.

3.3 APPLICATION

- A. Epoxy Resin Floor Coating System:
 - 1. Install flooring system according to manufacturer's instructions and reviewed submittals at locations indicated on the Drawings.

2. Ensure concrete is cured, dry, clean, and prepared according to manufacturer's instructions.
3. Locate all flexile joints required.
4. Apply flooring system materials to obtain consistent mil thickness and smooth, uniform appearance and texture.
5. Overlay: Apply overlay according to manufacturer's instructions. Apply overlay to prepared concrete surface.
6. Traction Aggregate: Broadcast traction aggregate according to manufacturer's instructions. Broadcast traction aggregate into wet overlay.
7. Cove:
 - a. Apply cove primer and cove according to manufacturer's instructions at locations indicated on the Drawings.
 - b. Apply cove to height and shape as indicated on the Drawings.
 - c. Apply cove to create seamless, smooth transition between flooring and walls.
8. Seal Coat:
 - a. Apply seal coat according to manufacturer's instructions.
 - b. Apply seal coat over traction aggregate.
9. Match finished work to approved samples. Work to be uniform in thickness, sheen, color, pattern and texture, and free from defects detrimental to appearance.

3.4 REPAIR/RESTORATION

- A. Damaged Coatings: Touch up or repair. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.
- B. Use materials, procedures recommended or furnished by manufacturer.
- C. Materials and surfaces not scheduled to be coated: Repair or replace.

3.5 FIELD QUALITY CONTROL

- A. Field Inspection:
 1. Coordinate field inspection according to appropriate sections in Division 01.
 2. Verify coatings are as specified.
 3. Verify surface preparation and application are as specified.
 4. Verify DFT of each coat and coating system are as specified using wet film and dry film gages.
 5. Check coatings for film characteristics or defects that would adversely affect performance or appearance of coating systems.
 6. Submit written reports to E/A and contractor describing inspections made and actions taken to correct nonconforming work.
- B. Manufacturer's Services: Provide technical assistance and guidance for surface preparation and application of coating systems.

3.6 CLEANING

- A. Site:
 1. Do not allow accumulation of scraps, debris arising from work of this Section.
 2. Maintain premises in neat, orderly condition.
 3. Safe and proper disposal of excess materials shall be done according to applicable federal, state, and local codes.

- B. System:
 - 1. Allow flooring system to dry according to manufacturer's instructions before opening to traffic.
 - 2. Allow flooring system to dry a minimum of one (1) week before cleaning by mechanical means.
 - 3. Clean exposed surfaces of special flooring using materials and methods recommended by manufacturer.
 - 4. Remove temporary coverings and protection of surrounding areas and surfaces.

3.7 PROTECTION

- A. Protect surfaces of coating systems from damage during construction until acceptance by Owner at Substantial Completion.

3.8 DEMONSTRATION

- A. Maintenance Instructions: Manufacturer's representative to schedule and attend meeting with Owner's representatives to explain:
 - 1. Maintenance and Care Instructions.
 - 2. Recommended Maintenance Program.
 - 3. Warranty Requirements.

3.9 ONE-YEAR INSPECTION

- A. Owner to set date for 1-year inspection of coating systems.
- B. Inspection to be attended by Owner, Contractor, E/A, and manufacturer's representative.
- C. Repair deficiencies in coating systems as determined by E/A according to manufacturer's instructions.

3.10 SCHEDULES

- A. See Room Finish Schedule on the Drawings.

END OF SECTION 09 67 00

SECTION 09 68 00 – Carpeting

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Modular Carpet Tile.
 - 2. Accessories including, but not limited to:
 - a. Adhesives.
 - b. Leveling Underlayment.
 - c. Transition/Edge moldings.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 09 65 13 - Resilient Wall Base and Accessories
 - 3. Section 09 69 00 - Access Flooring

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. American Association of Textile Chemists and Colorists (AATCC):
 - 1. 16 - Colorfastness to Light
 - 2. 24 - Resistance to Insects
 - 3. 134 - Electrostatic Propensity of Carpet
- B. ASTM:
 - 1. D 1335 - Standard Test for Tuft Bind
 - 2. D 2646 - Dry Breaking Strength of Textile Floor Coverings
 - 3. D 2859 - Ignition Characteristics of Textile Floor Coverings
 - 4. D 3936 - Tests for Delamination
 - 5. D 5116 - VOC Content
 - 6. E 84 - Surface Burning Characteristics of Building Materials
 - 7. E 648 - Flammability (radiant panel)
 - 8. E 662 - Smoke Density
 - 9. F 2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes
- C. Carpet and Rug Institute (CRI) 104 - Standard for installation of commercial textile floor covering materials

1.4 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.

- C. Shop Drawings: Show the following:
1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
 2. Carpet type, color, and dye lot.
 3. Locations where dye lot changes occur.
 4. Seam locations, types, and methods.
 5. Type of subfloor.
 6. Type of installation.
 7. Pattern type, repeat size, location, direction, and starting point.
 8. Pile direction.
 9. Type, color, and location of insets and borders.
 10. Transition details to other flooring materials.
 11. Type of carpet cushion.
- D. Test Reports:
1. Provide certified test reports showing concrete slab substrate meets carpeting manufacturer's requirements.
 2. Submit two copies of supplier's/manufacturer's written certification that flooring system meets or exceeds required properties.
- E. Samples:
1. Initial Color Selection: Submit manufacturer's standard color samples for each type of product with Product Data and Shop Drawings.
 2. Color Verification: Prior to shipping, submit carpet in selected colors 27 inches by 18 inches in size, with accessories, to E/A for approval. Include notification to E/A if selection is not within quoted price range.
 3. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components if requested by E/A.
- F. Quality Assurance/Control Submittals:
1. IAQ Construction Plan: Provide to sequence installation of materials to avoid contamination of carpet and other absorptive materials.
- G. Maintenance Manual: Provide to Owner maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide carpet units made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
1. Manufacturer: 5 years experience in the manufacture of carpet, with 6 projects of similar size, scope and type of which 3 have been in successful use for 3 years or longer.
 2. Contractor: 3 years experience in the installation of carpet.
 3. Personnel: For actual installation of carpet, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of Work.
- C. Certifications: Provide to E/A, certification of installer from manufacturer of carpet.

- D. Prior to installation of concrete floor slabs and concrete toppings, advise General Contractor of all manufacturer's requirements of the concrete substrate including finish, levelness, imperfection tolerances, and curing. The General Contractor is required to coordinate any special concrete floor slab and concrete topping requirements with the concrete floor mix designs prior to placement.
- E. Testing: The General Contractor shall be responsible for hiring an independent testing service to test the concrete floor slabs and concrete toppings for relative humidity, temperature, moisture vapor emission, and pH level as required by the carpeting manufacturer. Refer to Section 01 45 10 Quality Control for Building Construction for more information.
- F. Regulatory Requirements: Carpet systems must meet or outperform the Carpet and Rug Institute Green Label Indoor Air Quality Test Program.
- G. Testing Requirements:
 - 1. Flammability (Radiant Panel): ASTM E648, Class I.
 - 2. Smoke Density: ASTM E662, less than 450.
 - 3. Electrostatic Propensity: AATCC 134, under 1.5 KV.
 - 4. Delamination: ASTM D3936, not less than 3.5 lbf/in.
 - 5. Resistance to Insects: AATCC 24.
 - 6. Colorfastness to Light: AATCC 16, Option E.
 - 7. Antimicrobial Activity: AATCC 174.
 - 8. Dry Breaking Strength: ASTM D2646, not less than 100 lbf.

1.6 COORDINATION

- A. General Contractor to coordinate carpeting supplied by the manufacturer to the access flooring manufacturer for factory installation as part of that system. Refer to Section 09 69 00 Access Flooring for more information.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver to the Site until the building is enclosed or other enclosed storage is available.
- B. Do not store carpet near products that can offgas harmful substances.
- C. Comply with CRI 104, Section 5, "Storage and Handling."
- D. Carpet Tile:
 - 1. Store to prevent pile crush, in flat bins with maximum height not to exceed 3 boxes.
 - 2. Allow to acclimate for 24 hours at a minimum temperature of 65 degrees F.

1.8 PROJECT CONDITIONS

- A. Existing Conditions: Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.
- B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
- D. Concrete Substrate:
 - 1. Concrete shall have cured for at least 28 days, and be free of water for at least 7 days.

2. Prior to installation of carpeting, verify with the General Contractor that concrete substrate meets manufacturer's requirements for relative humidity, temperature, moisture vapor emission, and pH level.
 3. General Contractor is responsible for ensuring concrete substrate meets the flooring manufacturer's installation requirements and performing required mitigation. Means and methods of mitigation are the General Contractor's responsibility.
- E. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.
- F. Carpet Tile: Floor and room temperature to be between 65 degrees and 95 degrees F. Humidity to be between 10 and 65 percent for 24 hours prior to and during installation. Maintain conditions minimum of 48 hours after installation.

1.9 WARRANTY

- A. Provide non-prorated replacement warranty for the following:
1. Stain Removal: 10 years.
 2. Wear: Lifetime.
 3. Edge Ravel: Lifetime.
 4. Delamination: Lifetime.
 5. Tuft Bind: Lifetime.
 6. Color Fastness to Light: 10 years.
 7. Color Fastness to Atmospheric Contaminants: 5 years.
- B. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.

1.10 MAINTENANCE

- A. Extra Materials:
1. Provide for maintenance purposes, quantity equal to 10 percent of each material installed, from same production run.
 2. Furnish from same production run as materials installed.
 3. Maximum 40 percent of additional material may be scrap material not less than 2 feet in any dimension; carpet tiles to be full, uncut.
 4. Wrap carpet for long term storage; mark each roll or tile carton to indicate material, color of each type of material installed.
 5. Deliver and store where directed by Owner.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Modular Carpet Tile
1. Standard of Quality: Unless indicated otherwise, design is based on products of Interface, LaGrange, GA www.interface.com
 2. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - a. Mohawk Group, Calhoun, GA www.mohawkflooring.com
 - b. Tarkett, Solon, OH www.commercial.tarkett.com
 - c. Mannington Commercial, Salem, NJ www.manningtoncommercial.com
 - d. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

- B. Accessories: Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
1. Reducer and Edge Strips
 - a. Johnsonite (Tarkett), Chagrin Falls, OH www.commercial.tarkett.com
 - b. Mercer Products Company, Eustis, FL
 - c. Manufacturer of comparable products submitted in compliance with Section 01 25 13.
 2. Leveling Underlayment: Cementitious leveling products recommended by carpet manufacturer.
 3. Adhesives: As recommended by carpet manufacturer.
 4. Other Materials: Other materials not specifically described but required for complete, proper installation of carpeting.

2.2 MATERIALS

- A. Carpet:
1. Finish: The choice of colors and patterns to be selected by E/A is a consideration for approval of substitutions.
 2. VOC Limits: Provide carpet that complies with the following limits for VOC content when tested according to ASTM D 5116:
 - a. Total VOCs: 0.5 mg/sq. m x h.
 - b. 4-PC (4-Phenylcyclohexene): 0.05 mg/sq. m x h.
 - c. Formaldehyde: 0.05 mg/sq. m x h.
 - d. Styrene: 0.4 mg/sq. m x h.
 3. Carpet Classes:
 - a. Extra heavy duty commercial.
 4. Observe dye lot guidelines.
- B. Carpet Tile:
1. Minimize sequence separation of pallet numbers in a given area.
 2. Provide following carpets for types, in locations indicated on Drawings or Schedules, and colors selected by E/A.
 3. Carpet Type "1":
 - a. Construction: Tufted, textured loop.
 - b. Size: 19.69" x 19.69".
 - c. Yarn weight: 17 oz. per yard.
 - d. Dye method: 100% Solution dyed.
 - e. Gage: 1/12 inch.
 - f. Finished pile height: 0.13".
 - g. Stitches/inch: 9.0.
 - h. Density: 8,620 oz/cubic yard.
 - i. Backing: GlasBac® vinyl backing.
 - j. Carpet tile installation format: As indicated on the Drawings.
 - k. Product: Ice Breaker.
 - l. Color: Selected by A/E and Owner, or as indicated on the Drawings.

4. Carpet Type "2":
 - Construction: Tufted, textured loop.
 - Size: 19.69" x 19.69".
 - Yarn weight: 18 oz. per yard.
 - Dye method: 100% Solution dyed.
 - Gage: 1/12 inch.
 - Finished pile height: 0.16".
 - Stitches/inch: 8.30.
 - Density: 6,968 oz/cubic yard.
 - Backing: *GlasBac*® vinyl backing.
 - Carpet tile installation format: As indicated on the Drawings.
 - Product: Open Air 423.
 - Color: Selected by A/E and Owner, or as indicated on the Drawings.
- C. Transition Moldings:
 1. Where carpet abuts dissimilar flooring and no recess is indicated, provide vinyl edge molding, submitted in compliance with Division 1 Specifications.
 2. Color to be as selected by E/A.
- D. Accessory Materials:
 1. Adhesive: Waterproof adhesive as recommended by carpet manufacturer for specific carpet, substrate, and location.
 2. Latex Underlayment: As recommended by carpet manufacturer.
 3. Miscellaneous: Provide other materials not specifically described but required for complete, proper installation, as recommended by manufacturer.
- E. Carpet System:
 1. Woven Carpet: Natural fibers woven onto natural fiber backing.
 2. Nylon Carpet and Carpet Tile: 100 percent recycled vinyl backing with dry adhesive; total recycled content 28 percent to 52 percent.
 3. Continuous Dye Process

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect, with installer present, and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions:
 1. Verify that carpeting may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
 2. Include moisture and alkalinity testing as appropriate; verified by carpet manufacturers representative.
 3. Check floor's porosity. If water is absorbed rapidly, seal floor with manufacturer's recommended sealant.
- C. Testing of Concrete Substrate:
 1. The General Contractor shall perform the following tests to determine in-situ relative humidity (RH) and temperature, moisture vapor emission, and pH level of concrete substrate.

- a. Type of test and number of tests as required by ASTM F2170 or as recommended by manufacturer and installer.
 - b. ASTM F2170 - In-situ Probe Test: RH moisture limit as required by the carpeting manufacturer.
 - c. PH Level: As required by the carpeting manufacturer.
- 2. Notify E/A if test results are not within recommended limits and obtain instructions from carpeting manufacturer.
- D. Do not begin preparation or installation until satisfactory concrete substrate test results are achieved. The General Contractor is responsible for providing carpeting manufacturer's recommended moisture vapor control coating if required.
- E. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.
- B. Surface Preparation:
 - 1. Verify that surfaces to receive carpet are thoroughly cured, dry, broom clean, free of dirt, grease, oil, paint, wax, mortar, plaster droppings; free of dust.
 - 2. Level cracks, holes, voids, trowel marks, grout lines, and protrusions to provide smooth and level floor surface.
 - 3. Prime concrete according to adhesive manufacturer's recommendations.
 - 4. Feather irregularities or minor floor level variations between new and existing construction with accepted underlayment material.
 - 5. Bring any areas where this technique will not bring satisfactory results to E/A's attention.

3.3 INSTALLATION

- A. Installation of Tile Modules:
 - 1. Follow carpet manufacturer recommendations about application, squareness, and location of working chalk lines precisely.
 - 2. Comply with CRI 104, Section 14.
 - 3. Install on 90 degree formats, with corners aligned according to manufacturer specifications.
 - 4. Snugly join modules. Check modules for correct firmness of joint.
 - 5. To ensure proper spacing, measure the distance covered by 11 modules (10 joints) installed on the floor with no visible gaps, peaks, or overlaps. Comply with manufacturer's specifications for proper distance.
 - 6. Do not trap yarn between modules.
- B. Adhesive:
 - 1. Verify compatibility of carpet adhesive with paint, concrete sealer, or other agents affecting adhesive performance before installing any carpet.
 - 2. Install carpet with adhesive and spread rate strictly according to manufacturer's recommended procedure.
 - 3. Spread method: Full spread.
 - 4. Allow proper open time for adhesive to develop proper tack.
 - 5. Provide same spread rate on semi-smooth or rough surfaces.
 - 6. Do not use excessive adhesive, immediately remove adhesive from the pile face or serging.

- C. Solid Color Carpet Installation:
 - 1. Fit carpet neatly to walls, columns, casework, equipment, adjacent finish flooring.
 - 2. Carpet Tile:
 - a. Measure area to find best starting point, utilizing a maximum size perimeter tile.
 - b. Corners shall be flat to ensure proper fit.
 - c. Install modules snugly, do not over-tighten tiles.
 - 3. Extend into closets.
 - 4. Roll with light roller to remove air bubbles, so that installation is smooth and free of wrinkles and bubbles.
- D. Nap: All carpet must run same direction.
- E. Seams:
 - 1. Carpet nap shall match on each side of tile; form strictly according to carpet manufacturer's instructions with seams at door openings centered under door.
 - 2. Do not extend seams perpendicular to door openings through opening.
 - 3. Use seam roller to blend and enhance seams.
- F. Holes for Electrical Outlets:
 - 1. Accurately locate holes for floor mounted electrical outlets.
 - 2. Coordinate location with work of other trades.
 - 3. Cut holes neatly so that edges of carpet will be covered by outlet trim.
- G. Molding: Install where carpet meets other finish floor materials as instructed by manufacturer.

3.4 INDOOR AIR QUALITY

- A. Pre-ventilate Carpet. Unroll and air out carpet in a well-ventilated, uninhabited space prior to installation.
- B. Adhesives and Seam Sealants:
 - 1. Dry Adhesive: Peel and stick
 - 2. Wet Adhesive: Maximum VOC levels: 50 grams/liter
- C. Provide maximum ventilation during installation.
- D. Isolate area of installation from rest of building.
- E. Clean new carpet thoroughly with a high-efficiency particulate air (HEPA) filtration vacuum.
- F. Vacate and ventilate space for as long as possible (up to 2 weeks) after installation.

3.5 RESTORATION/PROTECTION

- A. Perform the following operations immediately after installing carpet:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
 - 2. Remove yarns that protrude from carpet surface.
 - 3. Vacuum carpet using commercial machine with face-beater element.
 - 4. Use materials, procedures recommended or furnished by manufacturer.
- B. Replace defective carpet tiles; provide corrections/repair to seams. Replace tiles in original position and pile direction.

- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

3.6 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from Work of this Section. Maintain premises in neat, orderly condition.
- B. System: Clean exposed surfaces of carpet, including removing adhesives from the surface, using materials and methods recommended by manufacturer.

3.7 WASTE MANAGEMENT

- A. Select carpet from manufacturers that take back their products for reuse or recycling.
- B. Set aside and protect offcuts and remainder greater than 1 square yard for reuse by Owner or nonprofit organizations such as Habitat for Humanity.
- C. Close and tightly seal all partly used adhesive containers and store protected in well-ventilated, fire-safe area at moderate temperature.
- D. CARE - Carpet America Recovery Effort: Government and carpet industry program to divert carpet from landfills.

3.8 DEMONSTRATION

- A. Maintenance Instructions: Manufacturer's representative to schedule and attend meeting with Owner's Representatives to explain:
 - 1. Maintenance and Care Instructions.
 - 2. Recommended Maintenance Program.
 - 3. Warranty Requirements.

3.9 PROTECTION

- A. Cover and protect installed carpet from stains, soiling and pile crushing prior to turning project over to Owner.

3.10 SCHEDULE

- A. Refer to Room Finish Schedule and Finish Specifications in the Drawings.

END OF SECTION 09 68 00

SECTION 09 69 00 – Access Flooring

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Access Floor System, including but not limited to:
 - a. Access floor panels.
 - b. Floor coverings.
 - c. Understructure.
 - d. Electrical, data, and communication accessories.
 - 2. Accessories including, but not limited to:
 - a. Adhesives.
 - b. Transitions.
- B. Related Sections:
 - 1. Section 03 41 00 - Plant-Precast Structural Concrete
 - 2. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 3. Section 08 14 00 - Wood Doors
 - 4. Section 09 29 00 - Gypsum Board
 - 5. Section 09 65 13 - Resilient Wall Base and Accessories
 - 6. Section 09 68 00 - Carpeting
 - 7. Section 12 51 70 - Technical Furniture
 - 8. Division 26 - Electrical

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. CISCA (Ceilings & Interior Systems Construction Association) - Recommended Test Procedures for Access Floors.

1.4 DESIGN REQUIREMENTS

- A. Access floor system, where indicated on the design documents, shall consist of modular and removable fully encased cementitious filled welded steel panels fastened onto, and supported by, adjustable height pedestal assemblies. Pedestal head and panel corner design must provide a positive location and lateral engagement of the panel to the understructure support system without the use of fasteners.
- B. Panel shall be easily removed by one person with a suction cup lifting device and shall be interchangeable except where cut for special conditions.
- C. Quantities, finished floor heights (FFH) and location of accessories shall be as specified on the contract drawings.

1.5 PERFORMANCE REQUIREMENTS

- A. Design Load: Panel supported on actual understructure system capable of supporting a point load of 1250 lbs. applied on a 1 square inch area at any location on the panel without experiencing permanent set (as defined by CISCA) exceeding 0.010 inch. The loading method used to determine design (allowable) load shall be in conformance with CISCA Concentrated Load test method but with panel tested on actual understructure instead of steel blocks.
- B. Safety Factor: Panel supported on actual understructure system capable of withstanding a point load of no less than two times the design load rating on a one square inch area anywhere on the panel without failure when tested according to CISCA A/F, Section 2 "Ultimate Loading". Failure is defined as the point at which the system will no longer accept the load.
- C. Ultimate Load: Panel supported on actual understructure system capable of supporting a point load of at least 2500 lbs. applied on a one square inch area at any location on the panel without failure (i.e., minimum safety factor of 2) when tested according to CISCA A/F, Section 2, "Ultimate Loading".
- D. Rolling Load: Panel supported on actual understructure system capable of withstanding the following rolling loads at any location on the panel without developing a local and overall surface deformation greater than 0.040 inch when tested according to CISCA A/F, Section 3, "Rolling Loads". Note: Wheel 1 and 2 tests are performed on separate panels.
 - 1. CISCA Wheel 1: (3" dia x 1-13/16" wide): 1000 lbs. Passes:10
 - 2. CISCA Wheel 2: (6" dia x 2" wide): 800 lbs. Passes:10,000
- E. Impact Load: Panel supported on actual understructure system capable of supporting an impact load of 150 lbs. dropped from a height of 36 inches onto a 1 square inch area at any location on the panel when tested according to CISCA A/F Section 8, "Drop Impact Load Test".
- F. Panel Cutout: Panel with an 8.625" diameter interior cutout shall be capable of withstanding an ultimate load of 2500 lbs. without failure without the use of additional supports.
- G. Flammability: Panel shall meet Class A Flame spread requirements for flame spread and smoke development. Tests shall be performed according to ASTM-E84-1998, Standard Test Method for Surface Burning Characteristics for Building Materials.
- H. Combustibility: Panel system shall qualify as noncombustible by demonstrating compliance with requirements of ASTM E 136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.
- I. Recycled Content: Panel and understructure system shall have a minimum post-consumer recycled content of 18% and a minimum total recycled content of 49%.
- J. Pedestal Axial Load: Pedestal support assembly to provide a minimum 6000 lb. axial load without permanent deformation when tested according to CISCA A/F, Section 5, "Pedestal Axial Load Test".
- K. Pedestal Overturning Moment: Pedestal support assembly to provide an average overturning moment of 1000 in-lbs. when glued to a clean, sound, uncoated concrete surface when tested according to CISCA AF, Section 6, "Pedestal Overturning Moment Test".

1.6 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections details of components, joint locations and configurations within system and between system and adjoining system. Include locker numbering sequence information.

- D. Samples:
 - 1. Initial Color Selection: Submit manufacturer's standard color samples for each type of finish with Product Data and Shop Drawings.
 - 2. Color Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics. Include notification to E/A if selection is not within specified price range.
 - 3. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components if requested by E/A.
- E. Maintenance Manual: Provide to Owner maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.

1.7 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide access floor system made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of access floor systems.
 - 2. Contractor: 3 years experience in the installation of access floor systems.
 - 3. Personnel: For actual installation of access floor systems, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of Work.
- C. Field Samples: If requested, furnish sample of each type of product to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.
- D. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.8 COORDINATION

- A. Prior to installation of concrete floor slabs and concrete toppings, advise General Contractor of all manufacturer's requirements of the concrete substrate including finish, levelness, imperfection tolerances, curing, and sealers. The General Contractor is required to coordinate any special concrete floor slab and concrete topping requirements with the concrete floor mix designs prior to placement.
- B. General Contractor to coordinate floor coverings provided by other manufacturers to access floor manufacturer for factory installation.

1.9 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.10 WARRANTY

- A. Provide manufacturer's standard warranty.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Product:
 - 1. Standard of Quality: Unless otherwise indicated, design is based on ConCore 1250 Access Floor Panel, supported by the PosiLock Understructure System, manufactured by Tate, Inc., Jessup MD www.tateinc.com

2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. ASM, Ladson, SC www.asmproducts.com
 - b. Global IFS, Kentwood, MI www.globalifs.com
 - c. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 SUPPORT COMPONENTS - PEDESTALS

- A. Pedestal assemblies shall be corrosive resistant, all steel welded construction, and provide an adjustment range of +/- 1" for finished floor heights 6" or greater.
- B. Pedestal assemblies shall provide a means of leveling and locking the assembly at a selected height, which requires deliberate action to change height setting and prevents vibration displacement.
- C. Pedestal head shall be designed with locating tabs and integral shape to interface with the panel for positive lateral retention and positioning without fasteners. Note: This allows the floor to be installed during the construction process without screws so that access by other related trades can be accomplished quickly and easily. It also enables the user to have a mixed installation of fastened and unfastened panels within the same installation.
- D. Hot dip galvanized steel pedestal head shall be welded to a threaded rod which includes a specially designed adjusting nut. The nut shall provide location lugs to engage the pedestal base assembly, such that deliberate action is required to change the height setting.
- E. Threaded rod shall provide a specially designed anti-rotation device, such that when the head assembly is engaged in the base assembly, the head cannot freely rotate (for FFH of 6" or greater). Note: This prevents the assembly from inadvertently losing its leveling adjustment when panels are removed from the installation during use.
- F. Hot dip galvanized pedestal base assembly shall consist of a formed steel plate with no less than 16 inches of bearing area, welded to a 7/8" square steel tube and shall be designed to engage the head assembly.

2.3 FLOOR PANELS

- A. Panels shall consist of a top steel sheet welded to a formed steel bottom pan filled internally with a lightweight cementitious material. Mechanical or adhesive methods for attachment of the steel top and bottom sheets are unacceptable.
- B. Cementitious fill material shall be totally encased within the steel welded shell except where cut for special conditions. Note: This greatly reduces the potential for dust in the environment from exposed cement materials.
- C. Panel shall have an electrically conductive epoxy paint finish.
- D. Corner of panel shall have a locating tab and integral shape design to interface with the pedestal head for positive lateral retention and positioning with or without fasteners.
- E. Fastening of panels to pedestal heads shall be accomplished by a machine screw which is specially designed to be self capturing within the body of the panel. Note: This prevents the inadvertent loss of panel fastening screws when accessing the underfloor space and potential damage to objects by screws which extend beyond the depth of the panel.
- F. Top surface of the panel shall have an option for four positioning location holes to engage positioning buttons on the carpet tile for precise matching of the carpet tile to the panel.
- G. Panel size: 24" x 24".

2.4 ACCESSORIES

- A. Provide manufacturer's standard steps, ramps, fascia plate, perimeter support, and grommets where indicated on the contract drawings.
- B. Provide for maintenance purposes, quantity equal to 10 percent of each material installed, from same production run. Deliver to project in manufacturer's standard packaging clearly marked with the contents.

- C. Provide one panel lifting devices.
- D. When applicable, provide manufacturer's standard underfloor air systems components (including grilles and diffusers) where indicated on the Drawings.

2.5 FINISHES

- A. Finish the surface of floor panels with floor covering material as indicated on the Drawings.
- B. Where floor coverings are by the access floor manufacturer, the type, color and pattern shall be selected from manufacturer's standard options.
- C. Where floor coverings are provided by a separate manufacturer, the floor covering must be compatible with access floor system and meet the manufacturer's requirements. Floor covering manufacturer will supply floor covering to the access floor manufacturer so that floor covering can be factory installed. Refer to floor covering specification sections for more information.
- D. All areas to be furnished with laminated floor panels must be maintained at ambient temperature between 50° to 90° F and at humidity level between 20% to 80% relative and shall remain within these ranges through installation and occupancy.
- E. Carpet tile: Access floor system shall be designed to accommodate modular carpet tiles that precisely match with floor panels in a one-to-one configuration. This is accomplished by four positioning buttons on the carpet tile which engage into button location holes in the floor panel. The carpet tile's backing maintains dimensional stability and holds the carpet tile flat without field application of adhesive. Adhesives shall not be required on the carpet tile installation except where a carpet tile is cut and more than two positioning buttons are removed.
- F. Resilient tile or Luxury Vinyl Tile (LVT) planks: Rigid underlayment (by others) must be installed over the access floor prior to installing tile or planks.

2.6 FABRICATION TOLERANCES

- A. Floor panel flatness measured on a diagonal: +/- 0.035"
- B. Floor panel flatness measured along edges: +/- 0.025"
- C. Floor panel width or length of required size: +/- 0.010"
- D. Floor panel squareness tolerance: +/- 0.015"

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that access floor system may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Examine structural floor for unevenness, irregularities, and dampness that would affect the quality and execution of the work. Do not proceed with installation until structural floor surfaces are level, clean, and dry as completed by others.
- D. Verify dimensions on contract drawings, including level of interfaces including abutting floor, ledges, and doorsills.
- E. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.02 PREPARATION

- A. Protection: Protect installed work and materials of other trades.

- B. Concrete sealers, if used, shall be identified and proven to be compatible with pedestal adhesive. Verify that adhesive achieves bond to slab before commencing work.
- C. The General Contractor shall provide clear access, dry subfloor area free of construction debris and other trades throughout installation of access floor system.
- D. Areas to receive and store access floor materials shall be enclosed and maintained at ambient temperatures between 35° to 95° F and a minimum relative humidity of 20%. At least 24 hours before installation begins, all floor panels shall be stored at ambient temperatures between 50° to 90° F and relative humidity levels between 20% to 80% and shall remain within these environmental limits throughout occupancy.

3.3 INSTALLATION

- A. Pedestal locations shall be established from approved shop drawings so that mechanical and electrical work can be installed without interfering with pedestal installation.
- B. Installation of access floor shall be coordinated with other trades to maintain the integrity of the installed system. All traffic on access floor shall be controlled by access floor installer. No traffic but that of access floor installers shall be permitted on any floor area for 24 hours to allow the pedestal adhesive to set. Access floor panels shall not be removed by other trades for 72 hours after their installation.
- C. Floor system and accessories shall be installed under the supervision of the manufacturer's authorized representative and according to manufacturer's recommendations.
- D. No dust or debris producing operations by other trades shall be allowed in areas where access floor is being installed to ensure proper bonding of pedestals to subfloor.
- E. Access floor installer shall keep the subfloor broom clean as installation progresses.
- F. Partially complete floors shall be braced against shifting to maintain the integrity of the installed system where required.
- G. Additional pedestals as needed shall support panels where floor is disrupted by columns, walls, and perimeter cutouts.
- H. Understructure shall be aligned such that all uncut panels are interchangeable and fit snugly but do not bind when placed in alternate positions.
- I. Finished floor shall be level, not varying more than 0.062" in 10 feet or 0.125" overall.
- J. Inspect system prior to application of floor covering and replace any floor panels that are cracked, broken and structurally damaged and do not comply with specified requirements.
- K. Installed panels shall be straight and square and spaced so that the distance from one end to the other of any line of 12 panels is not less than 24 feet and does not exceed 24' 1/8".
- L. Acceptance: General contractor shall accept floor in whole or in part prior to allowing use by other trades.
- M. All cable and wire openings shall be sealed with manufacturer's removable cable cutout seal or grommets.

3.4 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from Work of this Section. Maintain premises in neat, orderly condition.
- B. System: Clean exposed surfaces, including removing adhesives from the surface, using materials and methods recommended by manufacturer.

3.5 PROTECTION

- A. Cover and protect installed system from stains, soiling, and pile crushing prior to turning project over to Owner.

END OF SECTION 09 69 00

SECTION 09 77 00 – Fiberglass Reinforced Plastic (RFP) Panels

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Durable, decorative wall panels with smooth or textured finishes
 - 2. Mounting hardware
 - 3. Adhesives
 - 4. Accessories and Trims.
- B. Related Sections:
 - 1. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 2. Section 09 22 00 - Non-Structural Metal Framing
 - 3. Section 09 29 00 - Gypsum Board
 - 4. Section 09 65 13 - Resilient Wall Base and Accessories
 - 5. Section 09 91 00 - Painting

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. ASTM International:
 - 1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM D256 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
 - 3. ASTM D638 Standard Test Method for Tensile Properties of Plastics.
 - 4. ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - 5. ASTM D2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

1.4 SYSTEM DESCRIPTION

- A. A. Performance Requirements: Provide durable, decorative wall panels which have been manufactured and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.5 SUBMITTALS

- A. General: Submit listed submittals according to Conditions of the Contract and Section 01 33 00 Submittal Procedures.

- B. Product Data: Submit manufacturer's product data, storage, handling and preparation requirements and installation instructions.
- C. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures. Indicate location and dimension of joints and fastener attachment.
- D. Samples: Submit selection and verification samples for finishes, colors and textures. Submit 2 physical samples of each type of panel, trim and fastener.
- E. General: Firm experienced in successful production of wall system similar to that indicated for the Project.
- F. Quality Assurance/Control Submittals: Submit the following:
 - 1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
 - 2. Certificates:
 - a) Submit manufacturer's certificate that products meet or exceed specified requirements.
 - b) Submit certificate of installer's qualifications.
 - 3. Manufacturer's Instructions: Manufacturer's installation instructions.
- G. Closeout Submittals: Submit the following:
 - 1. Operations and Maintenance Data: Operation and maintenance data for installed products according to Division 01 Closeout Submittals. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.
 - 2. Warranty documents specified herein.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Installer shall have a minimum of 5 years experience with composite wall panel work similar in scope and size to this project.

1.7 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Division 01 Product Requirements Section.
- B. Lead Time: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- D. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
 - 1. Store panels indoors.
 - 2. Lay panels flat. Do not stand panels on edge.
 - 3. Protect panels from moisture.
 - 4. Do not store panels in contact with the floor or against an outside wall.
 - 5. Do not remove protective film from panel surface until after installation (if applicable).
 - 6. Maintain optimum storage conditions of 60-75 degrees F (16-24 degrees C) at 35 - 55% relative humidity. Avoid extremes in temperature and humidity.
- E. Handling: Remove foreign matter from face of panel by using a soft bristle brush, avoiding abrasive action.

1.8 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

1. Installation shall not begin until building is enclosed, permanent heating and cooling equipment is in operation and residual moisture from plaster, concrete or terrazzo work has dissipated.
2. Install panels between 60 degrees F - 75 degrees F (15 - 24 degrees C) and relative humidity below 55%, ideally at the same conditions as the room's normal operating temperatures after building is occupied.
3. Provide ventilation to disperse fumes during application of adhesive as recommended by adhesive manufacturer.
4. Do not install wall/ceiling system until normal lighting conditions exist. Normal lighting conditions are described as those in place when the project is finished.

B. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1. Wall, ceilings, floors and openings must be level, plumb, straight, in-line and square.

1.9 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

C. Warranty Period: 2 years commencing on Date of Substantial Completion.

1. Warranty extends to products assembled / installed and used in the manner intended and does not cover damage or failure caused by misuse, abuse or accidents, exposure to extreme temperature, improper installation, improper maintenance and exposure to water or excessive humidity or excessive moisture.

1.10 MAINTENANCE

A. A. Extra Materials: Provide 2 full sheets of additional material for use by owner in building maintenance and repair.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Composite Wall Panels

1. Standard of Quality: Unless indicated otherwise, design is based on FiberLite® FRP Wall Panels by Nudo Products, Inc., Springfield, IL, www.nudo.com
2. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - a. Marlite, Dover, OH, www.marlite.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

A. Fiberglass Reinforced Plastic (FRP) Panels

1. Texture: Smooth, Pebbled
 - a. (Texture selected by E/A)
2. High Pressure Laminate (HPL): NA Thickness: 0.090"

3. Fire-Rating Class: A
4. Color: Selected by Architect from Manufacturer's full range of standard colors
5. Size: 4 feet x 12 feet (1.2 x 3.6 m) or other standard sizes to minimize number of joints/seams.
6. Physical Properties
 - a. Flexural Strength (ASTM D790): -- psi.
 - b. Flexural Modulus (ASTM D790): -- psi.
 - c. Tensile Strength (ASTM D638): -- psi.
 - d. Barcol Hardness (ASTM D2583): --
 - e. Izod Impact (ASTM D256): -- ft-lb/in.
 - f. Surface Burning Characteristics (ASTM E84): Class A.

2.3 ACCESSORIES

- A. Moldings: Provide coordinating PVC (polyvinyl chloride) molding(s) and trims. Color shall match color of panels selected for project.

PART 3 – EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Adhesive: Provide panel adhesive as recommended by panel manufacturer.
- B. Trim and Seam Treatment:
 1. Manufacturer: Acceptable to panel manufacturer.
 2. Material and Color: Color matched acrylic latex caulk.
 3. Material and Color: Standard PVC Moldings Match color of selected panels.
- C. Fasteners: Provide appropriate fasteners and accessories as required to properly complete installation.

3.2 PREPARATION

- A. Comply with the instructions and recommendations of the durable, decorative wall/ceiling panel manufacturer.
- B. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation according to manufacturer's instructions. Verify that site conditions are acceptable for installation of durable, decorative wall/ceiling panels. Examine back-up surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails are countersunk and joints and cracks are filled flush and smooth with the adjoining surface. Do not proceed with installation of durable, decorative wall/ceiling panels until unacceptable conditions are corrected.

3.3 INSTALLATION

- A. General: Prior to installing panels, remove packaging and allow panels to acclimate to room temperature and humidity for at least 48 hours.
- B. Wall/ceiling substrate must be dry and free from dirt, dust, grease and other contaminants. Walls must be flat and even. Remove high spots and fill low spots with material acceptable to panel manufacturer.
- C. Remove soluble or loose paint and other foreign matter that might interfere with proper adhesive bond. Painted surfaces must be prepared to adhesive manufacturer specifications for proper adhesion.
- D. General: Inspect panels for any defects immediately. Do not install panels of unacceptable quality. Field cutting of all wall systems should be accomplished using a circular saw with fine tooth carbide blade.

- E. Position panel so that the saw blade enters the finished HPL side first to avoid chipping or damage. Protect decorative laminate face of panel by covering work area, do not remove protective will until after installation.
- F. Follow adhesive manufacturer's recommendations for appropriate height of adhesive bead left by trowel and do not allow adhesive to skin over. When interior paneling is on an exterior surface or wet area, provide a barrier sheet and/or follow the adhesive manufacturer's installation recommendations for a secure bond.
- G. Installation Using PVC Trims:
 - 1. Start in the corner. Mark plumb line 48 1/8 inches from corner.
 - 2. Apply adhesive directly to entire back of composite wall panel using correct trowel with 100% adhesive coverage using crosshatch pattern. Apply adhesive to within 1/2 inch of all edges of panel.
 - 3. Slide panel into molding and withdraw 1/8 inch for PVC moldings or 1/16 inch for aluminum moldings to provide appropriate gap. Align with plumb line.
 - 4. Begin in top corner nearest molding with laminate roller, rolling down and out toward the edge without molding.
 - 5. Continue rolling down and out working across panel away from previously installed panel or initial molding. Remove all trapped air.
 - 6. Install one-piece division bar and caps or next molding by sliding onto panel.
 - 7. Repeat process, working in one direction around room.
 - 8. Immediately remove all adhesive residue. To remove, clean with nonabrasive cotton cloth and warm water. If necessary, use a mild nonabrasive detergent. For cleanup with solvent based adhesives, use mineral spirits or acetone to remove residue.

3.4 CLEANING

- A. Clean panel surfaces in compliance with manufacturer's recommendations.
 - 1. Use a clean, damp, nonabrasive cotton cloth and a mild liquid detergent or household cleaner.
 - 2. Rinse with clean water using a clean, nonabrasive cotton cloth.
 - 3. Dry panels with a soft, clean nonabrasive cotton cloth.
 - 4. Do not use cleaners containing acid, alkali or sodium hypochlorite.

3.5 PROTECTION

- A. Protect installed work from damage due to subsequent construction activity on the site.

END OF SECTION 09 77 00

SECTION 09 91 00 – Painting

PART 1 – GENERAL

1.1 SUMMARY

A. Provide:

1. Paint:

a. Exterior Substrates:

- 1) Concrete.
- 2) Concrete masonry units.
- 3) Metal.

b. Interior Substrates:

- 1) Concrete.
- 2) Concrete masonry units.
- 3) Gypsum drywall.
- 4) Wood and hardboard.
- 5) Ferrous and zinc-coated metal.
- 6) Structural steel and overhead metal.
- 7) Steel anti-ski coating (Inspection Pits).

2. Stain:

a. Interior.

B. Perform the following:

1. Surface preparation, priming, and finish coats for exposed surfaces and items including bare and primed mechanical and electrical equipment as scheduled or considered standard practice.

C. Do not paint the following:

1. Prefinished items, except as noted.
2. Concealed spaces, except as noted.
3. Labels:
 - a. Code requirements such as UL, FM.
 - b. Equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections:

1. Section 03 30 00 - Cast-in-Place Concrete
2. Section 04 20 00 - Unit Masonry Assemblies
3. Section 05 12 00 - Structural Steel Framing
4. Section 05 50 00 - Metal Fabrications
5. Section 06 10 53 - Miscellaneous Rough Carpentry
6. Section 06 40 23 - Interior Architectural Woodwork
7. Section 07 84 00 - Firestopping
8. Section 08 11 13 - Hollow Metal Doors and Frames (Commercial)
9. Section 08 14 00 - Wood Doors
10. Section 09 29 00 - Gypsum Board
11. Section 09 67 00 - Fluid Applied Flooring

1.1 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.2 REFERENCES

- A. ASTM:
 - 1. D16 - Standard Definitions of Terms
 - 2. D2047 - Slip Resistance of Coated Flooring Surfaces
 - 3. D3450 - Washability of Interior Architectural Coatings
- B. Master Painters Institute (MPI): www.paintinfo.com
 - 1. Evaluation of Exterior Systems
 - 2. Evaluation of Interior Systems
 - 3. Surface Preparation
- C. Painting and Decorating Contractors of America (PDCA) P5 - Sample Procedures for Paint and Other Decorative Coating Systems
- D. Society for Protective Coatings (SSPC):
 - 1. SP 1 - Solvent Cleaning
 - 2. SP 13 - Surface Preparation of Concrete

1.3 DEFINITIONS

- A. DFT: Dry Film Thickness
- B. Minimum VS: Minimum Volume Solids
- C. Paint: Any "decorative, protective, or otherwise functional coating applied to a substrate. This substrate may be another coat of paint." The Paint Handbook, by Guy E. Weismantel.
- D. Sheen: Standard coating terms defined in ASTM D16 apply.
- E. VOC: Volatile Organic Compound

1.4 SYSTEM DESCRIPTION

- A. Environmental Requirements:
 - 1. Clear wood finishes, floor coatings, stains, sealers, and shellacs applied to interior elements must meet the VOC content limits established in South Coast Air Quality Management District, Rule 1113 for Architectural Coatings.
 - 2. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - 3. Formaldehyde-free; free of fungicides or bactericides classified as mercury acetates, phenol phenates, or phenol formaldehyde.
 - 4. Restricted interior paint components; do not use the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.

- f. Cadmium
- g. Di (2-thylhexyl) phthalate.
- h. Di-n-butyl phthalate.
- i. Di-n-octyl phthalate.
- j. 1,2-dichlorobenzene.
- k. Diethyl phthalate.
- l. Dimethyl phthalate.
- m. Ethylbenzene.
- n. Formaldehyde.
- o. Hexavalent chromium.
- p. Halogenated solvents.
- q. Isophorone.
- r. Lead.
- s. Lead acetate or cobalt manganese (drying agents).
- t. Mercury or mercury compounds.
- u. Methyl ethyl ketone.
- v. Methyl isobutyl ketone.
- w. Methylene chloride.
- x. Naphthalene.
- y. Toluene (methylbenzene).
- z. 1,1,1-trichloroethane.
- aa. Vinyl chloride.
- bb. Additives containing biocides and antifreeze.

1.5 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data:
 - 1. Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
 - 2. Provide schedule detailing the following:
 - a. Specific products to be used for each coat, identified by manufacturer's catalog number and general classification.
 - b. Documentation that manufacturer has reviewed and approved each painting system.
 - c. Cross reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - d. Data pages for all products listed. Highlight the following:
 - 1) Type of resin.
 - 2) Dry film thickness.
 - 3) Volume solids.
 - 4) Units of sheen.
 - 5) VOC levels and MSDS.
 - 6) Other performance or descriptive data specified.

- C. Samples:
1. Color Selection:
 - a. Submit manufacturer's full range of color drawdowns with Product Data for initial selection.
 - b. Label each card with:
 - 1) Job name.
 - 2) Date.
 - 3) Product name and number.
 - 4) Color number stated in color schedule.
 - 5) Name, address, phone number of supplying company.
 2. Color and Texture Verification Samples:
 - a. Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.
 - b. "Step" each separate coat, including blockfillers and primers.
 - c. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.
 - d. Submit samples on the following substrates for E/A's review of color and texture only:
 - 1) Concrete: Provide two 4-inch-square samples for each color and finish.
 - 2) Concrete masonry: Provide two 4-inch by 8-inch samples of masonry, with mortar joint in the center, for each finish and color.
 - 3) Painted wood: Provide two 12 inch by 12-inch samples of each color and material on hardboard.
 - 4) Stained or natural wood: Provide two 4-inch by 8-inch samples of natural and stained wood finish on actual wood surfaces.
 - 5) Ferrous metal: Provide two 4 inch square samples of flat metal and two 8-inch-long samples of solid metal for each color and finish.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.
- B. Qualifications:
1. Manufacturer: 5 years experience in the manufacture of coating systems.
 2. Applicator: 3 years experience in commercial application of coating systems.
- C. Regulatory Requirements:
1. Paint, stain, and wood preservative finishes and related materials are regarded as hazardous products and are subject to regulations for disposal.
 2. Products shall comply with the United States Clean Air Act for maximum VOC content.
 3. Clear wood finishes, floor coatings, stains, sealers, and shellacs applied to interior elements must meet the VOC content limits established in South Coast Air Quality management District, Rule 1113 for Architectural Coatings.
 4. Interior architectural paint, primers, and coatings must be certified by Greenseal GS 11 and be low odor.

5. Anti-corrosive and anti-rust paints applied to interior metal substrates must be certified by Greenseal GC 03.
 6. Comply with local Code requirements and authorities having jurisdiction for flame spread and smoke developed ratings of paints and coatings.
 7. Conform to requirements of local authorities having jurisdiction in regard to the storage, mixing, application, and disposal of all paint and related waste materials.
 8. All materials, preparation, and workmanship shall conform to requirements of the latest edition of the Architectural Paint Specification Manual by MPI.
- D. Certifications: Manufacturer's certification that products supplied comply with local regulations controlling use of VOCs and Greenseal GS 11 and GC-03.
- E. Workmanship Mockups: Provide a full-coat benchmark finish sample of each type of coating and substrate required on the Project. Comply with procedures specified in PDCA P5. Duplicate finish of approved prepared samples.
1. E/A will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.
 - a. Wall Surfaces: Provide samples on minimum of 100 square feet of wall surface.
 - b. Small Areas and Items: E/A will designate an item or area as required.
 2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.
 3. After finishes are accepted, E/A will use the room or surface to evaluate coating systems of a similar nature.
 4. Final approval of colors will be from job-applied samples.
- F. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 degrees F.
- B. Maintain containers in clean condition, free of foreign materials and residue.
- C. Remove rags and waste from storage areas daily.
- D. Containers shall bear the following information:
 1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Volume solids, pigment, sheen, and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
 8. VOC content.

1.8 ENVIRONMENTAL/PROJECT REQUIREMENTS

- A. Job Conditions:
 1. Paint: Apply only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 degrees F and 95 degrees F.
 2. Do not apply paint in snow, rain, fog, or mist, when the relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.

3. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
4. Restrictions on Spraying: Limited to work being performed without adequate protection from other work.

1.9 WARRANTY

- A. Provide minimum 5-year manufacturer's written warranty.

1.10 MAINTENANCE

- A. Provide set of properly labeled drawdowns for future reorder of paint.
- B. Provide not less than 1 quart for each paint and color used on site for Owner touch-up.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Paint:

1. Standard of Quality: Design is based on products of Sherwin-Williams Company (S-W)
www.sherwin-williams.com, except as noted.
2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers are:
 - a. PPG Industries, Pittsburgh Paints www.ppg.com
 - b. Diamond Vogel www.diamondvogel.com
 - c. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

B. Paint:

1. Standard of Quality: Design is based on products certified by Greenseal GS 11
2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers are:
 - a. Benjamin Moore www.benjaminmoore.com
 - b. PPG Industries, Pittsburgh Paints www.ppg.com
 - c. Rodda Paint www.rodapaint.com
 - d. Scuffmaster, Minneapolis, MN www.scuffmaster.com
 - e. Manufacturer of comparable products submitted in compliance with Section-*
 - f. 01 25 13.

C. Cementitious Coating:

1. Standard of Quality: Unless indicated otherwise, design is based on products of Thoro System Products, Miami, FL www.thorosystem.com
2. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - a. Benjamin Moore www.benjaminmoore.com
 - b. Sherwin Williams Company www.sherwin-williams.com
 - c. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS GENERAL

- A. Material Compatibility: Provide blockfillers, primers, finish coat materials and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality:
 - 1. Provide manufacturer's best quality trade sale paint material of the various coating types specified.
 - 2. Paint containers not displaying manufacturer's product identification will not be acceptable.
 - 3. Paint shall be ready-mixed and pre-tinted.
 - 4. Colors: As selected by E/A from manufacturer's full range of colors.
 - 5. Microban Antimicrobial Protection: Inhibits growth of stain and odor-causing bacteria, mold, mildew, and other fungal growth on the dried paint film. EPA approved; NSF approved (National Sanitation Foundation).

2.3 MISCELLANEOUS PRODUCTS

- A. Wood Fillers:
 - 1. Wood filler paste.
 - 2. Wood knots: As recommended in writing by topcoat manufacturer.
- B. Sealers:
 - 1. Interior Latex Primer/Sealer.
 - 2. Interior Alkyd Primer/Sealer.
 - 3. S-W: Wood Classics Sanding Sealer.
- C. Varnish:
 - 1. Exterior varnish, semigloss.
- D. Strippers:
 - 1. Low emitting.
 - 2. Shall not contain methanol and trichloroethane, or methylene chloride.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Test existing finishes (if any) for lead before sanding, scraping, or removing. If lead is present, notify E/A.
- B. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work. Maximum acceptable moisture content of substrates:
 - 1. Concrete: 12 percent.
 - 2. Masonry (clay and CMU): 12 percent.
 - 3. Wood: 12 percent.
 - 4. Plaster: 12 percent.
 - 5. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

- D. Coordination of Work:
1. Steel surfaces with less than 1.0 meter clear working access may necessitate applying material to inaccessible surfaces prior to erection of the finished steel members, either at the point of fabrication or on-site.
 2. Review other sections in which primers are provided to ensure compatibility of total systems for various substrates.
 3. On request of E/A, furnish information on characteristics of finish materials to ensure use of compatible primers.
 4. Notify E/A of problems anticipated using the materials specified.
 5. Commencement of installation signifies acceptance of surface conditions.
- E. Factory-Primed Materials:
1. Supplier shall disclose to the general contractor and to the painting contractor any pre-treatment and temporary coatings which have been applied.
 2. Manufacturer/supplier shall provide certification that the specified surface preparation and priming has been performed.
 3. Galvanized Metal:
 - a. Remove pre-treatment and temporary coatings at no extra cost to painting contractor.

3.2 PROTECTION

- A. Protect work of other trades and property of Owner against paint damage and overspray.
- B. Sealants at expansion joints shall be masked prior to application of coating system.
- C. Warning Signs: Provide "wet paint" signs to protect newly painted finishes.
- D. Comply with requirements in "MPI Architectural Painting Specification Manual" for paint products indicated.

3.3 SURFACE PREPARATION

- A. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted.
 1. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
 2. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning General:
 1. Clean substrates of dust, dirt, grease, mildew, or other substances that could impair the bond of the various coatings according to manufacturer's written instructions for each particular substrate condition and as specified.
 2. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
 3. Provide barrier coats over incompatible primers or remove and re-prime.
- C. Cementitious Substrates:
 1. Comply with SSPC-SP13.
 2. Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted.
 3. Determine alkalinity and moisture content of surfaces by performing appropriate tests.
 - a. Perform pH test prior to application of coating system to ensure pH is within acceptable levels.

- b. If surfaces are sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application.
 - c. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
- 4. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents.
- 5. Roughen as required to remove glaze.
- 6. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
- 7. Use abrasive blast-cleaning methods if recommended by the paint manufacturer.
- 8. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner.
- 9. Flush the floor with clean water to remove acid, neutralize with ammonia, and rinse.
- 10. Allow to dry and vacuum before painting.
- D. Gypsum Drywall Substrate:
 - 1. Surface to be clean and dry.
 - 2. Set and spackle nail heads, sand smooth, remove dust.
 - 3. Spackle exterior surfaces with exterior grade compounds.
- E. Wood:
 - 1. Prime, stain, or seal scheduled wood immediately upon delivery.
 - 2. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 3. Sand surfaces that will be exposed to view, and dust off.
 - 4. Prime edges, ends, faces, undersides, and backsides of wood.
 - 5. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler.
 - 6. Sand smooth when dried.
 - 7. When transparent finish is required, backprime with spar varnish.
 - 8. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.
- F. Ferrous Metal Substrates:
 - 1. Clean nongalvanized ferrous-metal surfaces that have not been shop coated.
 - 2. Remove oil, grease, dirt, loose mill scale, and other foreign substances.
 - 3. Surface shall be free of all visible rust.
 - 4. Use solvent or mechanical cleaning methods that comply with recommendations of the SSPC.
 - 5. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - 6. For application of aluminum (metallic) paint to steel surface, use alkyd anticorrosive or quick-drying alkyd metal primer.
- G. Galvanized Surfaces:
 - 1. Clean per SSPC-SP1.
 - 2. Use non-petroleum-based solvents so surface is free of oil and surface contaminants.
 - 3. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

4. For application of metallic (aluminum) paint: Galvanized steel must weather a minimum of 6 months prior to coating.
- H. Aluminum Substrates:
1. Remove surface oxidation.
 2. Use vinyl wash primer.
- I. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.4 PAINT PREPARATION

- A. Mixing:
1. Carefully mix and prepare paint materials according to manufacturer's directions.
 2. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
 3. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material.
 4. Remove film and, if necessary, strain material before using.
 5. Filter metallic (aluminum) paint slowly through a 55 mesh screen.
 6. Use only thinners approved by the paint manufacturer, and only within recommended limits.
- B. Tinting:
1. Tint each coat progressively lighter to enable confirmation of number of coats.

3.5 APPLICATION

- A. General:
1. Apply paint according to manufacturer's directions.
 2. Use applicators and techniques best suited for substrate and type of material being applied.
 3. Do not use heat guns with lead-based paints.
 4. Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
- B. Multiple Coats:
1. The number of coats and film thickness required is the same regardless of the application method.
 2. Do not apply succeeding coats until the previous coat has cured as recommended by manufacturer.
 3. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
 4. Sand between applications where sanding is required to produce an even smooth surface according to manufacturer's directions.
- C. Tolerances:
1. Match approved samples for color, texture, and coverage.
 2. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance.
 3. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.

- D. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate. Provide a total dry film thickness (DFT) of the entire system as recommended by manufacturer.
- E. Extent of Work:
1. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.
 2. Paint surfaces behind movable equipment and furniture and wall-mounted items same as similar exposed surfaces.
 3. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.
 4. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.
 5. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 6. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 7. Finish exterior doors on tops, bottoms, and side edges same as exterior faces.
 8. Sand lightly between each succeeding enamel or varnish coat.
- F. Mechanical and Electrical Work:
1. Painting mechanical and electrical work is limited to items exposed in mechanical equipment rooms and in occupied spaces including, but not limited to:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 - h. Switchgear.
 - i. Panelboards.
 - j. Electrical equipment indicated to have a factory-primed finish for field painting.
- G. Blockfillers: Apply blockfillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- H. Prime Coats:
1. Before application of finish coats, apply a prime coat of material as recommended by manufacturer to material that is required to be painted or finished and has not been prime coated by others.
 2. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.

- I. Stipple Enamel Finish:
 - 1. Roll and redistribute paint to an even and fine texture.
 - 2. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections.
- J. Transparent (Clear) Finishes:
 - 1. Use multiple coats to produce a glass-smooth surface film of even luster.
 - 2. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.
 - 3. Provide satin finish for final coats.

3.6 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials being used.
 - 2. Samples of material delivered to Site will be taken, identified, sealed and certified in presence of contractor.
 - 3. Testing agency will perform tests for compliance of paint materials with product requirements.
 - 4. Owner may direct contractor to stop applying paints if test results show materials being used do not comply with product requirements.
 - 5. Contractor shall remove noncomplying paint materials from Site, pay for testing, and repaint surfaces painted with rejected materials.
 - 6. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the 2 paints are incompatible.

3.7 CLEANING, ADJUSTING, AND PROTECTION

- A. At the end of each workday, remove empty cans, rags, rubbish, wash water, solvents, and other discarded paint materials from the Site.
- B. Do not clean painting equipment with free draining water. Retain cleaning water and filter out sediments to reduce contaminants entering waterways, drain systems, or into the ground.
- C. Clean glass and paint-spattered surfaces by washing and scraping, using care not to scratch or damage adjacent finished surfaces.
- D. Remove, refinish, or repaint Work not in compliance with specified requirements.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
- F. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

3.8 WASTE MANAGEMENT

- A. Separate waste according to local recycling rules, if no local rules, rules as determined by the State of Wisconsin shall govern.
 - 1. Recycle paint through local recycling or collection facilities, or donate to Habitat for Humanity, etc.
 - 2. Dispose according to the safety requirements of authorities having jurisdiction.
 - 3. Solvent-based paints shall be stored and disposed of as hazardous materials.
 - 4. Do not dispose of paints or solvents by pouring on the ground.

3.9 EXTERIOR PAINT SCHEDULE

- A. Ferrous Metal and Zinc-Coated Metals (exposed structural; surfaces subject to light foot traffic; columns and handrails):
 - 1. Primer coat: Rust-inhibitive waterborne self-cross-linking acrylic primer.
 - a. Minimum DFT: 2.0 mils (over iron and steel)
 - b. Minimum VS: 39 percent.
 - c. S-W: Pro-Cryl Universal Primer B66.
 - 2. 2-component acrylic polyurethane high gloss:
 - a. 1 finish coat.
 - b. Minimum DFT: 4.0 mils.
 - c. Minimum VS: 57 percent.
 - d. Sheen: 30 to 50 units at 60 degrees.
 - e. S-W: Acrolon 218 HS Acrylic Polyurethane Semigloss B65.

3.10 INTERIOR PAINT SCHEDULE

- A. Concrete and Masonry (Other than Concrete Masonry Units):
 - 1. Walls not scheduled for epoxy:
 - a. Primer: Alkali-resistant, acrylic-latex, interior primer:
 - 1) Minimum DFT: 3.0 mils.
 - 2) Minimum VS: 37 percent.
 - 3) S-W: PrepRite Masonry Primer B28W300.
 - b. Semigloss acrylic-latex interior enamel (Corridors):
 - 1) 2 finish coats.
 - 2) Minimum DFT: 1.5 mils.
 - 3) Minimum VS: 38 percent.
 - 4) S-W: ProMar 200 Semi-Gloss B31.
 - 2. Ceilings:
 - a. Primer: Alkali-resistant, acrylic-latex, interior primer:
 - 1) Minimum DFT: 3.0 mils.
 - 2) Minimum VS: 37 percent.
 - 3) S-W: PrepRite Masonry Primer B28W300.
 - b. Flat, latex-based, interior paint:
 - 1) 2 finish coats.
 - 2) Minimum DFT: 1.2 mils.
 - 3) Minimum VS: 37 percent.
 - 4) Sheen: 0 to 5 units at 85 degrees.
 - 5) S-W: ProMar 400 Flat Latex B30W, 400 Series.
 - 3. Walls requiring stain resistance, washability, durability:
 - a. Primer: Alkali-resistant, acrylic-latex, interior primer:
 - 1) Minimum DFT: 3.0 mils.
 - 2) Minimum VS: 37 percent.
 - 3) S-W: PrepRite Masonry Primer B28W300.

- b. Semigloss acrylic-latex interior enamel (Corridors):
 - 1) 2 finish coats.
 - 2) Minimum DFT: 1.5 mils.
 - 3) Minimum VS: 38 percent.
 - 4) S-W: ProMar 200 Semi-Gloss B31.
 - 4. Unconditioned spaces, electrical/ mechanical rooms:
 - a. Primer: Alkali-resistant, acrylic-latex, interior primer:
 - 1) Minimum DFT: 3.0 mils.
 - 2) Minimum VS: 37 percent.
 - 3) S-W: PrepRite Masonry Primer B28W300.
 - b. Semigloss, acrylic-latex, interior enamel.
 - 1) 2 finish coats.
 - 2) Minimum DFT: 2.4 mils.
 - 3) Minimum VS: 40 percent.
 - 4) Sheen: 38 to 48 at 60 degrees.
 - 5) S-W: Pro Industrial Series B66
 - B. Concrete Masonry Units:
 - 1. Walls:
 - a. Blockfiller: Latex-based, blockfiller:
 - 1) Minimum DFT: 8 mils.
 - 2) Minimum VS: 48 percent.
 - 3) Apply 2 coats if required by substrate.
 - 4) S-W: PrepRite Blockfiller B25W25.
 - b. Semigloss interior latex enamel:
 - 1) 2 finish coats.
 - 2) Minimum DFT: 1.5 mils.
 - 3) Minimum VS: 38 percent.
 - 4) Sheen: Satin
 - 5) S-W: ProMar 200 Latex Semi-Gloss Interior B31-200.
 - 2. Unconditioned spaces, electrical/ mechanical rooms:
 - a. Blockfiller: High-performance, latex-based, blockfiller:
 - 1) Minimum DFT: 8 mils.
 - 2) Minimum VS: 48 percent.
 - 3) Apply 2 coats if required by substrate.
 - 4) S-W: ProMar Blockfiller B25W25.
 - b. Semigloss, acrylic-latex, interior enamel.
 - 1) 2 finish coats.
 - 2) Mild alkali and acid resistance.
 - 3) Minimum DFT: 2.4 mils.
 - 4) Minimum VS: 40 percent.

- 5) Sheen: 38 to 55 at 60 degrees.
 - 6) S-W: Pro Industrial Series B66.
- C. Gypsum Board; Precast Concrete Panels:
- 1. Walls not scheduled for epoxy:
 - a. Blockfiller: High-performance, 100 percent acrylic blockfiller:
 - 1) Minimum DFT: 4.0 mils calculated rate.
 - 2) Minimum VS: 55 percent.
 - 3) S-W: Loxon Block Surfacers A24.
 - b. Primer: Vinyl acrylic:
 - 1) Minimum DFT: 1.1 mils.
 - 2) Minimum VS: 26 percent.
 - 3) S-W: PrepRite 200 Latex Wall Primer B28W200.
 - c. Low-luster, acrylic-latex, interior enamel (Non-Corridor Spaces / Rooms):
 - 1) 2 finish coats.
 - 2) Minimum DFT: 1.6 mils per coat.
 - 3) Minimum VS: 37 percent.
 - 4) Sheen: 10 to 20 units at 85 degrees.
 - 5) S-W: ProMar 200 Latex Eg-Shel B20W, 1200 Series.
 - d. High-gloss interior latex enamel (Heated Vehicle Storage Area and Maintenance Bays):
 - 1) 2 finish coats.
 - 2) Minimum DFT: 1.5 mils.
 - 3) S-W: ProMar 200 Latex Gloss Enamel B21.
 - 2. Ceilings:
 - a. Primer: Latex-based, interior primer.
 - 1) Minimum DFT: 1.1 mils.
 - 2) Minimum VS: 26 percent.
 - 3) S-W: PrepRite 200 Latex Wall Primer B28W200.
 - b. Flat, vinyl acrylic interior paint.
 - 1) 2 finish coats.
 - 2) Minimum DFT: 1.2 mils per coat.
 - 3) Minimum VS: 37 percent.
 - 4) Sheen: 0 to 5 units at 85 degrees.
 - 5) S-W: ProMar 400 Flat Latex B30W400 Series.
 - 3. Unconditioned spaces and mechanical rooms:
 - a. Primer: Latex-based, interior primer.
 - 1) Minimum DFT: 1.1 mils.
 - 2) Minimum VS: 26 percent.
 - 3) S-W: PrepRite 200 Latex Wall Primer B28W200.

- b. Semigloss, acrylic-latex, interior enamel.
 - 1) 2 finish coats.
 - 2) Minimum DFT: 2.4 mils.
 - 3) Minimum VS: 40 percent.
 - 4) Sheen: 38 to 48 units at 60 degrees.
 - 5) S-W: Pro Industrial B66 Series.
 - 4. Semigloss Epoxy Finish (dry or moderately humid areas scheduled to receive waterbased epoxy locker rooms / restrooms):
 - a. Primer: Vinyl acrylic primer.
 - 1) Minimum DFT: 1.1 mils.
 - 2) Minimum VS: 26 percent.
 - 3) S-W: PrepRite 200 Latex Wall Primer B28W200.
 - b. Water Based Catalyzed Epoxy.
 - 1) 3 finish coats.
 - 2) Minimum DFT: 2.5 mils per coat.
 - 3) Minimum VS: 38.
 - 4) Sheen: 20 to 30 units at 60 degrees.
 - 5) S-W: Water Based Catalyzed Epoxy B70 Series/B60V25.
- D. Ferrous and Zinc-Coated Metal:
 - 1. Primer: Quick-drying, rust-inhibitive, waterborne, self-cross-linking acrylic primer:
 - a. Minimum DFT: 2.0 mils.
 - b. Minimum VS: 39.
 - c. S-W: Pro-Cryl Universal Primer B66.
 - 2. Full-gloss, acrylic-latex, interior enamel:
 - a. 2 finish coats.
 - b. Minimum DFT: 1.6 mils.
 - c. Minimum VS: 35 percent.
 - d. S-W: ProClassic Waterborne Gloss B21 Series.
 - 3. Semigloss, alkyd-enamel odorless finish:
 - a. 2 finish coats.
 - b. Minimum DFT: 3.4 mils.
 - c. Minimum VS: 43 percent.
 - d. Sheen: 40 to 50 units at 60 degrees.
 - e. S-W: ProMar Alkyd Semi-Gloss B34W200 Series.
 - 4. Full-gloss, alkyd-enamel finish over wood undercoater.
 - a. 2 finish coats.
 - b. Minimum DFT: 2.4 mils.
 - c. Minimum VS: 38
 - d. Sheen: 80 to 90 units at 60 degrees.
 - e. S-W: ProMar 200 Alkyd Gloss, B35 Series.

5. 2-Component acrylic polyurethane high gloss:
 - a. 1 finish coat.
 - b. Minimum DFT: 4.0 mils.
 - c. Minimum VS: 57 percent.
 - d. Sheen: 30 to 50 units at 60 degrees.
 - e. S-W: Acrolon 218 HS Acrylic Polyurethane Semigloss B65.
- E. Metal Ceiling; Exposed Overhead Metal (Structural Steel) and Metal Superstructure, including columns and purlins:
 1. Dryfall waterborne system; semigloss acrylic finish.
 2. Spot Primer: Rust-inhibitive waterborne self-cross-linking acrylic primer:
 - a. Minimum DFT: 2.0 mils.
 - b. Minimum VS: 39 percent.
 - c. S-W: Pro-Cryl Universal Primer B66_310.
 3. Waterborne flat acrylic dryfall.
 - a. 1 finish coat.
 - b. Minimum DFT: 3.0 mils.
 - c. Minimum VS: 40 percent.
 - d. Sheen: 0 to 5 units at 85 degrees.
 - e. S-W: Waterborne Acrylic Dryfall B42W1.
- F. Steel Anti-Skid Coating:
 1. High solids, high build, fast drying, semi-gloss, polyamide epoxy coating.
 2. 2 finish coats.
 3. Minimum DFT: 5.0 – 10 mils per coat.
 4. Minimum VS: 72 percent.
 5. Location: Bridge Plank Rub Rail at Inspection Pits.
 6. Prep: prepare surface as recommended by manufacturer.
 7. Anti-skid Additive: Aluminum oxide 220 mesh added to second coat at a ratio of 3 – 4 lbs. per gallon.
 8. Color: Safety Yellow.
 9. SW: Macropoxy 646 Fast Cure Epoxy.

3.11 INTERIOR STAIN SCHEDULE

- A. New Interior Woodwork:
 1. Alkyd-based:
 - a. Stain coat: VOC compliant wiping stain:
 - 1) Transparent Finish: S-W Wood Classics Interior Oil Stain A49, 200 Series.
 - b. 2 finish coats: Alkyd-based or polyurethane satin varnish, as recommended by manufacturer:
 - 1) Minimum DFT: 0.8 mils per coat.
 - 2) Minimum VS: 24 percent.
 - 3) Sheen: 25 to 30 units at 60 degrees.
 - 4) S-W: Wood Classics Polyurethane Varnish A67F1.

- 2. Waterborne, Satin-Varnish Finish:
 - a. Stain Coat: Waterborne, oil, interior wood stain applied at spreading rate recommended by manufacturer:
 - 1) S-W: Wood Classics Oil Stain A49.
 - b. 2 finish coats: Waterborne, varnish finish applied at spreading rate recommended by manufacturer:
 - 1) Polyurethane Varnish Satin A68F90.

END OF SECTION 09 91 00

END OF DIVISION 09 - FINISHES

DIVISION 10 – SPECIALTIES

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SECTION 10 11 00 – Visual Display Surfaces

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Porcelain Enamel Magnetic Marker Boards.
 - 2. Vinyl-Fabric Faced Tack Boards.

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 RELATED SECTIONS

- A. Section 06 10 53 - Miscellaneous Rough Carpentry

1.4 REFERENCES

- A. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials

1.5 SUBMITTALS

- A. Reference: Division 1 Specifications.
- B. Product Data: Provide manufacturer's technical data and installation instructions for each material, including data verifying that materials meet specified requirements.

- C. Shop Drawings: Submit according to Division 1 Specifications, indicating elevations, dimensions, joint locations, anchor details, accessories, trim profiles, adhesive, backing and finish.
 - D. Samples: Submit samples of porcelain enamel marker board, vinyl-fabric faced tack board, and aluminum trim and accessories, showing full color range according to Division 1 Specifications.
 - E. Maintenance Data: Submit maintenance data including cleaning and stain removal.
- 1.6 QUALITY ASSURANCE
- A. Personnel: Workers skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work (5 years experience).
 - B. Regulatory Requirements: Conform to International Building Code, Section 803, flame spread index rating for wall finish materials according to ASTM E84.
- 1.7 PROJECT CONDITIONS
- A. Field Measurements:
 - 1. Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating visual display surfaces without field measurements.
 - 3. Coordinate wall construction to ensure that actual dimensions correspond to established dimensions.
 - 4. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.
 - B. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.
- 1.8 WARRANTY
- A. Porcelain Enamel Marker Boards: Lifetime of the installation including: markerboards that do not retain original writing and erasing qualities, become slick and shiny, or exhibit crazing, cracking, flaking and fading. Includes both material and replacement labor.
 - B. Assembled/Installed Units: Provide 5-year warranty including material and labor coverage from manufacturing defects.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Standard of Quality: Design is based on products of Claridge Products & Equipment, Inc., Coppel, TX www.claridgeproducts.com
 - 1. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Koroseal Interior Products, Fairlawn, OH www.koroseal.com
 - b. Platinum Visual Solutions, Corona, CA www.pvsusa.com
 - c. W.E. Neal Slate Company www.nealslate.com
 - d. Polyvision, Johns Creek, GA www.polyvision.com
 - e. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

A. Marker Board:

1. Porcelain enamel, 24 gauge enameling steel with porcelain/ceramic finish fused to steel sheet; marker board must be magnetic.
2. Marker Board Finish:
 - a. Acid resistant or better.
 - b. Gloss: High.
3. Refer to the Drawings for sizes and locations.
4. Units less than 16 feet by 4 feet: 1/2 inch gypsum board core with 0.001 inch aluminum foil balance sheet.
5. Larger units shall have 1/2 inch particle board core with 0.015 aluminum balance sheet.
6. Boards over 16 feet to be joined by 1 inch steel spline.

B. Vinyl-Fabric Faced Tackboards:

1. Mildew resistant, washable, vinyl fabric complying with FS CCC-W-408, Type II.
2. Laminated to 1/2 inch fiberboard backing.
3. ASTM E 84 Flame spread rating: 25 or less.
4. Refer to the Drawings for sizes and locations.
5. Color as selected by E/A from manufacturer's standard colors.

2.3 ACCESSORIES

A. Frames and Trim:

1. Aluminum: Fabricated from not less than 0.062-inch-thick extruded aluminum; of size and shape indicated. Provide straight, single-length units where possible with a minimum number of joints. Miter corners to a neat, hairline closure.
 - a. Where size of boards or other conditions exist that require support in addition to the normal trim, provide structural supports or modify trim as needed.
 - b. Factory applied trim: Slip-on with no visible screws.

B. Chalk tray: Continuous box-type aluminum chalk tray with slanted front and cast aluminum end closures.

C. Integral Map Rail: Provide map rail at the top of each marker board unit, with the following accessories:

1. Display Rail: Continuous cork display rail approximately 2 inches wide, integral with the map rail.
2. End Stops: Located at each end of map rail.
3. Map Hooks: 2 map hooks for every 48 inches of map rail or fraction thereof.

PART 3 – EXECUTION

3.1 EXAMINATION

- #### A.
- Verify that surfaces are ready to receive work. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

- #### A.
- Install plumb, true, square in neat, rigid substantial manner.

3.3 CLEANING

- #### A.
- Clean all surfaces according to manufacturer's instructions.

END OF SECTION 10 11 00

SECTION 10 12 00 – Display Cases

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Prefabricated aluminum map display cases.
 - 2. Acrylic brochure display rack.
- B. Related Sections:
 - 1. Section 04 20 00 - Unit Masonry Assemblies
 - 2. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 3. Section 09 29 00 - Gypsum Board

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. B221 - Specifications for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 2. C1048 - Specification for Heat-Treated Flat Glass – Kind FT Coated and Uncoated Glass.
 - 3. D172 - Specification for Cork Sheet, Bulletin Board.

1.4 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections details of components, joint locations and configurations within system and between system and adjoining system.
- D. Samples:
 - 1. Initial Color Selection: Submit manufacturer's standard color samples for each type of finish with Product Data and Shop Drawings.
 - 2. Color Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics. Include notification to E/A if selection is not within specified price range.
 - 3. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components if requested by E/A.
- E. Maintenance Manual: Provide to Owner maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide display cases and racks made of components of standard construction furnished by one manufacturer as coordinated assemblies.

1.6 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.7 WARRANTY

- A. Provide manufacturer's standard 1-year warranty. Warranty shall cover replacement of defective workmanship and product defects such as, but not limited to, deterioration of material or finish, and difficulty in operation.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Map Display Cases:
 - 1. Standard of Quality: Unless otherwise indicated, design is based on aluminum framed display cases by Aarco Products, Inc., Yaphank, NY www.aarco.net
 - 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers are:
 - a. Platinum Visual Solutions, Corona, CA www.pvsusa.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
- B. Wall Mounted Brochure Display Holder:
 - 1. Standard of Quality: Unless otherwise indicated, design is based on acrylic wall brochure rack as manufactured by Displays2Go, Fall River, MA www.displays2go.com
 - 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers are:
 - a. Braeside, Antioch, IL www.braesidedisplays.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

- A. Map Display Case:
 - 1. Aluminum Extrusions: meet ASTM B221, alloy 6063-T5.
 - 2. Aluminum Panels: meet ASTM B209, minimum 0.090 inch.
 - 3. Glass: meet ASTM C1048, fully tempered, Type 1 clear with minimum 0.25 inch thickness.
 - 4. Tackable Surface: 1/4 inch thick linoleum grade cork with burlap backing.
- B. Wall Mounted Brochure Holder: Clear acrylic.

2.3 FABRICATION

- A. Map Display Case Cabinet:
 - 1. Extruded aluminum cabinet and doors, with tempered glass window panels. Aluminum extrusion mitered and assembled with concealed corner angles.
 - 2. Cabinet Profile: 2 inches x 1/2 inch x 1/8 inch channel framed aluminum case. Cabinet depth to be 2 inches.
 - 3. Door Profiles:
 - a. Top hinged aluminum frame: continuous anodized aluminum piano hinges and stainless steel pins, hold-open devices, continuous door stops and weather-tight glazing channel suitable for exterior use.

- b. Side hinged aluminum frame: continuous anodized aluminum piano hinges and stainless steel pins, continuous door stops, and weather-tight glazing channel suitable for exterior use.
- 4. Locks: All hinged doors to be equipped with flush mounted cam locks that are keyed alike.
- 5. Mounting Method: Surface mounted to concrete masonry wall surfaces.
- 6. Cabinet Background Finish: 1/4 inch thick linoleum grade colored cork at background over 1/4 inch luan plywood. Finish and color to be selected by E/A from manufacturer's standard colors.
- 7. Frame Finish: Provide custom color acrylic polyurethane finish on all exposed framing in color to match aluminum storefront framing (refer to Section 08 43 13).
- B. Wall Mounted Brochure Holder (DC-3):
 - 1. Provide rack with six (6) acrylic pockets, 4 1/8 inch x 1 1/2 inch deep, and one pocket for 8 1/2 inch x 11 inch prints, mounted to a 22 3/4 inch wide x 20 inch high acrylic backplate.
- C. Other Materials: Other materials not specifically described but required for complete, proper installation of display cases, subject to acceptance of E/A.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that display cases may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.

3.3 INSTALLATION

- A. General Requirements:
 - 1. Install per manufacturer's instructions. Install plumb, true, square in neat, rigid, substantial manner.

3.4 ADJUSTING AND CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from Work of this Section. Maintain premises in neat, orderly condition.
- B. Clean display units of dirt, dust, and grease after installation.
- C. Protect finished installation from damage from work of other trades.

3.5 SCHEDULE

Drawing Symbol	Quantity	Location	Width x Height	Access Panel
DC-1	1	See Drawings	72" wide x 48" high	Top hinged
DC-2	1	See Drawings	48" wide x 48" high	Side hinged
DC-3	2	See Drawings	22 3/4" wide x 20" high	N/A

END OF SECTION 10 12 00

SECTION 10 14 19 – Dimensional Letter Signature and Plaques

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Dimensional letters and numbers.
 - 1) Individual cast aluminum characters.
 - 2. Signage accessories including, but not limited to:
 - a. Fasteners.
- B. Section does not include:
 - 1. Panel Signage

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ADA Accessibility Standards
- B. ANSI A117.1 - Information Systems
- C. ICC:
 - 1. 1003.2 - Accessibility and Exit Signs
 - 2. 1005.3.2.4 - Stairway Signs
- D. OSHA
- E. National Association of Architectural Metal Manufacturers

1.4 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Product Data: Submit manufacturer's current Product Data including specifications, installation instructions, and maintenance recommendations.
- C. Shop Drawings: Submit manufacturer's Shop Drawings showing system installation drawings, including elevations, sections details of components, and configurations within system and between system and adjoining system.
- D. Samples:
 - 1. Color Samples: Submit manufacturer's full range of color samples with Product Data and Shop Drawings.
 - 2. Font Samples: Submit example of font indicated, or if not indicated, manufacturer's standard fonts.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide signage units made of components of standard construction furnished by one manufacturer as coordinated assemblies for each system.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of signage.
 - 2. Contractor: 3 years experience in the installation of signage.

3. Personnel: For actual installation of signage, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Field Samples: Submit manufacturer's standard letter in style and font selected. If approved, this sample may be installed as part of the required identifying devices.
- D. Regulations Requirements:
 1. Comply with applicable provisions in:
 - a. ADA-ABA Accessibility Guidelines.
 - b. ICC.
 - c. ANSI A117.1.
 - d. OSHA.

1.6 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Dimensional Characters:
 1. Standard of Quality: Unless indicated otherwise, design is based on products of ASI Sign Systems, Inc., Irving, TX www.asisignage.com
 2. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - a. Poblocki Signs, Co., West Allis, WI, www.poblocki.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 COMPONENTS

- A. Dimensional Characters:
 1. Provide dimensional letters and numbers as indicated on the Drawings or in schedule at end of this section.
 2. Material: Aluminum castings, use alloy and temper recommended for casting process.
 3. Form characters by casting with smooth, flat faces, sharp corners, precisely-formed profiles and lines. Characters to be free from pits, scale, sandholes, or other defects. Cast lugs into the back and tap to receive threaded mounting studs.
 4. Font: Century Gothic.
 5. Fasteners: Concealed, non-corrosive metal fasteners.
 6. Anchors and Inserts: Non-ferrous metal or hot-dipped galvanized. Use toothed steel or lead expansion bolts for drilled in place anchors. Provide inserts to be set into concrete or masonry work.
 7. Finish:
 - a. Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations.

- b. Aluminum Finish: Comply with NAAMM "Metal Finishes Manual for Architectural and Metal Products" for finish recommendations.
 - 1) Finish: AAMA 605.2, Fluoropolymer Coating
 - 2) Color: Dark Gray, SC-904.
- B. Other Materials: Other materials not specifically described but required for complete, proper installation of signage are subject to acceptance of E/A.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that identifying devices may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 INSTALLATION

- A. Use standard fastening methods recommended in writing by manufacturer for character form, type of mounting, wall construction, and condition of exposure indicated. See building elevations for locations. Confirm with Owner exact placement of letters.
- B. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
- C. Install plumb, true, square in neat, rigid, substantial manner.

3.3 CLEANING AND PROTECTION

- A. After installation, clean all surfaces.
- B. Protect from damage until acceptance by Owner.

3.4 SCHEDULE

- A. Provide the following:
 - 1. Dimensional Letters and Numbers:
 - a. Font: Century Gothic.
 - b. Refer to Drawings for sizes and text.
 - c. Building identification text shown on the Drawings is for reference only. Architect shall provide a vector-based drawing with exact placement of text to contractor prior to installation.

END OF SECTION 10 14 19

SECTION 10 14 23 – Panel Signage

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Panel signs and frames:
 - a. Interior room identification signs.
 - b. Stairway identification signs.
 - c. Exit door signs.
 - 2. Die-cut vinyl letters and graphics.
 - 3. Exterior signs.

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. Industry Standards:
 - 1. ADA Accessibility Standards
 - 2. ANSI A117.1 - Information Systems
 - 3. ICC 1003.2 - Accessibility and Exit Signs
 - 4. ICC 1005.3.2.4 - Stairway Signs
 - 5. OSHA

1.4 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Shop Drawings: Submit Shop Drawings showing elevations, large-scale sections of typical members and other components, mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details. Refer to Drawings for room names. Submit list of rooms with sign shapes and sizes.
- C. Samples:
 - 1. Color Samples: Submit manufacturer's full color, including exotic color samples with Product Data and Shop Drawings.
 - 2. Font Samples: Submit example of font indicated, or if not indicated, manufacturer's standard fonts.
 - 3. Pictogram: Submit example of each symbol indicated.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide interior signage systems made of components of standard construction furnished by one manufacturer as coordinated assemblies for each system.
- B. Certifications:
 - 1. Submit certification that signage meets handicapped standards specified.
 - 2. Submit independent certification that Braille is correct for stated text.

- C. Field Samples: Submit manufacturer's sample for each signage system in style, color and font selected. If approved, this sample may be installed as part of the required signage.
- D. Regulations Requirements:
 - 1. Comply with applicable provisions in:
 - a. ADA-ABA Accessibility Guidelines.
 - b. ICC.
 - c. ANSI A117.1.
 - d. OSHA.

1.6 MAINTENANCE

- A. Extra Materials: Provide for maintenance purposes, a quantity of four (4) each of each type of panel sign installed. Package and mark to identify material type and color. Store as directed after completion of work.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Standard of Quality: Design is based on products of ASI Sign Systems, Inc., Irving, TX www.asisignage.com
- B. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - 1. Poblocki Signs, Co., West Allis, WI, www.poblocki.com
 - 2. ABC Sign Systems, Inc., Pennsauken, NJ www.abcsignsystems.com
 - 3. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.2 MATERIALS AND FABRICATION

- A. Panel Signs:
 - 1. Sign Frame: Square corner modular plastic molded frame, 1/2 inch deep, pre-punched for screw mounting to wall substrate.
 - 2. Signs: Sign plaques shall be of solid color plastic equal to Rowmark "Ultramatte" and shall incorporate both raised graphics and Grade 2 Braille. Raised letters and numbers shall be a minimum 1/32 inch high. Sign panel and graphics shall be as selected from manufacturer's full range of colors and meet the 70% contrast requirement of ADA 101-336, Section 4.30-5.
 - 3. Sign mounting surface shall not warp under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally.
 - 4. Signs to be furnished to the jobsite with factory applied double-face tape and prepunched for mechanical attachment (minimum two (2) screws).
- B. Panel Signage Types:
 - 1. Room Signs: Room name and number to be identified with 1 1/4 inch high raised letters in "Helvetica Medium" font with corresponding Grade 2 Braille text.
 - a. Size: 8 inches x 8 inches
 - b. Text information as indicated on the Drawings and Schedule below.
 - 2. Stairway Signs: Room name and number to be identified with 1 1/4 inch high raised letters in "Helvetica Medium" font with corresponding Grade 2 Braille text.
 - a. Size: 8 inches x 8 inches
 - b. Text information as indicated on the Drawings and Schedule below.

- c. Sign shall include pictogram showing stairs.
 - d. Signs to match style, material, and size of Room Signs.
- 3. Exit Signs: Provide exit sign at each exit door. Room name and number to be identified with 1 1/4 inch high raised letters in "Helvetica Medium" font with corresponding Grade 2 Braille text.
 - a. Size: 8 inches x 8 inches.
 - b. Text: "EXIT".
 - c. Signs to match style, material, and size of Room Signs.
 - d. Refer to the Drawings for locations. Contractor to confirm final location with the authority having jurisdiction (AHJ) prior to installation.
- C. Die-Cut Vinyl Lettering and Graphics:
 - 1. Vinyl Film: Opaque, non-reflective vinyl film 0.0035 inch minimum thickness, with pressure sensitive adhesive backing, suitable for exterior applications. Color shall be custom colors compatible with the State of Wisconsin State Patrol and DOT. Confirm locations with owner prior to installing.
 - 2. State Patrol and Department of Transportation Die-Cut Graphics will be provided by WisDOT. Contact Bob Spoerl at (608) 266-8655 for more information. Approximate size: 18 inches x 18 inches.
- D. Exterior Signs:
 - 1. Exterior signs shall be weather resistant, including resistance to damage from UV radiation, freezing temperatures and water.
 - 2. Signs shall be 1/8" thick matte acrylic, 9" wide x 12" high.
 - 3. Text style: Helvetica Neue LT Std 67 Medium Condensed.
 - 4. Color:
 - a. Background: Black.
 - b. Text: White.
 - c. Symbol: Red.
 - 5. Text:
 - a. Sign Type A:
 - 1) "NO SMOKING".
 - 2) No Smoking pictogram.
 - 3) "PURSUANT TO STATE STATUTE 101.123 WISCONSIN ACT 12".
 - 4) "FOR MORE INFORMATION VISIT www.dhs.wisconsin.gov/tobacco"
 - b. Sign Type B:
 - 1) "NOTICE".
 - 2) "EMPLOYEE ENTRANCE ONLY".
 - c. Sign Type C:
 - 1) "NOTICE".
 - 2) Firearm pictogram.
 - 3) "LAWFUL CONCEALED CARRY PERMITTED ON THESE PREMISES".

- d. Sign Type D:
 - 1) "KEEP OUT".
 - 2) "AUTHORIZED PERSONNEL ONLY".
- 6. Refer to the Drawings for locations. Contractor to confirm number, locations, and exact text of exterior signs with Owner prior to fabrication.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that interior signage may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 INSTALLATION

- A. Install plumb, true, square in neat, rigid, substantial manner.
- B. Comply with ADA.
- C. Install in compliance with manufacturer's written instructions.
- D. Sign surfaces shall be free from distortion and other defects in appearance.
- E. Location:
 - 1. Install signs on walls adjacent to latch side of door where applicable.
 - 2. Where not indicated or possible, install signs on nearest adjacent walls.
 - 3. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.
 - 4. Room signs to be mounted at heights as indicated on the Drawings.
 - 5. Apply die-cut vinyl lettering and graphics where directed by WisDOT personnel.

3.3 CLEANING

- A. After installation, clean all surfaces.

3.4 SCHEDULE

- A. See the Plans to identify all Rooms on this project site.
 - 1. Provide the following text on individual panel signs as specified.
 - 2. Text, room numbers, and pictograms to be confirmed with E/A and Owner prior to ordering.

Quantity	Room Name	Room No.	Graphic/Text
1	Public Vestibule	100	Room Name and Room Number
1	Men	100A	Room Name and Room Number Male Pictogram w/Universal Accessibility Symbol pictogram
1	Women	100B	Room Name and Room Number, Female Pictogram w/Universal Accessibility Symbol pictogram
1	Operations	101	Room Name and Room Number
1	Drivers	101A	Room Name and Room Number
1	Office	101B	Room Name and Room Number
1	Vestibule	101C	Room Name and Room Number
3	Lobby	102	Room Name and Room Number
1	Vestibule	102A	Room Name and Room Number
1	Coats	102B	Room Name and Room Number
1	Men	102C	Room Name and Room Number, Male Pictogram w/Universal Accessibility Symbol pictogram
1	Women	102D	Room Name and Room Number Female Pictogram w/Universal Accessibility Symbol pictogram
2	Lobby	102F	Room Name and Room Number
1	Vestibule	102H	Room Name and Room Number
2	Classroom	103	Room Name and Room Number
2	Training	104	Room Name and Room Number
2	Storage	104A	Room Name and Room Number
2	South Stair	105	Room Name and Room Number, Stair pictogram
1	Chem. Test	106	Room Name and Room Number
1	Equipment	106A	Room Name and Room Number
1	Janitor Closet	107	Room Name and Room Number
1	Antenna Equipment	107A	Room Name and Room Number
1	Intox	108	Room Name and Room Number
1	Evidence Check-in	109	Room Name and Room Number
1	Evidence Room	109A	Room Name and Room Number
2	North Stair	110	Room Name and Room Number, Stair pictogram
1	North Stair Exit	110A	Room Name and Room Number
1	Electrical	111	Room Name and Room Number
1	Storage Garage	112	Room Name and Room Number
2	Maintenance Garage	113	Room Name and Room Number
1	Comm. Tech.	114	Room Name and Room Number
1	Supervisor	114A	Room Name and Room Number
1	Telecom Room	114B	Room Name and Room Number
1	Mechanical	115	Room Name and Room Number
1	Sprinkler Room	115A	Room Name and Room Number
1	Inspection Bays	116	Room Name and Room Number
1	Storage	116A	Room Name and Room Number
1	Lobby	200	Room Name and Room Number
1	Interview	201	Room Name and Room Number
2	Admin. Clerical	202	Room Name and Room Number
2	Large Conference	204	Room Name and Room Number
1	Women	205	Room Name and Room Number, Female Pictogram w/Universal Accessibility Symbol pictogram
1	Men	206	Room Name and Room Number, Male Pictogram w/Universal Accessibility Symbol pictogram
1	Lieutenant	207	Room Name and Room Number

1	Captain	208	Room Name and Room Number
1	Office Supplies	209	Room Name and Room Number
1	Supply	210	Room Name and Room Number
2	Mechanical Room	211	Room Name and Room Number
1	Quiet	212	Room Name and Room Number
1	Break Room	213	Room Name and Room Number
1	Troopers	214	Room Name and Room Number
1	Sergeants	215	Room Name and Room Number
1	Emergency Management	216	Room Name and Room Number
1	Dispatch Area	217	Room Name and Room Number
1	Break	217A	Room Name and Room Number
1	Telecom	217B	Room Name and Room Number
1	Supervisors	217C	Room Name and Room Number
1	Unisex	217D	Room Name and Room Number, Male/Female Pictogram w/Universal Accessibility Symbol pictogram
1	Janitor Closet	218	Room Name and Room Number

END OF SECTION 10 14 23

SECTION 10 21 19 – Plastic Toilet Compartments

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Toilet enclosures.
 - a. Overhead braced.
 - b. Floor-anchored.
 - 2. Urinal screens.
 - 3. Accessories including, but not limited to:
 - a. Hardware.
 - b. Headrail.
 - c. Latch.
 - d. Coat hook/bumper.
- B. Related Sections:
 - 1. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 2. Section 10 28 13 - Toilet Accessories

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM
 - 1. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
 - 2. B85 - Standard Specification for Aluminum-Alloy Die Castings
 - 3. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth

1.4 SUBMITTALS

- A. Refer to Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings:
 - 1. Submit manufacturer's Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections, details of components, joint locations and configurations within system and between system and adjoining system.
 - 2. Show locations of cutouts and reinforcements for compartment-mounted toilet accessories.

- D. Samples:
1. Initial Selection: Submit manufacturer's standard color samples for each type of finish with Product Data and Shop Drawings.
 2. Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics. Include notification to E/A if selection is not within specified price range.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide units made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
1. Manufacturer: 5 years experience in the manufacture of plastic toilet compartments.
 2. Contractor: 3 years experience in the installation of plastic toilet compartment
 3. Personnel: For actual installation of plastic toilet compartments, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Field Samples: If requested, furnish sample of each type of plastic toilet compartments to E/A for review prior to manufacture/ installation. E/A will forward approved sample to the Site for installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
1. Do not deliver to the site until the building is enclosed or other enclosed storage is available.
 2. Deliver with protective plastic covering.

1.7 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.8 WARRANTY

- A. Provide manufacturer's standard 25-year warranty.

1.9 MAINTENANCE

- A. Extra Materials:
1. Provide for maintenance purposes, one (1) unit of each type, size, color, pattern of hardware and fasteners installed.
 2. Furnish from same production run as materials installed.
 3. Package and mark to identify building and material type and color.
 4. Deliver and store where directed by Owner.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Standard of Quality: Unless indicated otherwise, design is based on products of Scranton Products Company, Inc., Scranton, PA www.scrantonproducts.com

- B. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - 1. Hadrian, Mentor, OH www.hadrian-inc.com
 - 2. ASI Global Partitions, Eastanollee, GA www.asi-globalpartitions.com
 - 3. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.2 MATERIALS

- A. Plastic Panels:
 - 1. High density polyethylene (HDPE) suitable for exposed applications, waterproof, non-absorbent, and graffiti-resistant textured surface.
 - a. Fire-resistance Rating: Tested according to NFPA 286.
 - b. Fire-resistance Rating: Tested to meet ASTM E84, Class B.
- B. Aluminum Extrusions: ASTM B221, 6463-T5 alloy and temper.
- C. Aluminum Die Castings: ASTM B85, A380 alloy.
- D. Stainless Steel Castings: ASTM A167, Type 304.
- E. Rubber: Abrasion resistant Styrene Butadiene Rubber, 65 to 80 Shore A durometer, black.

2.3 FABRICATION

- A. Basis of Design: Eclipse Toilet Partitions, as manufactured by and supplied by Scranton Products.
 - 1. Style: Floor mounted overhead-braced toilet compartments.
- B. Doors and Panels:
 - 1. High density polyethylene (HDPE), fabricated from SEQ CHAPTER 1 extruded polymer resins, forming single thickness panel.
 - 2. Color and material homogeneous throughout.
 - 3. Color and texture as indicated on the Drawings or as selected by E/A.
 - 4. Waterproof and nonabsorbent, with self-lubricating surface, resistant to marks by pens, pencils, markers, and other writing instruments.
 - 5. Thickness: 1 inch.
 - 6. Edges: Shiplap.
- C. Doors and Dividing Panels:
 - 1. High Privacy:
 - a. Height: 62 inches high and mounted at 9 inches above the finished floor, unless otherwise noted on the Drawings.
 - 2. Urinal Screen:
 - a. Wall mounted.
 - b. Color and texture as selected by E/A.
 - c. Size: 18" x 42".
- D. Metal Posts: Heavy duty extruded aluminum, clear anodized finish, fastened to foot with stainless steel tamper resistant screw.
- E. Hidden Shoe (Foot): One-piece molded polyethylene invisible shoe inserted into metal post and secured to metal post with stainless steel tamper resistant screw.
- F. Headrail Cap and Corner Cap: One-piece molded polyethylene secured to metal post with stainless steel tamper resistant screw; adjustable to level headrail to finished floor.

- G. Wall Brackets: Continuous heavy duty extruded aluminum, clear anodized finish, inserted into slotted panel and fastened to panels with stainless steel tamper resistant screws.
 - 1. Type: Single Ear bracket aluminum.
- H. Headrail: Heavy duty extruded aluminum, designer anti-grip design, clear anodized finish, fastened to headrail bracket with stainless steel tamper resistant screw and to headrail cap or corner cap with stainless steel tamper resistant screw.
 - 1. Headrail Brackets: Heavy duty extruded aluminum, clear anodized finish, secured to wall with stainless steel tamper screws.
- I. Door Hardware:
 - 1. ADA compliant.
 - 2. Hinges:
 - a. Edge-mounted helix style stainless steel continuous hinge.
 - 1) Closing degree: 5 degrees.
 - 2) Comes to a full close on its own weight.
 - 3. Occupancy Indicator Latch and Housing:
 - a. Material: Satin stainless steel.
 - b. Occupancy indicators: Green for occupied and red not occupied.
 - c. Slide bolt and button.
 - 4. Door Bumper: Chrome plated Zamak rubber-tipped bumper at out-swinging doors.
 - 5. Coat Hook and Door Bumper Combination:
 - a. Material: Chrome plated Zamak.
 - b. Handicap Door: Equip with second door pull and door stop.
 - 6. Door Pulls: Chrome plated Zamak.
- J. Other Materials: Other materials not specifically described but required for complete, proper installation of plastic toilet compartments, subject to acceptance of E/A.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that plastic toilet compartments may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Examine areas to receive toilet partitions and screens for correct height and spacing of anchorage/blocking and plumbing fixtures that affect installation of partitions. Immediately notify E/A of discrepancies.
- D. Protection: Protect installed work and materials of other trades.

3.3 INSTALLATION

- A. Comply with manufacturer's written installation instructions.
- B. Secure units in position with manufacturer's recommended anchoring devices.
- C. Install units rigid, straight, level, and plumb.
- D. Locate bottom edge of doors and panels at height above finished floor as indicated above.
- E. Clearance at vertical edges of doors shall be uniform top to bottom and shall not exceed 3/8 inch.
- F. No evidence of cutting, drilling, and/or patching shall be visible on the finished work.
- G. Finished surfaces shall be cleaned after installation and be left free of imperfections.

3.4 ADJUSTING

- A. Adjust doors and latches to operate correctly.

3.5 REPAIR/RESTORATION

- A. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance.
- B. Use materials and procedures recommended or furnished by manufacturer.
- C. Finished work shall have no evidence of cutting, drilling, or patching visible.

3.6 CLEANING

- A. Site: Do not allow accumulation of scraps or debris arising from work of this section. Maintain premises in a neat and orderly condition.
- B. System: Clean exposed surfaces of plastic toilet compartments using materials and methods recommended by manufacturer.

END OF SECTION 10 21 19

SECTION 10 22 13 – Wire Mesh Partitions

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Wire Mesh Partitions.
 - 2. Wire Mesh Door Section.
 - 3. Accessories including, but not limited to:
 - a. Posts.
 - b. Door hardware, including lock.
 - c. Fasteners and anchorage devices.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 03 41 00 - Plant-Precast Structural Concrete
 - 3. Section 04 20 00 - Unit Masonry Assemblies

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections details of components, joint locations and configurations within system and between system and adjoining system.
- D. Samples: Submit finish color samples for selection in manufacturer's standard colors.
- E. Keys: Turn over keys for door locks to Owner at completion of project.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide wire mesh partitions, door, and accessories made of components of standard construction furnished by one manufacturer as coordinated assemblies.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store in dry space, protected from weather, at temperatures between 50 degrees and 90 degrees F.

1.6 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.7 WARRANTY

- A. Provide manufacturer's standard warranty.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Wire Mesh Partitions:

1. Standard of Quality: Design is based on products of WireCrafters, Louisville, KY www.wirecrafters.com
2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Folding Guard, Bedford Park, IL www.foldingguard.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

A. Wire Mesh Partitions:

1. Factory-assembled modular sized panels stacked between post uprights, complete with all components, accessories, hardware, and fasteners.
2. Style: Full mesh.
3. Provide fixed sections unless otherwise indicated.
4. Post Spacing: As required to suit dimensions shown on the Drawings, using manufacturer's standard panel widths.
5. Panel frames to be bolted together and to posts.
6. Height: As shown on the Drawings.
7. Provide ceiling panels.
8. Finish: Electrostatic sprayed enamel.

B. Posts:

1. Square 2 by 2 inch, 14 gauge steel tube.
2. Factory drilled holes for attaching panels.
3. Welded-on base plate with factory drilled holes for floor anchors.
4. Decorative plastic post cap.
5. Corner Posts to be same as in-line posts.
6. Provide appropriate hardware for attaching panels to posts and posts to floor.

C. Wire Mesh Panels:

1. Steel angle frames with wire mesh securely welded in place.
2. Frame joints coped at corner and securely welded.
3. Factory drilled holes for fasteners.
4. Wire mesh: 10 gauge steel wire woven into 2 by 1 inch rectangular mesh.
5. Frame: hot rolled steel angle.
6. Vertical Panel Stiffeners: Steel bar securely welded to frame behind mesh on panels 4 feet or wider.
7. Ceiling Panels: Same as wall panels. Provide supplemental support where required by span.

D. Door Sections:

1. Door Section to match Wire Mesh Panels.
2. Frame: Hot rolled steel angle.
3. Stiffeners: Two horizontal and one vertical stiffener to be flat, hot rolled steel bar.

4. Door size and operation as shown on the Drawings.
5. Door Hardware:
 - a. Sliding Doors:
 - 1) Door Hangers: Two 4-wheel roller bearing hangers.
 - 2) Track: Box track, twice the width of door panel.
 - 3) Floor mounted bottom guide/keeper.
 - b. Hinged Doors:
 - 1) Hinges: Three 5-knuckle tight-pin butt hinges fastened to door panel and frame.
6. Doors to be self-closing and self-locking.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that wire mesh partition system may be installed according to original design, pertinent codes and regulations.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protect installed work and materials of other trades.

3.3 INSTALLATION

- A. Install according to manufacturer's instructions.
- B. Install plumb, level, and securely anchored to floor and to other structural members as shown on the Drawings.
- C. Adjust doors for easy operation.

3.4 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from work of this section. Maintain premises in neat, orderly condition.
- B. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance.

END OF SECTION 10 22 13

SECTION 10 22 26 – Operable Partitions

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Manually operated, paired panel operable partitions.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 04 22 00 - Concrete Unit Masonry
 - 3. Section 05 12 00 - Structural Steel Framing
 - 4. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 5. Section 09 22 00 - Non-Structural Metal Framing
 - 6. Section 09 29 00 - Gypsum Board

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCE STANDARDS

- A. ASTM International
- B. ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
- C. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- D. ASTM C1036 - Standard Specification for Flat Glass.
- E. ASTM C1048 - Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass.
- F. ASTM E84 - Surface Burning Characteristics of Building Materials.
- G. ASTM E413 - Classification for Rating Sound Insulation
- H. Health Product Declaration Collaborative
- I. Health Product Declaration Open Standard v2.1
- J. International Standards Organization
- K. ISO 14021 - Environmental Labels and Declarations - Self-Declared Environmental Claims (Type II Environmental Labeling).
- L. ISO 14025:2011-10, Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures.
- M. ISO 14040:2009-11, Environmental Management - Life Cycle Assessment - Principles and Framework.
- N. ISO 14044:2006-10, Environmental Management - Life Cycle Assessment - Requirements and Guidelines.
- O. ISO 21930 – Sustainability in Buildings and Civil Engineering Works — Core Rules for Environmental Product Declarations of Construction Products and Services.
- P. ADA – Americans with Disabilities Act.
- Q. ANSI Z97.1 - Safety Glazing Materials Used in Buildings.

- R. CPSC 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
- S. NEMA LD3 - High Pressure Decorative Laminates.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
- B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory according to ASTM E90 test procedure and classified according to ASTM E413 to attain no less than the STC rating specified. Provide a complete and unedited written test report upon request.
- C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 "Standard Practice for Architectural Application and Installation of Operable Partitions."
- D. The operable wall must be manufactured by a certified ISO-9001-2015 company or an equivalent quality control system.

1.5 SUBMITTALS

- A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.
- B. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
- C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.
- D. Samples: Color samples demonstrating full range of finishes available by architect. Verification samples will be available in same thickness and material indicated for the work.
- E. Reports: Provide a complete and unedited written sound test report indicating test specimen matches product as submitted.
- F. Create spaces that are healthy for occupants.
 - 1. Furnish products and materials with Health Product Declaration (HPD), Manufacturer Inventory, or other material health disclosure documentation. Products without an HPD or other disclosure documentation are not acceptable.
- G. Furnish materials that generate the least amount of pollution.
 - 1. Furnish products and materials that have third party verified environmental product declarations (EPD's). Consider products and materials that have optimized environmental performance (reduced life cycle impacts). Products without an EPD or other disclosure documentation are not acceptable.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.
- B. Protect panels during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

1.7 WARRANTY

- A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.
- B. Partition Warranty period: Two (2) years from date of shipment.
- C. Suspension System Warranty: Five (5) years from date of shipment.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Standard of Quality: Design is based on products of Modernfold, Inc., Greenfield, IN www.modernfold.com
- B. Other Acceptable Manufacturers: Subject to compliance with the requirements, acceptable manufacturers are:
 - 1. Advanced Equipment, Fullerton, CA www.advancedequipment.com
 - 2. Moderco, www.moderco.com
 - 3. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 PRODUCT AND OPERATION

- A. Series of paired flat panels hinged together in pairs, manually operated, top supported with operable floor seals. Product: Acousti-Seal Premier – Paired Panel.
- B. Final Closure:
 - 1. Horizontally expanding panel edge with removable crank

2.3 PANEL CONSTRUCTION

- A. Nominal 3-inch thick panels in manufacturer's standard 48-inch widths. All panel horizontal and vertical framing members fabricated from minimum 18-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
- B. Panel skin shall be:
 - 1. Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction minimum:
 - a. 50 STC
- C. Hinges for Panels and Closure Panels shall be:
 - 1. Full leaf butt hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.
- D. Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at panel joints.
- E. Panel Weights:
 - 1. 50 STC – 8 lbs./square foot

2.4 PANEL FINISH

- A. Panel finish shall be:
 - 1. Manufacturer's standard woven fabric or carpeting with surface treatment to resist stains, as indicated on the Drawings.
- B. Panel Trim: Exposed panel trim of one consistent color:
 - 1. To be selected from manufacturer's standards, and as indicated on the Drawings.

2.5 SOUND SEALS

- A. Vertical Interlocking Sound Seals between panels: Roll-formed steel astragals, with reversible tongue and groove configuration in each panel edge for universal panel operation. Rigid plastic or aluminum astragals or astragals in only one panel edge are not acceptable.

- B. Horizontal Top Seals: Continuous contact extruded vinyl bulb shape with pairs of non-contacting vinyl fingers to prevent distortion without the need for mechanically operated parts.
- C. Horizontal bottom floor seals shall be:
 - 1. Manually activated operable bottom seals with removable handle providing nominal 2-inch operating clearance with an operating range of +0.50-inch to - 1.50-inch. Seal shall be operable from panel edge or face.
- D. Wall Jamb: Provide wall jamb at lead end to stabilize first panel with pass door. Jamb to be no more than 2" deep and shall have same fabric as the basic panels.

2.6 SUSPENSION SYSTEM

- A. Suspension System
 - 1. Suspension Tracks: Minimum 11-gauge, 0.12-inch roll-formed steel track, supported by adjustable steel hanger brackets, supporting the load-bearing surface of the track, connected to structural support by pairs of 0.38-inch diameter threaded rods. Aluminum track is not acceptable.
 - a. Exposed track soffit: Steel, integral to track, and pre-painted off-white.
 - 2. Carriers: One all-steel trolley with steel-tired ball bearing wheels per panel. Non-steel tires are not acceptable.

2.7 OPTIONS

- A. Pass Doors:
 - 1. Single Pass Doors:
 - a. Refer to Drawings for sizes and locations.
 - b. Matching pass door same thickness and appearance as the panels. ADA compliant pass door equipped with friction latch and flush pulls for panic operation. No threshold will be permitted.
 - c. Provide photo luminescent exit sign mounted above pass door.
- B. Markerboards:
 - 1. Refer to Drawings for sizes and locations.
 - 2. White enamel on steel, bonded to the face of the panel with horizontal trim without exposed fasteners. Trim is not acceptable on vertical edges to provide uninterrupted work surface.
- C. Tackboards:
 - 1. Refer to Drawings for sizes and locations.
 - 2. Minimum 1/4-inch (6.35 mm) natural cork, covered with vinyl or fabric, with horizontal trim without exposed fasteners. Trim is not acceptable on vertical edges.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Comply with ASTM E557, operable partition manufacturer's written installation instructions, Drawings and approved Shop Drawings.
- B. Install operable partitions and accessories after other finishing operations, including painting have been completed.
- C. Match operable partitions by installing panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed or unmatched panels are not acceptable.

3.2 CLEANING AND PROTECTION

- A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and installer that ensure operable partitions are without damage or deterioration at time of Substantial Completion.

3.3 ADJUSTING

- A. Adjust operable partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

3.4 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 DEMONSTRATION

- A. Demonstrate proper operation and maintenance procedures to Owner's representative.
- B. Provide Operation and Maintenance Manual to Owner's representative.

END OF SECTION 10 22 26

SECTION 10 26 00 – Wall and Door Protection

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Corner guards:
 - a. Plastic.
 - 2. Corner guard accessories including, but not limited to:
 - a. Fasteners and adhesives.
- B. Related Sections:
 - 1. Section 09 29 00 - Gypsum Board
 - 2. Section 09 91 00 - Painting

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. D256 - Impact Resistance of Plastics
 - 2. D543 - Resistance of Plastics to Chemical Reagents
 - 3. D635 - Burning Rate and Extent for Plastics
 - 4. D1784 - PVC and CPVC Compounds
 - 5. E84 - Surface Burning Characteristics
 - 6. E329 - Agencies Engaged in Testing and Inspection
- B. BHMA A156.6 - Architectural Door Trim
- C. UL 2079 - Tests for Fire Resistance of Building Joint Systems

1.4 SUBMITTALS

- A. Refer to Division 1 Specifications.
- B. Product Data: Include construction details, material descriptions, impact strength, fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall-protection unit.
- C. Shop Drawings: Show locations and extent for each impact-resistant wall-protection unit. Include sections, details, and attachments to other work.
- D. Color Sample: Submit samples of full range of manufacturer's standard colors and textures.
- E. Material Test Reports: For each impact-resistant plastic material.
- F. Material Certificates: For each impact-resistant plastic material, signed by manufacturer.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain impact-resistant wall-protection units through one source from a single manufacturer.

- B. Qualifications: For actual installation, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Fire-Test-Response Characteristics:
 - 1. Meet ASTM E84 surface burning characteristics.
 - 2. Provide UL Classified Components conforming with NFPA Class A fire rating.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 degrees F for not less than 72 hours before beginning installation and for the remainder of the construction period.
- B. Field Measurements: Verify actual locations of walls, columns, and other construction contiguous with impact-resistant wall protection units by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

- A. Provide 5-year warranty in which manufacturer agrees to repair or replace components that fail in materials or workmanship, including, but not limited to:
 - 1. Structural failures.
 - 2. Deterioration of plastic and other materials beyond normal use.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Standard of Quality: Design is based on products of Institutional Products Corporation (IPC) www.inprocorp.com
- B. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - 1. JL Industries www.jlindustries.com
 - 2. Pawling Corporation www.pawling.com
 - 3. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

- A. Extruded Rigid Plastic:
 - 1. ASTM D1784, Class 1.
 - 2. Textured.
 - 3. Chemical and stain resistant per ASTM D543.
 - 4. PVC or acrylic-modified vinyl plastic.
 - 5. Integral color throughout.
 - 6. High impact-resistant: Minimum 25.4 ft-lbf/in of notch when testing according to ASTM D256, Test Method A.
 - 7. Flame-Spread Index: 25 or less.
 - 8. Smoke-Developed Index: 450 or less.
 - 9. Self-extinguishing when tested per ASTM D635.

- B. Fasteners:
 - 1. Aluminum, nonmagnetic stainless steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened.
 - 2. Use security-type fasteners where exposed to view.
- C. Adhesive:
 - 1. As recommended by manufacturer for use with material being adhered to substrate indicated.
 - 2. Comply with VOC content of EPA Method 24, 40 CFR 59, Subpart D:
 - a. Gypsum board and panel adhesives: 50 gm/l.
 - b. Multipurpose construction adhesives: 70 g/l.
 - c. Contact adhesive: 250 g/l.

2.3 CORNER GUARDS

- A. Plastic Corner Guards, Surface Mounted:
 - 1. Snap-on plastic cover over continuous retainer; fabricated with 90- or 135 degree turn to match wall condition.
 - 2. Aluminum Retainer:
 - a. Thickness: 0.070 inch.
 - b. Finish: Mill finish.
 - 3. Snap-on Cover:
 - a. Chemical and stain resistant PVC with the addition of impact modifiers; no added plasticizers.
 - b. Thickness: 0.080 inch.
 - c. Height: 4 feet.
 - d. Finish: Color selected by E/A from manufacturer's standard color palette.
 - 4. Accessories:
 - a. Top and bottom caps, prefabricated, injection-molded plastic, color matching cover, field adjustable for close alignment with cover.
 - b. Mounting system appropriate for substrates.

2.4 ACCESSORIES

- A. Other Materials: Materials not specifically described but required for complete, proper installation of products of this Section, subject to acceptance of E/A.

2.5 FABRICATION

- A. Assemble components in factory to greatest extent possible to minimize field assembly.
- B. Fabricate components with tight seams and joints with exposed edges rolled.
- C. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections.
- D. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that units may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.

- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Install at locations according to Project Drawings and manufacturer's instructions.
- B. Install systems plumb and level, with surfaces free from distortion or other defects.
- C. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- D. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.

3.4 CLEANING

- A. At completion of installation, clean surfaces according to manufacturer's instruction.

3.5 SCHEDULE

- A. Provide the following quantities:
 - 1. Plastic Corner Guards: provide 12 (twelve) plastic corner guards for gypsum board corners. Final locations to be coordinated with Owner and E/A.

END OF SECTION 10 26 00

SECTION 10 28 13 – Toilet Accessories

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Grab bars.
 - 2. Hand dryer.
 - 3. Waste receptacle.
 - 4. Sanitary napkin disposal.
 - 5. Baby changing station.
 - 6. Channel frame mirror.
 - 7. Mop clip strip.
 - 8. Coat hook.
- B. Provided by Owner, and installed by contractor:
 - 1. Toilet paper dispenser.
 - 2. Paper towel dispenser.
 - 3. Soap dispenser.
- C. Related Sections:
 - 1. Section 04 20 00 - Unit Masonry Assemblies
 - 2. Section 06 10 53 - Miscellaneous Rough Carpentry
 - 3. Section 09 29 00 - Gypsum Board
 - 4. Division 26 - Electrical

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. A666 - Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, Flat Bar
 - 2. C1503 - Silvered Flat Glass Mirror
 - 3. F446 - Grab Bars and Accessories for Bathing Areas

1.4 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data:
 - 1. Manufacturer's current Product Data.
 - 2. Handling, storage requirements.
 - 3. Installation instructions, including construction details and dimensions, anchoring and mounting details.

4. Requirements for cutouts and substrate preparation.
5. Maintenance recommendations.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide toilet accessory units made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
 1. Manufacturer: 5 years experience in the manufacture of toilet accessories.
 2. Contractor: 3 years experience in the installation of toilet accessories.
 3. Personnel: For actual installation of toilet accessories, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of Work.
- C. Field Samples: If requested, furnish sample of each type of toilet accessories to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.

1.6 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.7 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.8 WARRANTY

- A. Provide manufacturer's standard warranty.
- B. Special Mirror Warranty: Manufacturer's standard form, agreeing to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within 10 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. General Toilet Accessories:
 1. Standard of Quality: Unless otherwise indicated, design is based on products of Bobrick Washroom Equipment, www.bobrick.com
 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Bradley Corporation, Menomonie Falls, WI, www.bradleycorp.com
 - b. American Specialties, Inc., Yonkers, NY www.americanspecialties.com
 - c. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
- B. Hand Dryers
 1. Standard of Quality: Unless otherwise indicated, design is based on products of Excel Dryer, Inc. East Longmeadow, MA www.exceldryer.com

2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. World Dryer, Bensenville, IL www.worlddryer.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

- A. ASTM A666, 304 stainless steel with satin finish, unless otherwise specified below.
- B. Mirrors:
 1. ASTM C1503 - Mirror Glazing Quality.
 2. Clear glass.
 3. Nominal 6.0 mm thick.

2.3 PRODUCTS

- A. Grab Bars:
 1. 1-1/2 inch diameter; 18 gauge tubing; safety grip finish; vandal resistant concealed mounting.
 2. Grab bars shall be capable of supporting minimum dead load of 250 pounds.
 3. Location and lengths as indicated on the Drawings.
 4. Product: Bobrick B-6806 Series Straight Grab Bar.
- B. Toilet Paper Dispenser:
 1. Provided by Owner and installed by Contractor.
- C. Hand Dryer:
 1. High Efficiency Heated Air Hand Dryer
 - a. High speed energy efficient, rapid-drying heated electric hand dryer with automatic sensor, adjustable speed and sound control, and adjustable heat controls.
 - b. Surface mounted.
 - c. Controls: Automatic, activated by infrared optical sensor located next to the air outlet. Dryer will operate if hands are under the air outlet and has a 35-second lockout feature if hands are not removed. Control includes adjustable sound and speed control mechanism, adjustable heat control with High, Medium, Low and Off settings and a filter sensor which is activated should the filter become clogged. Sensor equipped with externally visible Red LED light that flashes error codes to assist in troubleshooting. Control assembly sealed for protection against moisture, lint, dust, and vandalism.
 2. Product: Xlerator Hand Dryer, Model XL-SB.
- D. Combination Paper Towel Dispenser/Waste Receptacle:
 1. Recessed stainless steel paper towel dispenser and waste receptacle with satin finish, equipped with two tumbler locks keyed like other toilet room accessories. Waste receptacle capacity to be 3.8 gallons.
 2. Product: Bobrick B-38034 Recessed Paper Towel Dispenser and Waste Receptacle.

- E. Waste Receptacle:
 - 1. Recessed stainless steel waste receptacle with satin finish, equipped with two tumbler locks keyed like other toilet room accessories. Waste receptacle to include removable, leak-proof, rigid molded plastic waste container with minimum capacity of 12 gallons.
 - 2. Product: Bobrick B-35643 Recessed Waste Receptacle.
- F. Paper Towel Dispenser:
 - 1. Provided by Owner and installed by Contractor.
- G. Soap Dispenser:
 - 1. Provided by Owner and installed by Contractor.
- H. Sanitary Napkin Disposal:
 - 1. Surface mounted stainless steel sanitary napkin disposal with cover with satin finish.
 - 2. Product: Bobrick Contura Series B-270
- I. Baby Changing Station:
 - 1. Surface mounted horizontal baby changing station with stainless steel veneer panel.
 - 2. Frame and Hinge Mechanism: Concealed 11-gauge chassis, comprised of 1" diameter integral steel-tubing that supports the changing bed and interacts with 11-gauge steel wall mounting bracket to provide steel-on-steel hinge stop. The wall frame shall serve as wall-mounting bracket.
 - 3. Bed Surface: injection molded polypropylene with Microban® antimicrobial additive, and ISO 22196 tested for efficacy.
 - 4. Operation: Concealed pneumatic cylinder providing controlled opening and closing of the changing station bed.
 - 5. Provide safety straps, and dual cavity dispenser for bed liners and diaper disposal sacks.
 - 6. Color as selected by E/A.
 - 7. Product: Bobrick KB300-SS.
- J. Channel Framed Mirror:
 - 1. Surface mounted, one-piece roll-formed type-430 stainless steel channel frame with tempered glass. 15-year warranty against silver spoilage. Size: 18" x 36", unless otherwise noted on the Drawings.
 - 2. Product: Bobrick B-165 Mirror with Stainless Steel Channel Frame.
- K. Utility Shelf with Mop Clips:
 - 1. Surface mounted utility shelf with four (4) mop/broom holders, 18 gauge stainless steel, satin finish.
 - 2. Product: Bobrick B-239 Utility Shelf with Mop/Broom Holders and Rag Hooks.
- L. Coat Hook: Surface mounted chrome plated brass with bumper.
- M. Other Materials: Other materials not specifically described but required for complete, proper installation of toilet accessories, subject to acceptance of E/A.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.

- B. Verification of Conditions: Verify that toilet accessories may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.

3.3 INSTALLATION

- A. General Requirements:
 - 1. Install plumb, true, square in neat, rigid, substantial manner.
 - 2. Use theft-proof screws to install toilet accessories.
 - 3. Fasten to masonry with screws and expansion shields.
 - 4. Anchor grab bars securely. Install to withstand downward load of minimum 250 pounds per ASTM F446.
 - 5. After erection, clean surfaces, adjust hardware, leave in good operating condition.
- B. Contractor shall shim wall substrate where toilet accessories are mounted partially on tile. Provide continuous sealant at perimeter of wall mounted toilet accessories which span a tile wainscot condition.

3.4 ADJUSTING AND CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from Work of this Section. Maintain premises in neat, orderly condition.
- B. Toilet Accessories:
 - 1. Adjust for unencumbered smooth operation.
 - 2. Remove protection film.
 - 3. Accessories to be free of dust, grime, streaks.
 - 4. Clean and polish exposed surfaces.

END OF SECTION 10 28 13

SECTION 10 44 00 – Safety Specialties

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Fire extinguishers:
 - a. Dry chemical extinguisher.
 - b. Wall bracket.
 - 2. Fire extinguisher cabinet:
 - a. Recessed.
 - b. Semi-recessed.
 - 3. Fire extinguisher signage
- B. The following is not included in this section:
 - 1. Fire Department Access Box (Section 08 71 00)
- C. Related Sections:
 - 1. Section 04 20 00 - Unit Masonry Assemblies
 - 2. Section 09 22 00 - Non-Structural Metal Framing
 - 3. Section 09 29 00 - Gypsum Board

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, rating and classification, dimensions of individual components and profiles, finishes, handling, storage and installation instructions, and maintenance recommendations.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide life protection specialties units made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of life protection specialties.
 - 2. For actual installation of life protection specialties, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- C. Regulatory Requirements:
 - 1. UL Listing: Provide portable fire extinguishers which are UL listed and bear UL "Listing Mark" for type, rating and classification of extinguisher listed.
 - 2. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10 "Portable Fire Extinguishers."

1.5 WARRANTY

- A. Provide manufacturer's 6-year warranty to repair or replace fire extinguishers and life safety equipment that fail in materials or workmanship.
- B. Fire extinguisher failures include, but are not limited to, failure of hydrostatic test according to NFPA 10 and faulty operation of valves or release levers.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Standard of Quality: Design is based on products of J.L. Industries, Bloomington, MN www.jlindustries.com
- B. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - 1. Nystrom, Brooklyn Park, MN www.Nystrom.com
 - 2. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 COMPONENTS

- A. Fire Extinguishers:
 - 1. Fully charged and ready for use at final acceptance.
 - 2. Enameled-steel container with pressure-indicating gauge.
 - 3. Size, type indicated in schedule at end of this section.
 - 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- B. Standard Wall Hanger Brackets:
 - 1. Size according to fixture size where indicated by symbol on Drawings or as directed by E/A.
 - 2. Provide red letter decal reading "Fire Extinguisher", and apply to wall surface. Letter size, style, and location as selected by E/A.
 - 3. Locate as indicated on Drawings (see Life Safety / Code Sheet) and as indicated on the schedule at the end of this section.
- C. Fire Extinguisher Cabinets:
 - 1. Provide fire extinguisher cabinets where indicated on the Drawings, of suitable size for housing fire extinguishers of types and capacities indicated in the schedule at the end of this section. Provide fire rated cabinets in 1 hour and 2 hour wall construction to maintain fire rating of wall.
 - 2. Model: Classic Series Aluminum Fire Extinguisher Cabinet by JL Industries.
 - 3. Trim: One piece trim with mitered corners, welded, and ground smooth.
 - 4. Door Style: Contemporary (narrow vision acrylic).
 - 5. Door Glazing: 1/4 inch clear acrylic
 - 6. Color: White.
 - 7. Options:
 - a. Provide die cut red letters reading "FIRE EXTINGUISHER" and apply to cabinet door.
 - b. Provide handle meeting ADA requirements.

- D. Fire Extinguisher Signage:
1. Provide 3D tent "FIRE EXTINGUISHER" signage at each fire extinguisher.
 2. Model: 23S by JL Industries, 4" x 18".

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify specialties may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Examine fire extinguishers and life safety equipment for proper charging and tagging. Remove and replace damaged, defective, or undercharged fire extinguishers.
- D. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 INSTALLATION

- A. Install according to ADA code.
- B. Install plumb, true, square in neat, rigid, substantial manner.
- C. Install in compliance with requirements of authorities having jurisdiction.
- D. Clean surfaces, adjust hardware, leave in good operating condition.

3.3 SCHEDULE

<u>Drawing Symbol</u>	<u>Size and Type</u>	<u>Rating</u>	<u>General Location</u>
FE-1	10-pound ABC Dry Chemical (bracket)	4A:60B:C UL	Inspection Bays, Storage Garage Maintenance Garage
FE-2	20-pound ABC (bracket)	20A:120B:C UL	Electrical/Mechanical Equipment Rooms
FE-3	10-pound ABC Dry Chemical (cabinet)	4A:60B:C UL	Corridors and Miscellaneous Spaces

END OF SECTION 10 44 00

SECTION 10 51 13 – Metal Evidence Lockers

PART 1 – GENERAL

1.1 SUMMARY

- A. Metal Evidence Lockers
 - 1. Standard Pass-through.
- B. Related Sections:
 - 1. Section 04 20 00 - Unit Masonry Assemblies
 - 2. Section 10 22 13 - Wire Mesh Partitions

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. American National Standards Institute (ANSI) Standards: Applicable standards for fasteners used for assembly.
- B. American Society for Testing and Materials (ASTM) Standards: Applicable standards for steel sheet materials used for fabrication. Applicable standards for the testing of electrostatically applied Powder Coat Paint
- C. American Institute of Steel Construction (AISC) Standards: Applicable standards for steel materials used for fabrication.

1.4 DESCRIPTION

- A. General: Metal Keyless Pass Through Wall Evidence Lockers with Trim. No keys will be accepted to meet CALEA.org standards.
- B. Finishes: Fabricated Metal Components and Assemblies: All components to be painted with an electrostatically applied Powder Coat paint that can meet or exceed test requirements set out by ASTM standard D3451-06 Standard Guide for Testing Coating Powders and Powder Coatings.
- C. Sizes as noted on the Drawings.

1.5 PERFORMANCE REQUIREMENTS

- A. Design Requirements:
 - 1. Limit overall width to 0.032 inches greater or less than the nominal specified width.
 - 2. Include trim pieces on both sides of the wall.
 - 3. Keyless pass-through wall evidence lockers.
 - 4. Provide documentation from the International Association of Property and Evidence Technicians (IAPE) that this locker cannot be defeated in an audit to meet CALEA.org standards.

1.6 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's product literature and installation instructions for each type of evidence lockers required. Include data substantiating that products to be furnished comply with requirements of the contract documents.

- C. Shop Drawings:
 - 1. Show fabrication, assembly, and installation details including descriptions of procedures and diagrams. Show complete extent of evidence lockers installation layout including quantities, locations and types of accessory units required. Include notations and descriptions of all installation items and components.
 - 2. Show installation details at non-standard conditions, if any.
 - 3. Provide layout, dimensions, and identification of each unit corresponding to sequence of installation procedures.
 - 4. Provide installation schedule and procedures to ensure proper installation.
- D. Samples: Provide minimum 3-inch square example of each color and texture on actual substrate for each component to remain exposed after installation.
- E. Selection Samples: For initial selection of colors and textures, submit manufacturer's color charts consisting of actual product pieces, showing full range of colors and textures available.
- F. Warranty: Submit draft copy of proposed warranty for review by the E/A.
- G. Maintenance Data: provide written documentation of the manufacturer's statement claiming the maintenance free nature of the product.
- H. Reference List: Provide a list of recently installed evidence lockers to be visited by owner, architect, and contractor. Intent of list is to aid in verifying the suitability of manufacturer's products and comparison with materials and product specified in this section.

1.7 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide metal evidence locker systems made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
 - 1. Manufacturer Qualifications: Engage an experienced manufacturer who is ISO 9001 certified for the design, production, installation and service of evidence lockers. Furnish certification attesting ISO 9001 quality system registration.
 - 2. Installer Qualifications: Engage an experienced installer who is a manufacturer's authorized representative for the specified products for installing evidence lockers. Installers must be full time employee or certified installer for brand. Minimum Qualifications: 5-year experience installing evidence lockers of comparable size and complexity to specified project requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Do not deliver to Site until the building is enclosed. Deliver materials to the job site in factory sealed containers bearing the manufacturer's name and brand.
- B. Follow manufacturer's instructions and recommendations for delivery, storage and handling requirements.
- C. Damaged Material: Replace damage material prior to acceptance at no additional cost to Owner.

1.9 PROJECT CONDITIONS

- A. Field Measurements: Verify quantities of evidence lockers before fabrication. Indicate verified measurements on Shop Drawings. Coordinate fabrication and delivery to ensure no delay in progress of the Work.
- B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating evidence lockers units without field measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.10 SEQUENCING AND SCHEDULING

- A. Sequence evidence lockers units with other work to minimize possibility of damage and soiling during remainder of construction period.
- B. Schedule installation of specified evidence lockers after finishing operations; including painting have been completed.
- C. Provide components which must be built in at a time which causes no delays general progress of the Work.
- D. Pre-installation Conference: Schedule and conduct conference on project site to review methods and procedures for installing evidence lockers including, but not limited to the following:
Recommended attendees include:
 - 1. Owner's Representative.
 - 2. Prime Contractor or representative.
 - 3. The Architect
 - 4. Manufacturer's representative.
 - 5. Subcontractors or installers whose work may affect or be affected by the work of this section.

1.11 WARRANTY

- A. Provide a written warranty executed by Contractor, Installer and Manufacturer, agreeing to repair or replace units which fail in materials or workmanship within the established warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have under the General Conditions provisions of the Contract Documents.
- B. Limited Lifetime Warranty: Subject to the terms in the written warranty, warrant the original purchaser exclusively that the locker frames manufactured by it will be free from defects in materials and workmanship for the lifetime of the locker. Warrant the original purchaser exclusively that all moving parts manufactured by it will be free from defects in materials and workmanship for 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Standard of Quality: Design is based on products known as DSM Evidence Lockers as manufactured by Spacesaver Corporation, Fort Atkinson, WI www.spacesaver.com
- B. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers are:
 - 1. Tiffin Metal Products, Tiffin, OH www.steelesolutions.com
 - 2. Fasco, Rush City, MN www.fascosecurityproducts.com
 - 3. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.

2.2 BASIC MATERIALS

- A. General: Provide materials and quality of workmanship, which meets or exceeds established industry standards for products specified. Use furniture grade sheet metal and fasteners for component fabrication unless indicated otherwise. Material thicknesses/gauges are manufacturer's option unless indicated otherwise.

2.3 MANUFACTURED COMPONENTS - STANDARD EVIDENCE LOCKERS

A. Welded Frame:

1. The welded frame is structural and shall consist of top, bottom, back and sides constructed of a minimum of 18 gage (1.21MM) steel. All frame components shall be joined using resistance welding. Riveting or bolting of structural members will not be permitted.
2. Horizontal and vertical outer front flanges will be a minimum of 1.5 inches (38MM). Horizontal and vertical flanges will overlap with a minimum of 2 resistance welds per corner.
3. Center vertical lock housing is structural and will run the full height and depth of the locker. All locks will be completely enclosed by a full height removable panel. Pass-through rear release mechanisms will be completely enclosed by the lock housing and accessible only when the rear door is open. Provide engagement points for the anti-pry tabs that are on all front doors.
4. Exposed lock mechanisms that can snag evidence and be obstructed by stored articles will not be permitted.

B. Welded Bases:

1. Each welded base shall be permanently affixed to each locker using modern Inert Gas Metal Arc Welding techniques for lateral unit stability. The base shall be a minimum of 14 gage (1.98MM) steel 4 inches (101MM) high with a 1.5 inch (38MM) return on the bottom for support.
2. Provide four 0.375 inch (9.5MM) mounting holes and four 0.375 inch (9.5MM) nuts welded in place for the mounting of floor levelers. Provide four appliance levelers per locker.
3. Provide removable access panels for access to mounting holes and leveling points.

C. Shelves:

1. Shall be a single-piece formed from a minimum of 18-gage (1.21MM) cold rolled steel with a double 90-degree bend on the rear of the shelf and a double 90-degree bend on the front of the shelf. Shelf sides shall be turned up 90-degrees for ease of cleaning and to prevent debris from becoming caught between the shelf and the sidewall.
2. All shelves shall be welded into place. Rivets, screws, bolts or other loose fasteners will not be permitted for the fastening of shelves to the locker frame.

D. Locks:

1. Patent Pending. Lock shall be push button locking with a stainless-steel push button and alignment bezel. Locks shall be a one-piece removable design. Locks will secure the door with the single push of a button with no other action required by the user.
2. Locks will be deadbolt type locks with multi-point engagement. Rotary latches or cam locks will not be tolerated.
3. Pass-through locks will be reset from the rear of the locker when the rear door is in the open position only.
4. Provide documentation for cycle testing where locks are tested successfully to a minimum 40,000 cycles without failure.
5. Locks shall be pre-lubricated with no maintenance required for the lifetime of the unit (estimated at 20 years).

E. One Piece Welded Doors:

1. Shall be formed from two pieces of minimum 18-gauge (1.2MM) cold rolled steel box formed and welded together using modern GMAW techniques. The one-piece door with inner and outer door skins shall have a combined steel thickness of no less than 0.096 inches (2.4MM) thick.

2. Each door shall have a nickel plated; flush mounted door handle installed with fasteners visible only in the unlocked position.
 3. Provide neoprene silencers on each door.
 4. Provide anti-pry tabs that engage with the Center Vertical Lock Housing when the door is locked.
 5. Doors shall have no moving parts except the door and the hinge.
 6. Provide stainless-steel spring-loaded hinges that are welded to prevent pin removal. Spring loaded hinges shall be capable of holding the door closed and flush with the door frame. Doors that hang ajar are a safety concern and will not be tolerated.
- F. Rear Doors (Pass-through lockers)
1. Shall be formed from two pieces of minimum 18-gauge (1.2MM) cold rolled steel box formed and welded together using modern Inert Gas Metal Arc Welding techniques. The one-piece door with inner and outer door skins shall have a combined steel thickness of no less than 0.096 inches (2.4MM) thick.
 2. Each locker module shall have one rear door each and allow evidence to be removed from all compartments at once.
 3. Each rear door shall have multi-point engagement with a built-in L handle lock. Access to all lock mechanisms shall be hidden behind cover plates that are secured with tamperproof fasteners.
- 2.4 FABRICATION
- A. General: Coordinate fabrication and delivery to ensure no delay in progress of the Work.
- 2.5 FINISHES
- A. Colors: Selected from manufacturer's standard available colors as selected by Architect
- B. Paint Finish: Provide factory applied electrostatic powder coat paint. Meet or exceed specifications of the American Society for Testing and Materials (ASTM) standards.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that locker system may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A in writing. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.

3.3 INSTALLATION

- A. General: Follow manufacturer's written instructions for installation of each type of accessory item specified.
- B. Verify accessory unit alignment and plumb after installation. Correct if required following manufacturer's instructions.
- C. Remove components that are chipped, scratched, or otherwise damaged and which do not match adjoining work. Replace with new matching units, installed as specified and in a manner to eliminate evidence of replacement.

3.4 REPAIR/RESTORATION

- A. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance. Use materials, procedures recommended or furnished by manufacturer.

3.5 ADJUSTING

- A. Adjust units to operate in proper manner and easily without binding and provide a visually acceptable installation.

3.6 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from work of this Section. Maintain premises in neat, orderly condition.
- B. Immediately upon completion of installation, clean components and surfaces. Remove surplus materials, rubbish and debris resulting from installation upon completion of work and leave areas of installation in neat, clean condition.

3.7 DEMONSTRATION

- A. Schedule and conduct demonstration of installed accessory items and features with Owner's personnel.
- B. Schedule and conduct maintenance training with Owner's maintenance personnel. Training session should include lecture and demonstration of all maintenance and repair procedures that end user personnel would normally perform.

3.8 PROTECTION

- A. Protect system against damage during remainder of construction period. Advise Owner of additional protection needed to ensure that system will be without damage or deterioration at time of substantial completion.

END OF SECTION 10 51 13

SECTION 10 56 26 – Mobile Storage Shelving Units

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Mechanically assisted, carriage mounted high-density mobile storage shelving units.
 - 2. Support rails.
 - 3. Accessories required for a full and complete installation.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 04 22 00 - Concrete Unit Masonry
 - 3. Section 10 22 13 - Wire Mesh Partitions

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. American National Standards Institute (ANSI).
- B. American Society for Testing and Materials (ASTM).
- C. American Institute of Steel Construction (AISC).

1.4 SYSTEM DESCRIPTION

- A. General: The system consists of storage units mounted on manufacturer's track-guided carriages to form a compact storage system. System design permits access to any single aisle by manually moving units until the desired aisle is opened. The carriage/rail system provides uniform carriage movement along the total length of travel, even with unbalanced loads.
- B. Carriage System Design and Features: The carriage system consists of a formed structural steel frame with machined and balanced wheels riding on steel rails surface mounted to the floor. Rails shall be types selected by the manufacturer to ensure smooth operation and self-centering of mobile storage units during travel without end play or binding. Rail types, quantities and spacing shall be selected by the manufacturer to suit installation conditions and requirements. All bearings used in the drive mechanism shall be permanently shielded and lubricated.
- C. Movement Controls: Triple or single arm operating wheels with rotating hand knobs shall be provided on the accessible (drive) ends of shelf units, centered on the end panel, located 40 inches (1051MM) from the base of each unit to permit units to be moved to create a single aisle opening. Turning the handle transmits power through chain drive to drive wheels on each carriage.
- D. Drive System: The system shall be designed with a positive type mechanically-assisted drive which minimizes end play, ensures there is no play in the drive handle, and that carriages will stop without drifting.

1. System shall include a chain sprocket drive system for each movable carriage to ensure that carriages move uniformly along the total length of travel, even with unbalanced loads. All system components shall be selected to ensure a smooth, even movement along the entire carriage length. Drive system gearing shall be designed to permit 1 lb. of force applied to the drive handle to move a minimum of 4,000 lbs. of load.
 2. A tensioning device shall be provided on each chain drive with provision for adjusting tension without removing end panels.
 3. All bearings used in the drive mechanism shall be permanently shielded and lubricated.
- E. Safety Features:
1. Color-coded visual indicators shall provide verification that carriages are in a locked or unlocked mode.
 2. A single safety lock button, mounted on each operating wheel hub, will permit moving a carriage in either direction to create a new access aisle when pulled out (unlocked), or locking the carriage when pushed in.
- F. Finishes:
1. Fabricated Metal Components And Assemblies: Manufacturer's standard powder coat paint finish.
 2. End Panels, Accessible Ends: Plastic laminate
- 1.5 PERFORMANCE REQUIREMENTS
- A. Design Requirements: Refer to size and location as indicated on the Drawings.
 - B. Ease of Movement: Provide mechanically assisted units capable of being moved by exerting a maximum horizontal force of five (5) pounds on the operating wheel.
- 1.6 SUBMITTALS
- A. Refer to the Division 1 Specifications.
 - B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
 - C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections details of components, joint locations and configurations within system and between system and adjoining system. Include locker numbering sequence information.
 - D. Samples:
 1. Initial Color Selection: Submit manufacturer's standard color samples for each type of finish with Product Data and Shop Drawings.
 2. Color Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics. Include notification to E/A if selection is not within specified price range.
 3. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components if requested by E/A.
 - E. Maintenance Manual: Provide to Owner maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.
- 1.7 QUALITY ASSURANCE
- A. Single Source Responsibility: Provide mobile storage shelving units made of components of standard construction furnished by one manufacturer as coordinated assemblies.

- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of mobile storage shelving units.
 - 2. Installer: 3 years experience in the installation of mobile storage shelving units.
 - 3. Personnel: For actual installation of mobile storage shelving units, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of Work.
- C. Field Samples: If requested, furnish sample of each type of product to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.
- D. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.8 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.
- B. Field Dimensions: Verify dimensions before fabrication. Indicate verified measurements on Shop Drawings. Coordinate fabrication and delivery to ensure no delay in progress of the Work.
- C. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating mobile storage units. Coordinate construction to ensure actual dimensions correspond to established dimensions.

1.9 SEQUENCING AND SCHEDULING

- A. Sequencing: Coordinate storage shelving system installation with other work to minimize possibility of damage and soiling during remainder of construction period.
- B. Scheduling: Plan installation to commence after finishing operations, including painting have been completed.
- C. Built-In Items: Provide components which must be built in at a time which causes no delays general progress of the Work.

1.10 WARRANTY

- A. Provide a written warranty, executed by Contractor, Installer, and Manufacturer, agreeing to repair or replace units which fail in materials or workmanship within the established warranty period.
- B. Warrant the entire movable compact shelving installation against defects in materials and workmanship for a period of five years from date of acceptance by the Owner.

1.11 MAINTENANCE

- A. Provide manufacturer's extended maintenance agreement for 5 years, commencing on the day the standard maintenance warranty ends.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Mobile Storage Shelving Units:
 - 1. Standard of Quality: Unless otherwise indicated, design is based on products of Spacesaver Corporation, Fort Atkinson, WI www.spacesaver.com

2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Aurora Storage Products, Aurora, IL www.aurorastorage.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 COMPONENTS

A. Rails:

1. Material: ASTM/AISI Type 1035 or 1045 steel, manufacturer's selection.
2. Capacity: 1,000 pounds per linear foot (1385kg/M) of carriage.
3. Rail configuration shall permit attachment to top of structural floor system with provision for leveling rails to compensate for variations in floor surface level.
4. Provide rail connections designed to provide horizontal and vertical continuity between rail sections, to gradually transfer the concentrated wheel point load to and from adjoining rail sections. Butt joints are not permitted.

B. Floor / Ramp:

1. Floor/Ramp Sheathing: Minimum 3/4 inch (19MM), 5-ply underlayment grade plywood. Particle board sheathing materials are not permitted.
2. Provide fire retardant treated floor/ramp materials when required by code.
3. Finished flooring materials shall be provided by others.

C. Carriages:

1. Provide manufacturer's design movable carriages fabricated of welded or bolted steel construction. Galvanized structural components and/or riveted carriages are unacceptable.
2. Provide fixed carriages of same construction and height as the movable carriages, anchored to rails. Setting fixed shelving directly on floors is not permitted.
3. When required, provide bolted carriage splices designed to maintain proper unit alignment and weight load distribution.
4. Design carriages to allow the shelving uprights to recess and interlock into the carriages a minimum of 3/4 inch (19MM). Top mount carriages are unacceptable.
5. Provide each carriage with two wheels per rail.

D. Drive / Guide System

1. Design: Provide drive system which prevents carriage whipping, binding and excessive wheel/rail wear under normal operation.
 - a. Line shafts are used, all wheels on one side of carriage shall drive.
2. Shafts: Solid steel rod or tube.
3. Shaft Connections: Secured couplings.
4. Bearing Surfaces: Provide rotating load bearing members with ball or roller bearings. Provide shafts with pillow block or flanged self-aligning type bearings.

E. Wheels:

1. Capacity: Minimum load capacity per wheel: 3200 lbs (1455kg).
2. Size: Minimum 5 inches (127MM), outside diameter drive wheels.
3. Guides: Determined by manufacturer; minimum 2 locations.

F. Face Panels:

1. Materials: Plastic laminate clad particle board with plastic edging on vertical edges.

2.3 FABRICATION

- A. Wheels: Provide precision machined and balanced units with permanently shielded and lubricated bearings.
- B. Carriages:
 - 1. Fabricate to ensure no more than 1/4 inch (6MM) maximum deviation from a true straight line.
 - 2. Splice and weld to ensure no permanent set or slippage in any spliced or welded joint when exposed to forces encountered in normal operating circumstances.
- C. Shelving, Supports and Accessories: See individual descriptions in "Shelving" paragraphs.

2.4 FINISHES

- A. Colors: Selected from manufacturer's standard available colors.
- B. Paint Finish: Provide factory applied electrostatic powder coat paint. Meet or exceed specifications of the American Library Association.
- C. Laminate Finish: Provide factory applied laminate panels at locations indicated on approved shop drawings.
- D. Edgings: Provide preformed edging, color-matched to unit colors selected.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that mobile storage shelving units may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.

3.3 INSTALLATION

- A. General Requirements:
 - 1. Install plumb, true, square in neat, rigid, substantial manner.
 - 2. Install at locations shown according to manufacturer's instructions.

3.4 FIELD QUALITY CONTROL

- A. Verify shelving unit alignment and plumb after installation. Correct if required following manufacturer's instructions.
- B. Remove components which are chipped, scratched, or otherwise damaged and which do not match adjoining work. Replace with new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.5 ADJUSTING

- A. Adjust components and accessories to provide smoothly operating, visually acceptable installation.

3.6 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from Work of this Section. Maintain premises in neat, orderly condition.

- B. Immediately upon completion of installation, clear components, and surfaces. Remove surplus materials, rubbish and debris resulting from installation upon completion of work and leave areas of installation in neat, clean condition.

3.7 PROTECTION

- A. Protect system against damage during remainder of construction period. Advise Owner of additional protection needed to ensure that system will be without damage or deterioration at time of substantial completion.

END OF SECTION 10 56 26

SECTION 10 60 00 – Safety Netting

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Safety net system to be used with the recessed floor inspection pits.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 05 50 00 - Metal Fabrications

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. OSHA:
 - 1. Regulations 1910.22c, 1910.23(a), and General Duty Clause 5(a)(1).

1.4 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections details of components, joint locations and configurations within system and between system and adjoining system.
- D. Samples: Submit 36 inch long sample of netting, complete with hemmed edge and grommets.
- E. Maintenance Manual: Provide to Owner maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide safety netting system made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of toilet accessories.
 - 2. Contractor: 3 years experience in the installation of toilet accessories.
 - 3. Personnel: For actual installation of toilet accessories, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of Work.
- C. Field Samples: If requested, furnish sample of each type of safety netting system to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.

1.6 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.7 WARRANTY

- A. Provide manufacturer's standard warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver netting in protected, waterproof packaging, labelled as "Inspection Bay Trench Netting". Store in dry area.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Safety Netting
 - 1. Standard of Quality: Unless otherwise indicated, design is based on products of Incord, Colchester, CT www.incord.com

2.2 MATERIALS

- A. Provide bi-parting net systems to cover the inspection pits as indicated on the Drawings.
- B. Netting:
 - 1. Fiber: High Tenacity, Polypropylene (HTPP).
 - 2. Cord diameter: 3/16 inch.
 - 3. Mesh Size: 2 1/2 inch square opening measured between mesh joints.
 - 4. Mesh Break: 719 lbf.
 - 5. Dynamic Drop Test: 12,075 ft-lb (ANSI A10.11 test method).
 - 6. Weight: 0.0528 PSF.
 - 7. Melting Point: 340 degrees F.
 - 8. UV: Extra UV stabilizers added.
 - 9. Color: Black.
- C. Quick Link Connectors:
 - 1. Stainless steel.
 - 2. Threaded.
 - 3. Size and minimum load bearing capacity as required by safety net system.

2.3 PRODUCTS

- A. Product: BayNets BNS38 Safety System™.
- B. Other Materials: Other materials not specifically described but required for complete, proper installation of safety netting system, subject to acceptance of E/A.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that safety netting system may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.

3.3 INSTALLATION

A. General Requirements:

1. Install plumb, true, square in neat, rigid, substantial manner.

3.4 ADJUSTING AND CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from Work of this Section. Maintain premises in neat, orderly condition.

END OF SECTION 10 60 00

SECTION 10 73 16 – Aluminum Canopies

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Extruded aluminum stationary exterior canopies.
- B. Related Sections:
 - 1. Section 03 41 00 - Precast Structural Concrete
 - 2. Section 06 10 00 - Rough Carpentry
 - 3. Section 07 62 00 - Sheet Metal Flashing and Trim
 - 4. Section 07 92 00 - Joint Sealants

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. AAMA 2604 – High Performance Organic Coatings on Architectural Extrusions and Panels.
- B. AAMA 2605 – High Performance Organic Coatings on Architectural Extrusions and Panels.
- C. ASCE 7 – Minimum Design Loads for Buildings and Other Structures
- D. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- E. ASTM B221 – Standard Specifications for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- F. ASTM D822 – Standard Practice for Filtered Open-Flame Carbon-Arc Exposure of Paint and Related Coatings.
- G. ASTM D4214 – Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films.
- H. ASTM D2244 – Standard Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- I. ASTM E330 – Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Air Pressure Difference.
- J. Living Building Challenge – Red List Free.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide sun control devices which have been manufactured, fabricated and installed to withstand loads from ASCE – 7, or local requirements of Authority Having Jurisdiction.
- B. Sun control devices shall be designed to perform under conditions herein or required by site conditions with no permanent damage to or deforming of the sunshade blades or assembly, noise or metal fatigue caused by sunshade blade rattle or flutter, or permanent damage to fasteners or anchors.

1.5 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: For each product to be used, including:
 - 1. Manufacturer's product data including performance data.
 - 2. Installation Instructions
 - 3. Maintenance and Operations Manuals
 - 4. Health Product Declarations (HPDs) and Declare Labels.
- C. Shop Drawings:
 - 1. Submit shop drawings indicating materials, construction, dimensions, accessories, and installation details.
- D. Samples: Submit color chip samples for units with factory-applied paint.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. The manufacturer shall have implemented the management of quality objectives, continual improvement, and monitoring of customer satisfaction to assure that customer needs and expectations are met.
 - 2. Manufacturer shall have International Living Future (ILFI) Just Label or equivalent.

1.7 DELIVERY, STORAGE & HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material
- B. Storage: Store materials in a dry area indoors, protected from damage and according to manufacturer's instructions.
- C. Handling: Protect materials and finishes during handling and installation to prevent damage
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, according to requirements of local authorities having jurisdiction.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by the manufacturer for optimum results. Do not install products under environment conditions outside the manufacturer's absolute limits.
- B. Field Measurements: Verify actual measurements of openings by field measurements before fabrication. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.9 WARRANTY

- A. Manufacturer shall provide a standard limited warranty for sun control systems for a period of 5 years from date of installation, no more than 18 months after shipment from manufacturing plant. When notified in writing from the Owner of a manufacturing defect, manufacturer shall promptly correct deficiencies without cost to the owner.
- B. Manufacturer shall provide 20 year limited warranty for fluoropolymer-based finish on aluminum substrates.
 - 1. Finish coating shall not peel, blister, chip, crack, or check.
 - 2. Chalking, fading, or erosion of finish when measured by the following tests:
 - a. Finish coating shall not chalk in excess of 8 numerical ratings when measured according to ASTM D4214.

- b. Finish coating shall not change color or fade in excess of 5 NBS units as determined by ASTM D2244 and ASTM D822
- c. Finish coating shall not erode at a rate in excess of .01 mils/year confirmed by Florida test samples.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Standard of Quality: Design is based on Standard Canopy as manufactured by Industrial Louvers Inc. (ILI), Delano, MN www.industriallouvers.com
- B. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - 1. Vestis Manufacturing, Spokane, WA www.vestissystems.com
 - 2. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIAL

- A. Fascia shall be fabricated from a minimum .125 (1/8") wall thickness extruded aluminum tube.
- B. Outrigger material shall be fabricated from a minimum .250 (1/4") wall thickness plate aluminum.
- C. Mounting brackets shall be fabricated from a minimum .375 (3/8") wall thickness.
- D. Suspension Rods shall be fabricated from a minimum .75 (3/4") diameter rod with clevis ends.
- E. Aluminum Extrusions: ASTM B221, Alloy 6063-T6
- F. Fully mechanically fastened construction

2.3 FINISHES (FACTORY)

- A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process. Provide color as indicated on the Drawings or, if not otherwise indicated, as selected by E/A.
- B. Fluorocarbon Two Coat Finish
 - 1. Coating shall conform to AAMA 2605.
 - 2. Sun Control Devices to be finished with a minimum 1.0 mil (0.025 mm) thick full strength 70% resin, 2 coat Fluoropolymer system.
 - 3. All aluminum shall be thoroughly cleaned, etched, and given a chrome-free conversion pretreatment before application of coating. Coating shall be ILFI LBC Red List Free.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by the manufacturer for achieving the best results for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install sun control devices at locations as indicated on the drawings and according to the manufacturer's instructions.

3.4 CLEANING

- A. Clean sun control device surface according to manufacturer's instructions.
- B. Touch-up paint, repair or replace damaged products before Substantial Completion.

END OF SECTION 10 73 16

END OF DIVISION 10 – SPECIALTIES

DIVISION 12 – FURNISHINGS

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12 30 00	Manufactured Casework
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END OF INDEX

SECTION 12 20 00 – Window Treatments

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Manual rolling fabric room darkening solar shades.
 - 2. Horizontal louver blinds.
 - 3. Manual roller tinted film shades.
 - 4. Window treatment accessories including, but not limited to:
 - a. Mounting hardware.
 - b. Pulls.
- B. Related Sections:
 - 1. Section 03 41 00 - Plant-Precast Structural Concrete
 - 2. Section 06 10 00 - Rough Carpentry
 - 3. Section 08 43 13 - Aluminum-Framed Storefront
 - 4. Section 08 44 13 - Glazed Aluminum Curtain Walls
 - 5. Section 09 22 00 - Non-Structural Metal Framing
 - 6. Section 09 29 00 - Gypsum Board
 - 7. Section 09 51 13 - Acoustical Panel Ceilings
 - 8. Section 09 91 00 - Painting

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 SUBMITTALS

- A. Refer to Section 01 33 00.
- B. Product Data: Submit manufacturer's current Product Data including installation instructions for each type of opening and supporting structure.

- C. Shop Drawings: Submit for window treatment units not fully dimensioned or detailed in manufacturer's Product Data. Show relationships to adjoining work. Include typical elevation layout indicating proposed division between blind units, meeting edges at corners. Provide sections, details at head, sill between units and corners; schedule of units to be furnished, including field measurements at each location.
- D. Schedule: Provide schedule of all units to be furnished, including field measurements at each location.
- E. Samples:
 - 1. Color Samples: Submit manufacturer's standard color samples with Product Data and Shop Drawings.
 - 2. Samples for Verification Purposes: Submit two 12" long samples, illustrating color and pattern for each horizontal blind material specified.
- F. Manufacturer's installation instructions: Indicate special procedures and perimeter conditions requiring special attention.
- G. Maintenance Data: Include maintenance procedures. Recommendations for maintenance materials and equipment, and suggested schedule for cleaning.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide units produced by 1 manufacturer for each type required, with complete standard assemblies including hardware accessory items, mounting brackets, and fastenings.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of window treatment units.
 - 2. Contractor: 3 years experience in the installation of window treatment units.

1.5 WARRANTY

- A. Three years or manufacturer's standard warranty, whichever is greater.

1.6 MAINTENANCE

- A. Furnish extra materials matching products installed, packaged with protective covering for storage and identified with labels clearly describing contents.
- B. Typical Window Treatment Units: Furnish quantity of full size typical window treatment units equal to 5 percent of amount installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers and Products: Subject to compliance with requirements, manufacturers offering products which may be incorporated in work include, but are not limited to:
 - 1. Horizontal Louver Blinds (WT-1)
 - a. Hunter Douglas, Pearl River, NY www.hunterdouglas.com
 - b. Graber, Montgomery, PA www.graberblinds.com
 - c. Manufacturer of comparable products submitted in compliance with Section 01 25 13.
 - 2. Rolling Fabric Solar Shades (WT-2)
 - a. BTX Window Automation, Dallas, TX www.btxinc.com
 - b. Draper Shade & Screen Co., Spiceland, IN www.draperinc.com
 - c. Mecho Shade Systems, Long Island City, NY www.mechoshade.com
 - d. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

3. Rolling Tinted Film Solar Shades (WT-3)
 - a. Hunter Douglas, Pearl River, NY www.hunterdouglas.com
 - b. Sol-R-Veil, Quebec, ON www.sol-r.ca
 - c. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.2 MATERIALS - HORIZONTAL BLINDS (WT-1)

- A. Louver Slats: Aluminum, alloy and temper recommended by manufacturer for type of use and finish indicated with crowned profile and radiused corners.
 1. Slat width: 1 inch (25 mm)
 2. Slat spacing: Not less than every 20 mm for 15.2 slats or more per foot (20 mm).
 3. Nominal slat thickness: Not less than 0.008 inch (0.20 mm)
- B. Headrail/Valance: Decorative, integrated headrail, valance not requiring a separate valance or end brackets for finished appearance; formed steel or extruded aluminum; log edges returned or rolled; fully enclosing operating mechanism on three sides and ends; capacity for one blind per headrail, unless otherwise indicated.
 1. Finish Color Characteristics: Match color, texture, pattern, and gloss of louver slats.
- C. Bottom Rail: Formed-steel or extruded-aluminum tube, sealed with plastic or metal capped ends top contoured to match crown shape or louver slat, bottom contoured for minimizing light gaps; with enclosed and protected ladders and tapes to prevent their contact with sill.
- D. Tilt Control Method: Consisting of enclosed worm gear mechanism, slip clutch or detachable wand preventing over-rotation, and linkage rod, for the following operation:
 1. Tilt Operation: Manual with clear plastic wand.
 2. Tilt Two-Direction, positive stop or lock-out limited at an angle of 60 degrees from zero-degree horizontal, both directions.
- E. Lift Operation: Manual, top-locking cord lock; locks pull cord to stop blind in either fully opened or fully closed position only and is equipped with a ring pull not more than 4" long.
- F. Ladders: Evenly spaced to prevent long-term louver sag.
- G. Mounting: End mounting permitting easy removal and replacement without damaging blind or adjacent surfaces and finishes; with spacers and shims required for blind placement and alignment indicated. Provide intermediate support brackets if end support spacing exceeds spacing recommended by manufacturer for weight and size of blinds.
- H. Colors and Patterns: Furnish materials selected by E/A from specified manufacturer's standard colors and patterns.

2.3 MATERIALS – ROLLING SOLAR SHADES (WT-2)

- A. Fabrication
 1. Fabric: Vinyl-coated polyester yarns consisting of 25% polyester, 75% PVC on polyester, Greenguard Certified based on Mecho/5 Manual Shade System Thermovell Open Basket Weave 2100 Series.
 - a. Percent Opening: 10 %.
 - b. Solar Shade Color: Based on Mechoshade: Grey #2113
 - c. Shade must be the sizes as shown on the Drawings. Splitting of shades is not allowed.
- B. Roller: Fabricated from extruded aluminum or steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade size. Provide with roller idler assembly of molded nylon and zinc-plated steel pin. Sliding pin to allow easy installation and removal of roller.

- C. Hem Bar: Provide manufacturer's standard aluminum extrusion enclosed in a fabric hem pocket with heat-welded seams and ends.
- D. Recessed Pocket Headbox: Fabrication from manufacturer's standard extruded aluminum sections with endcaps and integral ceiling angled leg for support of abutting acoustical tile.
 - 1. Exposed Aluminum Finish: Baked enamel paint finish available in manufacturer's standard range of colors.
 - 2. Attachment Hardware: Window Treatment Contractor shall provide wall brackets and mounting hardware as necessary to secure roller assembly.
- E. Endcaps: Stamped steel with universal design suitable for mounting to ceiling, wall, and jamb.
- F. Lift Operation: Manual, top-locking cord lock.

2.4 MATERIALS – ROLLER TINTED FILM SHADES (WT-3)

- A. Shade Material:
 - 1. Based on Mecho/5 Manual Shade System MirroFilm 0600 Series.
 - 2. PVC-free, light filtering, and heat insulating of tinted polyester film with a deposit of pure aluminum in the core.
 - 3. Color: Smoke/Silver-Smoke 0606
- B. Hem Bar: Provide extruded aluminum oval or rectangular shaped hembar with matching end caps, pre-weighted, to maintain bottom of shade fabric straight and flat. Aluminum extrusions to be finished to match color or curtainwall framing.
- C. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets with manufacturer's standard method for attaching shade material.
- D. Recessed Pocket Headbox: Fabrication from manufacturer's standard extruded aluminum sections with endcaps and integral ceiling angled leg for support of abutting acoustical ceiling tile.
 - 1. Exposed Aluminum Finish: Baked enamel paint finish available in manufacturer's standard range of colors.
 - 2. Attachment Hardware: Window Treatment Contractor shall provide wall brackets and mounting hardware as necessary to secure roller assembly.
- E. Lift Operation: manual, top-locking cord lock.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Inspect the project prior to installation; if conditions do not meet approval, notify E/A. Proceeding without notification implies acceptance of conditions.

3.2 INSTALLATION

- A. General: Comply with manufacturer's instructions:
 - 1. Position units level, plumb, secure, at proper height and location relative to adjoining window units and other related work.
 - 2. Securely anchor units with proper clips, brackets, anchorages, suited to type of mounting indicated.
 - 3. Provide adequate clearance between sash and blinds to permit unencumbered operation of sash hardware, if any.

- 4. Isolate metal parts from concrete and mortar to prevent galvanic action. Use tape or thick coating or other means recommended by manufacturer to effect separation.
- B. Protection: Protect installed units to ensure their being in operating condition, without damage, blemishes, or indication of use at completion of project. Repair or replace damaged units as directed by Owner.

3.3 CLEANING

- A. Window Treatment: After completing the installation, clean window treatment surfaces according to manufacturer's instructions.
- B. Premises: Keep premises free from accumulation of waste materials or rubbish caused by work. At completion of work, remove waste materials, rubbish, tools, surplus materials from and about premises.

END OF SECTION 12 20 00

SECTION 12 30 00 – Manufactured Casework

PART 1 – GENERAL

1.1 SUMMARY

A. Provide:

1. Plastic laminate clad casework.
2. Countertops:
 - a. Plastic laminate.
 - b. Stainless steel.
3. Casework accessories including, but not limited to:
 - a. Hardware.
 - b. Filler panels.
 - c. Casework joint sealant.
4. Countertop accessories including, but not limited to:
 - a. Grommets.
 - b. Prefinished steel support brackets.
 - c. Casework joint sealant.
5. Coat rack shelving.
6. Adjustable plastic laminate shelving system:
 - a. Plastic laminate shelves.
 - b. Shelf standards and adjustable brackets.

B. The following is not included in this section:

1. Plumbing fixtures.
2. Quartz countertops (Cast Polymer Fabrications).

C. Related Sections:

1. Section 06 10 53 - Miscellaneous Rough Carpentry
2. Section 06 40 23 - Interior Architectural Woodwork
3. Section 06 61 00 - Cast Polymer Fabrications
4. Section 09 22 00 - Non-structural Metal Framing
5. Section 09 29 00 - Gypsum Board
6. Section 09 65 13 - Resilient Wall Base and Accessories
7. Section 12 36 53 - Epoxy Resin Worksurfaces
8. Division 22 Plumbing sections

1.2 FEDERAL BIDDING REQUIREMENTS

A. Buy America:

1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.

B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ADA - Exposed Hot Water Pipes and Surfaces
- B. ANSI A208.2 - Fiberboard
- C. ASTM:
 - 1. D570 - Water Absorption of Plastics
 - 2. D635 - Rate and Extent of Burning of Plastics
 - 3. D638 - Tensile Properties of Plastics
 - 4. D695 - Compressive Properties of Rigid Plastics
 - 5. D785 - Rockwell Hardness of Plastics and Electrical Insulation Materials
 - 6. D790 - Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - 7. D792 - Density and Specific Gravity of Plastics
 - 8. G21 - Resistance of Synthetics to Fungi
- D. MCAA - Plumbing Standards
- E. IBC Code Requirements
- F. NEMA - NEMA LD3

1.4 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Comply with ADA Requirements.
 - a. Countertop height: with or without cabinet below, not-to-exceed a height of 34 inches above finished floor (AFF), at a surface depth of 24 inches.
 - b. Knee space clearance: Minimum 29 inches AFF; 30 inches clear span width.
 - c. 12-inch-deep shelving, adjustable or fixed: not-to-exceed a range from 9 inches AFF to 54 inches AFF, unless otherwise shown on the Drawings.
 - d. Sink cabinet clearances: in addition to above, upper knee space frontal depth to be no less than 8 inches, and lower toe frontal depth to be no less than 11 inches, at a point 9 inches AFF.
 - e. Insulate exposed hot water and drain pipes under lavatories.
- B. Performance Requirements:
 - 1. Plastic Laminate Casework:
 - a. General:
 - 1) Base cabinet construction/ racking test: 800 pounds.
 - 2) Cabinet front joint loading test: 425 pounds.
 - 3) Wall cabinet static load test: 2,200 pounds.
 - 4) Drawer front joint loading test: 600 pounds.
 - 5) Drawer construction/static load test: 750 pounds.
 - 6) Keyboard tray: 100 pounds.
 - 7) Cabinet and shelf support device/static load test: 300 pounds.
 - b. Particleboard and agriboard:
 - 1) Screw holding power: 300 pounds.

- c. Fiberboard core:
 - 1) Screw holding, face: 355 pounds.
 - 2) Modulus of rupture: 4,000 psi.
 - 3) Modulus of elasticity: 400,000 psi.
 - 4) Internal bond: 120 psi.

1.5 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings:
 - 1. Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections, details of components, joint locations and configurations within system and between system and adjoining system.
 - 2. Show location, size of each type of unit accessories, materials, finishes, hardware types and locations, fillers, etc.
 - 3. Indicate details of anchorage.
- D. Samples:
 - 1. Initial Color Selection: Submit manufacturer's full range of color samples for each type of finish with Product Data and Shop Drawings. Color selections MUST be from manufacturer's full range of colors, including ALL exotic colors.
 - 2. Color Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics. Include notification to E/A if selection is not within quoted price range.
 - 3. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components if requested by E/A.
- E. Quality Assurance/Control Submittals:
 - 1. Test Reports: Reports from independent testing laboratories approved by E/A indicating compliance with the above performance requirements.
- F. Certificates:
 - 1. Product: Signed by manufacturers of casework certifying that products furnished comply with requirements.
- G. Maintenance Manual: Furnish Owner with maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.

1.6 QUALITY ASSURANCE

- A. Casework Group: Manufacturer shall offer an integrated product line servicing the user function indicated with a coordinated design, supply, and installation of casework, equipment, work surfaces, and accessories:
 - 1. General casework.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of plastic laminate clad casework, with 6 projects of similar size, scope and type of which 3 have been in successful use for 3 years or longer.
 - 2. Installer: 3 years experience in the installation of manufactured casework.
 - 3. Personnel: For actual installation of manufactured casework, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.

- C. Regulatory Requirements for Cabinets:
 - 1. Comply with ANSI/KCMA A161.1 or A161.2 and provide cabinets with KCMA seal affixed in unexposed location of each unit, showing compliance.
- D. Provide AWI Quality Certification Program (QCP) labels on finished goods.
- E. Field Samples: If requested, furnish sample of each type of manufactured casework to the E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.
- F. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements: Do not deliver to Site until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels for the remainder of the construction period.
- B. Field Measurements:
 - 1. Casework to fit to other construction:
 - a. Establish dimensions for areas where casework is to fit.
 - b. Coordinate to ensure actual dimensions correspond to established dimensions.
 - 2. Casework to fit to existing construction:
 - a. Verify dimensions of existing construction by field measurements before fabrication and indicate on Shop Drawings.
 - 3. Provide fillers and scribes to allow for trimming and fitting.
 - 4. Countertops: Verify dimensions after base cabinets are installed but before countertop fabrication is complete.
- C. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.8 WARRANTY

- A. Furnish warranty from manufacturing defects and poor workmanship for a period of 5 years.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Plastic Laminate Clad Manufactured Casework:
 - 1. Standard of Quality for design is based on Casework USA by WB Manufacturing, Thorp, WI www.wibenchmfg.com
 - 2. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - a. Hamilton Casework Solutions, Fairfield, OH www.hamiltoncs.com
 - b. Wilkie Sanderson, Sauk Rapids, MN www.wilkiesanderson.com
 - c. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
- B. Countertops:
 - 1. Plastic Laminate:
 - a. Standard of Quality for design is based on Formica Corporation, Cincinnati, OH www.formica.com

- b. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - 1) Nevamar Corporation, Odenton, MD www.panolam.com
 - 2) Pionite Decorative Laminates, Auburn, ME www.panolam.com
 - 3) Wilsonart International, Temple, TX www.wilsonart.com
 - 4) Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
 - 2. Stainless Steel Countertops: 16 gauge, No. 4 satin finish.
 - 3. Quartz/Solid surface: Refer to Section 06 61 00 Cast Polymer Fabrications.
 - 4. Epoxy Resin: Refer to Section 12 36 53 Epoxy Resin Worksurfaces.
 - C. Adjustable Support Brackets and Shelving Hardware:
 - 1. Standard of Quality for design is based on Rakks, Westborough, MA www.rakks.com
 - 2. Other acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers are:
 - a. Steel Design Solutions, Fleming Island, FL www.steeldesignsolutions.com
 - b. National Hardware, Middleton, WI www.national-hardware.com
 - c. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS

- A. Plastic Laminate Casework:
 - 1. Core Materials:
 - a. Particleboard
 - 1) High performance industrial grade particleboard.
 - 2) 45 pound density.
 - 3) Conform to ANSI A208.1-1993 type M-3.
 - b. Medium Density Fiberboard
 - 1) 45 pound density.
 - 2) Conform to ANSI A208.2.
 - 3) Use at all glass doors and where indicated.
 - c. Plywood
 - 1) Exterior Grade.
 - 2) Use at toe base.
 - 2. Decorative Laminate:
 - a. Thermal fused laminate (TFL) for all surfaces.
 - b. Compliant with NEMA performance standards.
 - c. Colors to be selected from manufacturer's full range of colors unless noted otherwise.
 - 3. Edge Banding:
 - a. .5mm nominal (.020/.018) PVC for drawer boxes only.
 - b. 3 mm nominal (.118) PVC, edges and corners to be machined to a nominal 1/8 inch (.125) radius.

4. Adhesives:
 - a. Water resistant adhesives containing no health hazardous ingredients are required.
 - b. Methods requiring heat and/or "contact laminating" are not allowed.
- B. Countertops:
 1. Plastic Laminate:
 - a. Meet applicable requirements of AWWA UCFA,
 - b. High-pressure plastic laminate, post-forming (PF) 0.042-inch on particleboard core.
 - c. Finish: standard or custom laminate.
 - d. Edge Finish:
 - 1) High-pressure plastic laminate.
 - 2) 0.5mm PVC edge banding, square corners.
 - e. Thickness: 1.25 inches.
 2. Stainless Steel:
 - a. 16 gauge 304 stainless steel with particle board core.
 - b. Finish: exposed surfaces to have No. 4 satin finish.
 - c. Edge: wrapped with welded corners.
 - d. Thickness: 1.625 inches.
 - e. Steel frame around front and ends for fastening to cabinet.
 - f. Joints electrically welded, then ground and polished to hand-blended satin finish.
 - g. If used, drain boards, flanges, curbs, and backsplashes to be integral. Refer to the Drawings for locations.
- C. Countertop Support Brackets:
 1. Heavy duty, wall mounted, BHMA Grade 2 compliant, cold rolled steel.
 2. Load rated at 1,200 pounds per pair, minimum.
 3. Finish: Color to be white or as indicated on the Drawings.

2.3 CASEWORK HARDWARE

- A. Hinges:
 1. Concealed hinges, 120° swing. Provide baseplates to maintain 1/8 inch nominal reveals between doors/drawers within the same cabinet, and between doors of adjoining cabinets. Doors shall be self-closing and fitted with silencer bumpers.
 2. Heavy duty, five knuckle 2 3/4 inch hinge shall meet ANSI/BHMA A156.9 Grade 1 requirements.
 3. Provide door catches as required to comply with Americans with Disabilities Act for opening resistance.
 4. Each hinge to have minimum 9 screws, No. 7, 5/8 inch, FHMS to ensure positive door attachment.
 5. One pair per door to 48 inches height. 1-1/2 pair over 48 inches in height.
 6. Color as selected by E/A from manufacturer's full range of colors.
- B. Pulls:
 1. Comply with the Americans with Disabilities Act.
 2. Wire design, 96 mm.

3. Pulls are to be factory installed in reverse position.
 4. Provide 2 pulls for drawers over 24 inches wide.
 5. Color as selected by E/A from manufacturers full range of colors.
- C. Catches:
1. Provide opening resistance in compliance with ADA.
 2. Provide 1 top-mounted magnetic catch for base, wall and tall cabinet door when using 5-knuckle hinge.
- D. Cabinet Overhead Doorstop:
1. Provide to prevent doors from swinging into walls, other cabinets or objects.
- E. Drawer Slides:
1. Standard Drawers: 100 lbs. side-mount, full extension slides.
 2. File and Paper Storage Drawers: 150 lbs. side-mount, full extension slides.
 3. Ball-bearing type slides.
 4. Finish: Standard Chrome.
 5. Positive in-stop, out-stop, and out-keeper to maintain drawer in 80 percent open position.
 6. Captive nylon rollers, front and rear.
- F. Adjustable Shelf Supports:
1. Twin pin design with anti tip-up shelf restraints shelves with slot to mechanically attach shelf to clip.
 2. Load rating shall be minimum 300 lbs. each support.
- G. Cabinet Locks:
1. As indicated on the Drawings.
 2. Disc tumbler deadbolt action.
 3. Bright nickel finish.
 4. All locks keyed alike, unless otherwise requested by Owner.
 5. Master keys supplied upon request.
- H. Wardrobe rod:
1. 14 gauge, 1 1/16 inch diameter, chrome-plated hang rod with captive supports at each end, securely fastened to cabinet sides and/or fixed vertical divider.
- I. Specialty Hardware:
1. Hardware not listed herein, as required for specialty products, shall be of the manufacturer's standard, or as approved by the E/A prior to manufacture.
- 2.4 PLASTIC LAMINATE CLAD CASEWORK FABRICATION
- A. Surfaces:
1. Exposed surfaces: Decorative thermal fused laminate (TFL).
 2. Semi-exposed surfaces:
 - a. Closed interior: Decorative thermal fused laminate (TFL).
 - b. Drawer boxes: White thermal fused laminate (TFL).
 3. Edges:
 - a. Cabinet body edge: nominal 3mm PVC at all exposed and semi-exposed edges.
 - b. Door and drawer front edge: 3mm PVC, four sides.

- c. Shelves: nominal 3mm PVC, front edge. Color to match shelf color.
 - d. Drawer boxes: nominal .5mm PVC, color white.
- 4. Material balancing:
 - a. Thermal fused laminate (TFL) is to be applied to both faces. Panels with melamine on one side only, or with decorative laminate balanced with melamine are not permitted.
- B. Cabinet Construction:
 - 1. Style: Flush overlay.
 - 2. Components:
 - a. Material Thickness
 - 1) 11/16 inch particle board core door and drawer face, base, wall, and tall cabinet tops and bottoms, cabinet sides, drawer spreaders, structural dividers, and cabinet backs.
 - 2) 1/2 inch particle board core drawer body and drawer bottoms.
 - b. Fastening Methods:
 - 1) All fixed components permanently assembled with dowel connectors, with additional support at these locations:
 - a) Vertical dividers to be mechanically fastened through the cabinet back at no more than 24 inches on center.
 - b) Wall cabinet bottoms to be mechanically fastened at no more than 24 inches on center, via castle mortise or pocket screw method, so screw heads do not protrude.
 - c. Cabinet Body:
 - 1) Fully housed 4 sides.
 - 2) Back-pinned.
 - 3) Provide 3/4-inch-thick stiffeners glued and fastened to back/body as specified herein.
 - 4) Back perimeter and stiffeners to be fully sealed with hot melt adhesive.
 - 5) Hang rails:
 - a) Glue to rear of cabinet back and adhesive fasten to cabinet sides.
 - b) Provide minimum of two (2) at base, two (2) at wall, and three (3) at tall cabinets.
 - d. Tops and Bottoms:
 - 1) Exterior exposed wall cabinet bottoms shall be matching TFL.
 - 2) Solid sub-top shall be furnished for all base and tall cabinets, except sink cabinets.
 - 3) Sink cabinets to have full width doweled in place spreader, with sink clearance. Clips or other mechanical type fasteners are not permitted, unless used to strengthen the spreader.
 - e. End Panels:
 - 1) Exposed exterior cabinet ends shall be matching TFL.
 - 2) Holes drilled for adjustable shelves 1 1/4 inch on center.

- f. Backs:
- 1) Cabinet back to be full 11/16 inch back panel mechanically fastened to top and bottom depending on final assembly methods, and shall be fully bound into sides, top, and bottom.
 - 2) Sink Cabinets: Rear hang rails shall be doweled to cabinet end panels. Provide minimum of two (2) at base.
 - 3) Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on the Drawings.
 - 4) Exposed exterior backs shall be matching TFL.
- g. Shelves:
- 1) 3/4 inch thick up to 36 inches in length, 1 inch thick over 36 inches in length.
 - 2) Fixed shelves to be securely fastened to end panels and/or dividers during the manufacturing process. Locations as indicated on the Drawings or as defined by manufacturer model number. Field applied fasteners or clips to create a fixed shelf are not permitted.
- h. Vertical and Horizontal Dividers:
- 1) Secured in cabinet with dowels and mechanical fasteners.
- i. Drawer Spreaders:
- 1) Provide minimum 3/4 inch x 4 inch x full width cabinet body rails immediately behind all door/drawer horizontal joints to maintain exact body dimensions, close off reveal, and be locator for lock strikes.
- j. Drawers:
- 1) Drawer sides shall be doweled and glued to receive front and back, machine squared and held under pressure to set.
 - 2) Drawer bottom shall be fully bound into front, sides, and back. Routing, in drawer body for bottom, shall receive glue. Reinforce drawer bottoms with 1/2 inch x 4 inch side to side intermediate under body stiffeners.
 - 3) Drawer fronts shall be applied to separate drawer body component sub-front.
- k. Door / Drawer Front Rail:
- 1) Provide minimum 3/4 inch by 6 inch by full width cabinet body rails immediately behind all door/drawer and multiple drawer horizontal joints to maintain exact body dimensions, close off reveal, and be locator for lock strikes.
- l. Door and Drawer Fronts;
- 1) Laminated door and drawer fronts shall be 3/4 inch finished thickness for all hinged and sliding doors. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum of 1/8 inch reveal between pairs of doors (dependent on hinge selection), between door and drawer front, at bottom of cabinet, or between multiple drawer fronts within the cabinet. Maximum 1/4 inch reveal at top of base cabinets to the underside of the countertop.
 - 2) Stile and Rail doors shall be 3/4 inch thick, medium density fiberboard with machined exposed interior frame. All exposed light-opening edges shall be finished with black paint and sealed.

- 3) Exposed lite-opening edges to be trimmed and glazed with extruded vinyl glazing bead.
 - 4) Frameless sliding glass doors to be 1/4-inch-thick plate glass with ground and polished edges; fitted with anodized aluminum shoes and nylon rollers.
- m. Cabinet Base / Toe Kick:
- 1) Each base and tall cabinet to have factory applied ladder base system unless noted otherwise on the Drawings. Material is to be plywood.
 - 2) Full length ladder base system is acceptable provided it is factory assembled to the size requirements for each location, for field placement, leveling and securing.
 - 3) Base to be leveled and floor-mounted prior to cabinet body placement.
 - 4) No cabinet sides-to-floor will be allowed.
 - 5) Attach to cabinet with concealed fastening.
- n. Filler panels and Scribes:
- 1) Laminated filler panels shall be 3/4 inch thick and made from the same material as the cabinet end panels.
 - 2) Color to match cabinet door and drawer front color, vertical grain.
 - 3) Fillers to be oversized in width and field cut as necessary to provide a tight fit between the cabinet and wall.

C. Workmanship:

1. Cabinet parts shall be accurately machined and bored to ensure consistent sizing.
2. All cases shall be square, plumb, and true.

2.5 PLASTIC LAMINATE COUNTERTOPS

A. Plastic Laminate Countertops:

1. Provide high-pressure plastic laminate bonded to particle board core.
2. Furnish countertops with edge treatment and design profile as shown on the Drawings.
3. Provide tops in as long as practical continuous lengths.
4. Provide heavy gage neutral colored backing sheet for balanced construction.
5. Provide mechanical fasteners at splines and joints. No joints closer than 24 inches either side of sink cutout unless conditions do not allow.
6. No splines or joints are to occur over open areas below and are to be fully supported by casework. No ledger strips or other supports at open areas are allowed.
7. Unsupported spans are not to exceed 48 inches without brackets or blocking. Provide prefinished steel support brackets as required.
8. Sink Cutouts:
 - a. Rout cutouts for drop-in sinks forming openings to mount minimum 3/8 inch deep supporting flanges flush to the work surface.
 - b. Rout and sand cutouts for under-mounted sinks or machine polish to form smooth edged openings with the top edge radius of 1/8 inch. Finish bottom edge of sink opening smooth with the edge broken to prevent sharpness.

- c. Sink corner cutout radius to be not less than 1/4 inch.
 - d. Provide drip groove where indicated.
 - B. Countertop Accessories:
 - 1. Grommets:
 - a. Provide round, nylon grommets with removable cap, 2 1/2 inch diameter. Cap to include cord slot.
 - b. Number of grommets and locations as indicated on the Drawings.
 - c. Color as selected by E/A from manufacturer's full range of colors.
 - 2. Joint Sealant: 1 part polyurethane.
 - C. Prefinished steel support brackets:
 - 1. Bracket to support countertop where there is no base cabinet.
 - 2. Adjustable countertop support brackets.
 - a. Fixed or flexible rail-mounted with integral wire management and leveling pad.
 - b. Undercounter support frames, suitable for support of countertop depth shown. Prefinish with 2 coats of epoxy paint, color as selected by E/A (black or white).
 - c. Locate as indicated by Drawings, or if not indicated, 2'-8" on center.
- 2.6 ADJUSTABLE PLASTIC LAMINATE SHELVING SYSTEM
- A. Shelves: 1 inch thick x 12 inch deep plastic laminate finished particle board core, with 3 mm PVC edging. Refer to Drawings for number, locations, and lengths. Color as selected by E/A from manufacturer's full range of colors.
 - B. Shelf Standards: Heavy-duty 12 gauge steel, 7/8 inch face width. Finish as selected by E/A from manufacturer's full range of finishes.
 - C. Adjustable Shelf Brackets: Super-duty steel adjustable bracket to match shelf standards. Finish as selected by E/A from manufacturer's full range of finishes.
- 2.7 COAT RACK SHELVING
- A. Shelving: 1 inch thick x 12 inch deep plastic laminate finished particle board core, with 3 mm PVC edging. Refer to drawings for number, locations, and lengths. Color as selected by E/A from manufacturer's full range of colors.
 - B. Brackets: Fixed heavy duty steel shelf and rod support bracket. Finish as selected by E/A from manufacturer's full range of finishes.
 - C. Coat Rod: Stainless steel heavy duty 1 1/16 inch OD tubing, with end caps. Finish as selected by E/A from manufacturer's full range of finishes.
- 2.8 ACCESSORIES
- A. Other materials not specifically described but required for complete, proper installation of manufactured casework, subject to acceptance of E/A.
- 2.9 FINISHES
- A. Plastic Laminate Casework:
 - 1. Standard finish vertical surface laminate from casework manufacturer's full range of colors consisting of wood grain patterns and solid colors, including premium colors.
 - 2. Minimum of 200 selections available.
 - 3. E/A may select up to 4 different colors available per project.

- B. Countertops:
 - 1. Plastic Laminate: Color as selected from manufacturer's full range of patterns and solid colors, including premium colors.
 - 2. Stainless Steel: No. 4 satin finish.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that manufactured casework may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies:
 - 1. Immediately notify E/A in writing.
 - 2. Do not proceed with installation in areas of discrepancy until fully resolved.
 - 3. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.
- B. Sequence of Operations: Install after painting, wet work, grinding and similar operations, which can be performed before installation, are completed.
- C. Prior to delivery, casework representative is to verify that the job site conditions as required by this section have been established. Work is not to proceed until conditions are acceptable.
- D. Prior to installation, casework and countertops are to be conditioned to the average prevailing humidity levels of the building.
- E. Coordination:
 - 1. Layout and installation of blocking and reinforcement in partitions for support of casework.
 - 2. Locations of utilities that will penetrate countertops or backsplashes.

3.3 INSTALLATION

- A. Plastic Laminate Clad Casework:
 - 1. Install casework using factory-trained personnel experienced in installation of this type of equipment.
 - 2. Install casework level, plumb, true, and straight. Shim as required including base/toe kick assemblies.
 - 3. Use concealed shims.
 - 4. Align and secure all adjoining cabinets to each other, and to wall via in wall blocking or direct if masonry or other type of solid wall is present.
 - 5. Securely anchor in place.
 - 6. Scribe and closely fit to adjacent work.
 - 7. Provide filler strips, scribe strips, and moldings in finish to match cabinet face.
 - 8. Cut and fit work around pipes, ducts, etc.
 - 9. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind.
 - 10. Adjust joinery for uniform appearance.

B. Plastic Laminate Clad Countertops

1. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64 inch difference between planes of adjacent units.
2. Fasten countertops to base units by anchoring through cabinet braces at front and back and into underside of countertop at 18 to 24 inches on center. Shim as needed to align sub tops in a level plane.
3. Where seams are prepped to receive wood biscuits and compression bolts, lay countertop upside down, use wood glue to secure wood biscuits and draw countertops tight, place compression bolts in routs and tighten.
4. Install all splashes, supports and grommets as shown on manufacturer's drawings, and as required in this section.
5. Install backsplashes and end splashes by adhering to wall and countertops with 100-percent silicone material in dab format (not bead format) at 6 to 8 inches on center.
6. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
7. Seal all joints between countertops, splashes, and walls with clear acrylic caulk (refer to Section 07 92 00 - Joint Sealants).

- C. Accessory Installation: Install accessories and fittings according to manufacturer's recommendations. Turn screws to seat flat; do not drive.

3.4 REPAIR/RESTORATION

- A. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance, using materials, procedures recommended or furnished by manufacturer.

3.5 ADJUSTING

- A. Adjust all hardware to manufacturer specifications to ensure smooth operation.
- B. Adjust all doors and drawers as required to maintain uniform reveals.

3.6 CLEANING

- A. Site:
1. Do not allow accumulation of scraps, debris arising from work of this section.
 2. Maintain premises in neat, orderly condition.
- B. System:
1. Clean exposed and semi-exposed surfaces of manufactured casework using materials and methods recommended by manufacturer.
 2. Leave surfaces clean and free from defects at time of final acceptance.

3.7 DEMONSTRATION

- A. Deliver any keys, as-built drawings, warranty information, or other materials that were shipped with casework and countertops to the Owner.
- B. Maintenance Instructions: Manufacturer's representative to schedule and attend meeting with Owner's Representative to explain:
1. Maintenance and Care Instructions.
 2. Recommended Maintenance Program.
 3. Warranty Requirements.

END OF SECTION 12 30 00

SECTION 12 48 43 – Floor Mats and Frames

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide entrance mats and recessed frames.
- B. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 09 30 00 - Porcelain Tile

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM B 221-93 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
- B. ASTM A 276-92 Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
- C. AAMA 606.1 Voluntary Guide Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum
- D. AAMA 607.1 Voluntary Guide Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.

1.4 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings: Show layout and types of grates and frames of typical installations, details of patterns or designs, anchors, and accessories, and field measurements of slab recess to receive frames grates (if applicable).
- D. Samples:
 - 1. Initial Color Selection: Submit manufacturer's standard color samples for each type of finish with Product Data and Shop Drawings.
 - 2. Color Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics.
 - 3. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components including 12-inch lengths of frame members if requested by E/A.
- E. Maintenance Manual: Provide to Owner maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion; include manufacturer's printed instructions for cleaning, drying, maintaining, rehandling.

1.5 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide floor mat systems units made of components of standard construction furnished by 1 manufacturer as coordinated assemblies.

- B. Qualifications:
 - 1. Manufacturer: 5 years' experience in the manufacture of floor mat systems, with 6 projects of similar size, scope and type of which 3 have been in successful use for 3 years or longer.
 - 2. Contractor: 3 years' experience in the installation of floor mat systems.
 - 3. Personnel: For actual installation of floor mat systems, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Protection: Protect floor mat systems from damage during shipment, storage, and construction.
 - B. Delivery: Do not deliver to Site until the building is enclosed or other enclosed storage is available. Deliver materials to the job site in factory sealed containers bearing the manufacturer's name and brand.
 - C. Damaged Material: Replace damaged material prior to acceptance at no additional cost to Owner.
- 1.7 WARRANTY
 - A. Provide manufacturer's standard warranty.
- 1.8 MAINTENANCE
 - A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 – PRODUCTS

- 2.1 MANUFACTURERS
 - A. Standard of Quality: Unless indicated otherwise design is based on products of Babcock –Davis, Brooklyn Park, MN www.babcockdavis.com
 - B. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
 - 1. J.L. Industries www.activarcpg.com
 - 2. MATS Inc, Braintree, MA www.matsinc.com
 - 3. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.
- 2.2 ENTRANCE FLOOR MATS AND FRAMES - GENERAL
 - A. Accessibility Standard: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
- 2.3 MATERIALS AND FABRICATION
 - A. Roll-Up Rail Mats:
 - 1. QuietFLEX Roll-up, LDPE-Hinged Mats:
 - 2. Extruded-aluminum tread rails 2 inches on center by 3/8-inch-thick sitting on continuous vinyl cushions.
 - 3. Tread Inserts
 - a. Premium Carpet:
 - 1) 3700 denier, solution-dyed, woven nylon fibers.
 - 2) Minimum of 100, 10 mil monofilament fibers per square inch.

- 3) Each Carpet fiber and monofilament shall be fusion-bonded to a rigid two-ply backing to prevent fraying and supplied in continuous spliced-free lengths.
 - 4) Fibers shall be treated with anti-stain and anti-static additives.
 - b. Rugged Scrub crimped solution-dyed 600 denier polypropylene fibers tufted into a woven double backing and mechanically secured to tread rails.
 - c. Brush: Brush made with rigid nylon bristles, 9 tufts per inch, each tuft containing 80 bristles.
 - d. Serrated Aluminum: Plain serrated aluminum treads.
 - e. Recycled Rubber: Ecotread recycled rubber with a SC of 90 manufactured with recycled rubber and EPDM backing.
 - f. Ribbed Rubber: TPV, dual durameter rubber insert with convex and continuous serrations.
- 4. Colors, Textures, and Patterns of Inserts: As selected by Architect from full range of industry colors.
- 5. Rail Color: As selected by Architect from full range of industry colors.
- 6. Hinges: LDPE.
- 7. Structural Performance: Wheel load of 300 lb (136 kg) per wheel
- 8. Mat Size: As indicated on the Drawings.
- 9. Frame:
 - a. Recessed Frames
 - 1) LBC: Level-bed, cast-in-place 6063-T5 aluminum frame.
 - 2) Color: As selected by Architect from full range of industry colors and color densities.
 - b. Surface-Mounted Frames:
 - 1) Tapered Ramp Frames: SAM; Mechanically fastened, tapered 6063-T5 aluminum frame with mitered corners.
 - 2) Tapered Ramp Frames: SV; Tapered vinyl frame.
- B. Other Materials: Other materials not specifically described but required for complete, proper installation of floor mat systems, subject to acceptance of E/A.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to the point where this installation may properly commence.
- B. Verification of Conditions: Verify that floor mat systems may be installed according to original design, pertinent codes and regulations, pertinent portions of referenced standards, and manufacturer's recommendations.
- C. Discrepancies: Immediately notify E/A in writing. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.
- B. Install product when no further wheeled construction traffic will occur and wet type operations including painting and decorating are complete.

3.3 INSTALLATION

- A. Comply with manufacturer's instructions, at locations indicated, with top of frames in proper relationship to adjoining finished flooring. Coordinate top of mat surfaces with doors that swing across mats, to provide under door clearance.
- B. Provide necessary shims, spacers, and anchorages for proper location and secure attachment of frames to concrete.
- C. Clean dirt and debris from frame recess before installing floor system.

3.4 REPAIR/RESTORATION

- A. Touch up marred finishes but replace units that cannot be restored to factory-finished appearance. Use materials, procedures recommended or furnished by manufacturer.

3.5 ADJUSTING

- A. Adjust the top surface of assembly to be flush with adjacent finishes.

3.6 CLEANING

- A. Site: Do not allow accumulation of scraps or debris arising from the work of this Section. Maintain premises in neat, orderly condition.
- B. System: Clean exposed surfaces of floor mat systems using materials and methods recommended by manufacturer.

3.7 DEMONSTRATION

- A. Maintenance Instructions: Manufacturer's Representative to schedule and attend meeting with Owner's Representatives to explain:
 - 1. Maintenance and Care Instructions.
 - 2. Recommended Maintenance Program.
 - 3. Warranty Requirements.

3.8 PROTECTION

- A. Protection: After frame installations and concrete work completed, provide temporary filler of plywood or fiberboard in mat recesses, cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and the project is near time of substantial completion.

3.9 SCHEDULES

- A. Coordinate size and location of mats with tile contractor. Refer to the Drawings.

<u>Room</u>	<u>Size (Nominal Dimensions)</u>
Public Vestibule - 100	10'-0" x 7'-0"
Vestibule - 101C	4'-0 x 5'-0"
Vestibule - 102A	10'-0" x 10'-0"
Vestibule - 102H	8'-0" x 11'-0"

END OF SECTION 12 48 43

SECTION 12 50 00 – Furniture

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Open wire metal shelving.
 - 2. Boltless metal storage shelving.
 - 3. Stainless steel tables.
 - 4. Steel cart.

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections details of components, joint locations and configurations within system and between system and adjoining system. Include locker numbering sequence information.
- D. Samples:
 - 1. Initial Color Selection: Submit manufacturer's standard color samples for each type of finish with Product Data and Shop Drawings.
 - 2. Color Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics. Include notification to E/A if selection is not within specified price range.
 - 3. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components if requested by E/A.
- E. Maintenance Manual: Provide to Owner maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide products made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of toilet accessories.
 - 2. Contractor: 3 years experience in the installation of toilet accessories.
 - 3. Personnel: For actual installation of toilet accessories, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of Work.
- C. Field Samples: If requested, furnish sample of each type of products to E/A for review prior to manufacture/installation. E/A will forward approved sample to the Site for installation.
- D. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.5 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.6 WARRANTY

- A. Provide manufacturer's standard warranty.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Furnishings:

1. Standard of Quality: Unless otherwise indicated, design is based on products of Uline, Pleasant Prairie, WI www.uline.com
2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Safco, New Hope, MN www.safcoproducts.com
 - b. Little Giant, University Park, IL www.littlegiant-usa.com
 - c. Aero, Clifton, NJ www.aeromfg.com
 - d. InterMetro Industries Corporation, Wilkes-Barre, PA www.metro.com
 - e. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 FURNISHINGS SCHEDULE

A. Open Wire Metal Shelving (S-1):

1. Model H-2945-86 and H-2946-86 by Uline
2. Size: 36 inches x 24 inches x 86 inches; and 48 inches x 24 inches x 86 inches.
3. Shelf Capacity: 800 lbs.
4. Shelves: 4.
5. Quantity: Refer to Drawings.

B. Boltless Metal Storage Shelving (S-2):

1. Model H-5187 and H-5189 by Uline
2. Size: 36 inches x 24 inches x 84 inches; and 48 inches x 24 inches x 84 inches.
3. Shelf Capacity: 400 lbs. and 300 lbs.
4. Shelves: 5.
5. Quantity: Refer to Drawings.

C. Stainless Steel Tables (WT-1):

1. Model H-5000 and H-8450 by Uline.
2. Size: 60 inches x 30 inches; and 36 inches x 30 inches.
3. Capacity: 600 lbs.
4. Gauge: 16.
5. Shelves: 1.
6. Quantity: 2.

D. Steel Cart (SC-1):

1. Model H-3037 by Uline.
2. Size: 42 inches x 24 inches x 35 inches.

3. Shelves: 1.
4. Capacity: 1,200 lbs. load.
5. Quantity: 2.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that products may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. Protection: Protect installed work and materials of other trades.

3.3 INSTALLATION

- A. General Requirements:
 1. Install plumb, true, square in neat, rigid, substantial manner.

3.4 ADJUSTING AND CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from Work of this Section. Maintain premises in neat, orderly condition.

END OF SECTION 12 50 00

SECTION 12 51 70 – Technical Furniture

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Workstations, including but not limited to:
 - a. Dual surface, curved, height-adjustable desks.
 - b. Individual surface lift motor.
 - c. Adjustable monitor rack.
 - d. Acoustical panel system.
 - e. CPU storage cabinet.
 - f. Cable management system.
 - g. Data and power circuits for each station.
 - 2. File cabinets/Personal Storage.
 - 3. Revolving storage tower.
- B. Related Sections:
 - 1. Section 09 69 00 - Access Flooring
 - 2. Division 26 - Electrical
 - 3. Division 27 - Communications

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. ASTM:
 - 1. C423-08 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 2. E84 - Test for Surface Burning Characteristics of Building Materials.
- B. ANSI HFES 100-2007 – Human Factors Engineering of Computer Workstations.
- C. Underwriters Laboratories (UL)

1.4 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Shop Drawings: Submit Shop Drawings showing system fabrication, installation drawings, including plans, elevations, sections details of components, joint locations and configurations within system and between system and adjoining system. Include locker numbering sequence information.
- D. Samples:
 - 1. Initial Color Selection: Submit manufacturer's standard color samples for each type of finish with Product Data and Shop Drawings.

2. Color Verification: Prior to shipping, submit each type of finish indicated; in sets for each color, texture, and pattern specified, showing a full range of variations expected in these characteristics. Include notification to E/A if selection is not within specified price range.
 3. Components: Submit samples of anchors, fasteners, hardware, assembled corner sections and other materials and components if requested by E/A.
 - E. Maintenance Manual: Provide to Owner maintenance and warranty data in "Maintenance Manual" at Maintenance Demonstration at Substantial Completion.
- 1.5 QUALITY ASSURANCE
- A. Single Source Responsibility: Provide systems furniture made of components of standard construction furnished by one manufacturer as coordinated assemblies.
 - B. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.
- 1.6 PROJECT CONDITIONS
- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.
- 1.7 WARRANTY
- A. Provide manufacturer's standard warranty.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Product:
 1. Standard of Quality: Unless otherwise indicated, design is based on products of Xybix Systems, Inc., Littleton, CO www.xybix.com
 2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Evans Consoles, Calgary, Canada www.evansonline.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 COMPONENTS

- A. Workstation
 1. The workstation shall meet ergonomic requirements of the work environment of ANSI/HFES 2007-100.
 2. The workstation shall be of a modular design to allow flexibility in configuration, either as part of cluster, continuous row, or as a standalone unit. Major components shall have the ability to be reused in future configurations where possible.
 3. The workstation will meet ADA clearance requirements.
 4. The workstation shall be adjustable using floor levelers in order to account for inconsistencies in the floor surface to ensure proper leveling.
 5. Height-Adjustable desk
 - a. Desk to have automated sit/stand capability through an electric drive system. No physical demands shall be placed on the user for this functionality.

- b. Desk to use heavy duty electro-mechanical columns, which are capable of compensating for differential loading from side to side, to prevent racking or damage to the structure.
 - 1) Surface to be capable of supporting 500 lbs. of static weight.
 - 2) Desk to have an additional lifting capacity of 360 lbs.
 - c. The work surface height range shall be from 22 inches to 47.7 inches above finish floor.
 - B. File Cabinet / Personal Storage
 - 1. Sizes and configurations as indicated on the Drawings.
 - C. Revolving Storage Cabinet
 - 1. Cabinet shall hold two rows of books and binders, and shall be capable of rotating when completely full.
 - 2. Sizes as indicated on the Drawings.
- 2.3 MATERIALS
 - A. Monitor arc shall be made of steel or aluminum and be sturdy enough to support the monitors.
 - B. Panel System
 - 1. Base frame to be 14 gauge powder coated steel.
 - 2. Panels to be connected with steel bolt fasteners.
 - 3. Panel System Tiles (covers):
 - a. 22 gauge galvanneal steel.
 - C. Desk Surface:
 - 1. Medium density fiberboard (MDF).
 - 2. Thickness: 1".
 - 3. Plastic laminate on both sides and edging.
 - D. Under-surface supports: 1" x 1 1/2" steel tubing.
 - E. Lift Columns:
 - 1. Steel
 - 2. Steel connections.
 - F. Cabinets:
 - 1. Thermofoil board.
 - 2. Thickness: 3/4 inch.
 - 3. Edging: 3-D laminate or 1 mil edge banding.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that systems furniture may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

- A. General: Follow manufacturer's written instructions for installation of each type of item specified.
- B. Remove components that are chipped, scratched, or otherwise damaged and which do not match adjoining work. Replace with new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- C. Protection: Protect installed work and materials of other trades.

3.3 INSTALLATION

- A. General Requirements:
 - 1. Install plumb, true, square in neat, rigid, substantial manner.

3.4 REPAIR/RESTORATION

- A. Touch up marred finishes, but replace units that cannot be restored to factory-finished appearance. Use materials, procedures recommended or furnished by manufacturer.

3.5 ADJUSTING

- A. Adjust units to operate in proper manner and easily without binding and provide a visually acceptable installation.

3.6 CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from Work of this Section. Maintain premises in neat, orderly condition.
- B. Immediately upon completion of installation, clean components and surfaces. Remove surplus materials, rubbish and debris resulting from installation upon completion of work and leave areas of installation in neat, clean condition.

3.7 DEMONSTRATION

- A. Schedule and conduct demonstration of installed accessory items and features with Owner's personnel.
- B. Schedule and conduct maintenance training with Owner's maintenance personnel. Training session should include lecture and demonstration of all maintenance and repair procedures that end user personnel would normally perform.

3.8 PROTECTION

- A. Protect system against damage during remainder of construction period. Advise Owner of additional protection needed to ensure that system will be without damage or deterioration at time of substantial completion.

END OF SECTION 12 51 70

SECTION 12 93 00 – Site Furnishings

PART 1 – GENERAL

1.1 SUMMARY

- A. Provide:
 - 1. Precast concrete cigarette snuffers.

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 SUBMITTALS

- A. Refer to the Division 1 Specifications.
- B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.
- C. Samples:
 - 1. Initial Color Selection: Submit manufacturer's standard color samples for each type of finish, color, texture, and pattern with Product Data and Shop Drawings.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide precast concrete cigarette snuffers made of components of standard construction furnished by one manufacturer as coordinated assemblies.
- B. Qualifications:
 - 1. Manufacturer: 5 years experience in the manufacture of site furnishings.

1.5 PROJECT CONDITIONS

- A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.6 PRODUCT STORAGE, DELIVERY, AND HANDLING

- A. All shipping, storage, and delivery costs for equipment furnished by the site furnishings supplier.
- B. Do not deliver site furnishings until authorized by the General Building Contractor. Verify storage areas with the contractor prior to delivery. Verify delivery route and building access prior to fabrication or installation.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Precast Concrete Cigarette Snuffers
 - 1. Standard of Quality: Unless otherwise indicated, design is based on products of Wausau Tile, Inc., Wausau, WI www.wausautile.com

2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - a. Petersen Manufacturing, Denison, IA www.petersenmfg.com
 - b. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 PRODUCTS

- A. Precast Concrete Cigarette Snuffers
 1. Number and location as indicated on the Drawings.
 2. Description:
 - a. 14 inch square x 34 inch high, reinforced precast concrete pyramid shaped smokeless concrete snuffer.
 - b. Granitex surface texture, with galvanized pan and stainless steel access door.
 - c. Inkjet logo.
 3. Product: Model TF2052.
 4. Color and finish to be selected by E/A from manufacturer's full range.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
- B. Verification of Conditions: Verify that site furnishings may be installed according to original design, pertinent codes and regulations, and pertinent portions of referenced standards.
- C. Discrepancies: Immediately notify E/A. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 INSTALLATION

- A. General Requirements:
 1. Install plumb, true, square in neat, rigid, substantial manner.

3.3 ADJUSTING AND CLEANING

- A. Site: Do not allow accumulation of scraps, debris arising from Work of this Section. Maintain premises in neat, orderly condition.
- B. Repair minor abrasions and imperfections in finishes with coating that matches factory-applied finish.
- C. Protect site furnishings against damage during the remainder of construction period, complying with manufacturer's directions.

END OF SECTION 12 93 00

END OF DIVISION 12 - FURNISHINGS

DIVISION 14 – CONVEYING EQUIPMENT

TABLE OF CONTENTS

Section	Title
14 24 00	Machine Room-less Hydraulic Passenger Elevators
END OF INDEX	

SECTION 14 24 00 – Machine Room-less Hydraulic Passenger Elevators

PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes: Machine room-less hydraulic passenger elevators as shown and specified. Elevator work includes:
 - 1. Standard pre-engineered hydraulic passenger elevators.
 - 2. Elevator car enclosures, hoistway entrances and signal equipment.
 - 3. Operation and control systems.
 - 4. Jack(s).
 - 5. Accessibility provisions for physically disabled persons.
 - 6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
 - 7. Materials and accessories as required to complete the elevator installation.
- B. Related Sections:
 - 1. Division 1 General Requirements: Meet or exceed all referenced sustainability requirements.
 - 2. Division 3 Concrete: Installing inserts, sleeves and anchors in concrete.
 - 3. Division 4 Masonry: Installing inserts, sleeves and anchors in masonry.
 - 4. Division 5 Metals:
 - a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
 - b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
 - 5. Division 9 Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
 - 6. Division 16 Sections:
 - a. Providing electrical service to elevators, including fused disconnect switches where permitted. (note: fused disconnect switch to be provided as part of elevator manufacture product, see section 2.11 Miscellaneous elevator components for further details.)
 - b. Emergency power supply, transfer switch and auxiliary contacts.
 - c. Heat and smoke sensing devices.
 - d. Convenience outlets and illumination in control room (if applicable), hoistway and pit.
 - 7. Division 22 Plumbing
 - a. Sump pit and oil interceptor.

8. Division 23 Heating, Ventilation and Air Conditioning
 - a. Heating and ventilating hoistways and/or control room.
- C. Work Not Included: General contractor shall provide the following according to the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Part 3 for hydraulic elevators. State or local requirements must be used if more stringent.
 1. Elevator shaft construction, dimensions, and all related work, are based on the product identified as the Basis of Design. General contractor shall immediately notify the architect of any changes from the Basis of Design, and is responsible for any and all associated engineering and design costs related to said change.
 2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.
 3. Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point.
 4. Elevator hoistways shall have barricades, as required.
 5. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
 6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.
 7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.
 8. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.
 9. All wire and conduit should run remote from the hoistways.
 10. When heat, smoke or combustion sensing devices are required, connect to elevator control cabinet terminals. Contacts on the sensors should be sided for 12 volt D.C.
 11. Install and furnish finished flooring in elevator cab.
 12. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained when drywall construction is used.
 13. Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.
 14. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.
 15. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.
 16. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.
 17. General Contractor shall fill and grout around entrances, as required.
 18. All walls and sill supports must be plumb where openings occur.
 19. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.

20. Provide telephone line, light fixture (200 lx / 19 fc), and convenience outlet in the hoistway at the landing where the elevator controller is located. Typically, this will be at the landing above the 1st floor. Final location must be coordinated with elevator contractor.
21. As indicated by elevator contractor, provide a light outlet for each elevator, in center of hoistway.
22. For signal systems and power operated door: provide ground and branch wiring circuits.
23. For car light and fan: provide a feeder and branch wiring circuits to elevator control cabinet.
24. Controller landing wall thickness must be a minimum of 8 inches thick. This is due to the controller being mounted on the second floor landing in the door frame on the return side of the door. For center opening doors, the controller is located on the right hand frame (from inside the elevator cab looking out). These requirements must be coordinated between the general contractor and the elevator contractor.
25. Cutting, patching and recesses to accommodate hall button boxes, signal fixtures, etc.

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 SUBMITTALS

- A. Product data: When requested, the elevator contractor shall provide standard cab, entrance and signal fixture data to describe product for approval.
- B. Shop drawings:
 1. Show equipment arrangement in the corridor, pit, and hoistway and/or optional control room. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
 2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
 3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
 4. Indicate electrical power requirements and branch circuit protection device recommendations.
- C. Powder Coat paint selection: Submit manufacturer's standard selection charts for exposed finishes and materials.
- D. Plastic laminate selection: Submit manufacturer's standard selection charts for exposed finishes and materials.
- E. Metal Finishes: Upon request, standard metal samples provided.
- F. Operation and maintenance data. Include the following:
 1. Owner's manuals and wiring diagrams.
 2. Parts list, with recommended parts inventory.
- G. Preinstallation Meetings: Installer and manufacturer's technical representative shall meet with E/A prior to the start of installation.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: An approved manufacturer with minimum 15 years of experience in manufacturing, installing, and servicing elevators of the type required for the project.
 - 1. The manufacturer of machines, controllers, signal fixtures, door operators cabs, entrances, and all other major parts of elevator operating equipment.
 - a. The major parts of the elevator equipment shall be manufactured by the installing company, and not be an assembled system.
 - 2. The manufacturer shall have a documented, on-going quality assurance program.
 - 3. ISO-9001:2000 Manufacturer Certified
 - 4. ISO-14001:2004 Environmental Management System Certified
 - 5. LEED Gold certified elevator manufacturing facility.
- B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than 15 years of satisfactory experience installing elevators equal in character and performance to the project elevators.
- C. Regulatory Requirements:
 - 1. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
 - 2. Building Code: National.
 - 3. NFPA 70 National Electrical Code.
 - 4. NFPA 80 Fire Doors and Windows.
 - 5. Americans with Disabilities Act - Accessibility Guidelines (ADAAG)
 - 6. Section 407 in ICC A117.1, when required by local authorities
 - 7. CAN/CSA C22.1 Canadian Electrical Code
 - 8. CAN/CSA B44 Safety Code for Elevators and Escalators.
 - 9. California Department of Public Health Standard Method V1.1–2010, CA Section 01350
- D. Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory (2 hour label in Canada).
- E. Inspection and testing:
 - 1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
 - 2. Arrange for inspections and make required tests.
 - 3. Deliver to the Owner upon completion and acceptance of elevator work.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Manufacturing shall deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

1.6 PROJECT CONDITIONS

- A. Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

1.7 WARRANTY

- A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months after final acceptance.

1.8 MAINTENANCE

- A. Furnish maintenance and call back service for a period of 3 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.
 - 1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.
 - 2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
 - 3. Manufacturer shall have a service office and full time service personnel within a 100 mile radius of the project site.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Design is based on products of ThyssenKrupp Elevator, Atlanta, GA; Model: endura MRL, www.tkelevator.com
 - 1. Elevator shaft construction, dimensions, and all related work, are based on the product identified as the Basis of Design. General contractor shall immediately notify the architect of any changes from the Basis of Design, and is responsible for any and all associated engineering and design costs related to said change.
- B. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
 - 1. Otis Elevator Company, Farmington, CT www.otis.com
 - 2. Manufacturer of comparable products submitted in compliance with the Division 1 Specifications.

2.2 MATERIALS, GENERAL

- A. All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD, and shall meet the California Department of Public Health Standard Method V1.1–2010, CA Section 01350 as mentioned in 1.03.9 of this specification.
- B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.
- C. Steel:
 - 1. Shapes and bars: Carbon.
 - 2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
 - 3. Finish: Factory-applied baked enamel for structural parts, powder coat for architectural parts. Color selection must be based on elevator manufacture's standard selections.
- D. Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050" thickness. Laminate selection must be based on elevator manufacture's standard selections.
- E. Flooring by others.

2.3 HOISTWAY EQUIPMENT

- A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood sub-floor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.
- B. Sling: Steel stiles bolted or welded to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.
- C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.
- D. Guides: Slide guides shall be mounted on top and bottom of the car.
- E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.
- F. Jack: A jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to ensure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type: Twin post holeless telescopic 3-stage. Two jacks piped together, mounted one on each side of the car with each having three telescopic sections designed to extend in a synchronized manner when oil is pumped into the assembly. Each jack section will be guided from within the casing or the plunger assembly used to house the section. Each plunger shall have a high pressure sealing system which will not allow for seal movement or displacement during the course of operation. A follower guide shall be furnished for the top of the lower two plungers and be guided by rollers running inside a steel guide channel which is firmly attached to the guide rail system. This plunger guide system shall maintain a stabilized support for the plunger sections. Each jack assembly shall have check valves built into the assembly to allow for automatically re-syncing the three plunger sections by moving the jack to its fully contracted position.
- G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for over travel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.
- H. Wiring, Piping, and Oil: Provide all necessary hoistway wiring according to the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit.
- I. Pit moisture/water sensor located approximately 1 foot above the pit floor to be provided. Once activated, elevator will perform "flooded pit operation", which will run the car up to the designated floor, cycle the doors and shut down and trip the circuit breaker shunt to remove 3 phase power from all equipment, including pit equipment.
- J. Motorized oil line shut-off valve shall be provided that can be remotely operated from the controller landing service panel. Also a means for manual operation at the valve in the pit is required.

2.4 POWER UNIT

- A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit located in the elevator pit consisting of the following items:
 - 1. NEMA 4/Sealed Oil reservoir with tank cover including vapor removing tank breather.
 - 2. An oil hydraulic pump.
 - 3. An electric motor.
 - 4. Electronic oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.

- B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.
- C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating – motors shall be capable of 80 starts per hour with a 30% motor run time during each start.
- D. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
 - 1. Relief valve shall be adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.
 - 2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
 - 3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
 - 4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.
 - 5. Provided with constant speed regulation in both up and down direction. Feature to compensate for load changes, oil temperature, and viscosity changes.
 - 6. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.
 - 7. A secondary hydraulic power source (powered by 110VAC single phase) must be provided. This is required to be able to raise (reposition) the elevator in the event of a system component failure (i.e. pump motor, starter, etc.)
 - 8. Oil Type: Provide a zinc free, inherently biodegradable lubricant formulated with premium base stocks to provide outstanding protection for demanding hydraulic systems, especially those operating in environmentally sensitive areas.

2.5 HOISTWAY ENTRANCES

- A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
 - 1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware.
 - 2. Main landing door and frame finish: ASTM A1008 steel panels, factory applied powder coat finish.
 - 3. Typical door and frame finish: ASTM A 366 steel panels, factory applied powder coat finish.
- B. Integrated Control System: the elevator controller to be mounted to hoistway entrance above 1st landing. The entrance at this level, shall be designed to accommodate the control system and provide a means of access to critical electrical components and troubleshooting features. See section 2.09 Control System for additional requirements.
- C. At the controller landing, the hoistway entrance frame shall have space to accommodate and provide a lockable means of access (group 2 security) to a 3 phase circuit breaker. See section 2.11 Miscellaneous Elevator Components for further details.
- D. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.

- E. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway horizontal sliding door.
 - 1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
 - 2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
 - 3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.
- F. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.

2.6 PASSENGER ELEVATOR CAR ENCLOSURE

- A. Car Enclosure:
 - 1. Walls: Cab type a laminate wall design, durable wood core finished on both sides with high pressure plastic laminate.
 - 2. Reveals and frieze: Not applicable.
 - 3. Canopy: Cold-rolled steel with hinged exit.
 - 4. Ceiling: Suspended type, LED lighting with translucent diffuser mounted in a metal frame. Framework shall be finished with a factory applied powder coat finish.
 - 5. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with No. 4 brushed stainless steel.
 - 6. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
 - a. Door Finish: Stainless steel panels: No. 4 brushed finish.
 - b. Cab Sills: Extruded aluminum, mill finish.
 - 7. Handrail: Provide 1.5" diameter cylindrical metal on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, No. 4 brushed finish.
 - 8. Ventilation: Manufacturer's standard exhaust fan, mounted on the car top.
 - 9. Protection pads and buttons: Provide one set of vinyl protection pads with metal grommets for the project. Provide pad buttons on cab front(s) and walls.
- B. Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection" switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station shall give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.7 DOOR OPERATION

- A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.

1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
 2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
 3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel shall reverse and the door shall reopen to answer the other call.
 4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.
 5. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.
 6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.
 7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.
 8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.
- B. Door Protection Device: Provide a door protection system using microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.8 CAR OPERATING STATION

- A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Wrap return shall have a No. 4 brushed stainless steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED's shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.
- B. Emergency Communications System: Integral phone system provided.
- C. Auxiliary Operating Panel: Not Required
- D. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.
- E. Special Equipment: Limited Access Operation: Keyswitch and card reader space (card reader by others).

2.9 CONTROL SYSTEMS

- A. Controller: Shall be integrated in a hoistway entrance jamb. Should be microprocessor based, software oriented and protected from environmental extremes and excessive vibrations in a NEMA 1 enclosure. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.
- B. Service Panel – to be located outside the hoistway in the controller entrance jamb and shall provide the following functionality/features:
 - 1. Access to main control board and CPU
 - 2. Main controller diagnostics
 - 3. Main controller fuses
 - 4. Universal Interface Tool (UIT)
 - 5. Remote valve adjustment
 - 6. Electronic motor starter adjustment and diagnostics
 - 7. Operation of pit motorized shut-off valve with LED feedback to the state of the valve in the pit
 - 8. Operation of auxiliary pump/motor (secondary hydraulic power source)
 - 9. Operation of electrical assisted manual lowering
 - 10. Provide male plug to supply 110VAC into the controller
 - 11. Run/Stop button
- C. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.
- D. Emergency Power Operation: Full automatic operation (Simplex 10-D4A) Upon loss of the normal power supply, building-supplied standby power is available to the elevator on the same wires as the normal power. Once the loss of normal power has been detected and standby power is available, the elevator is lowered to a pre-designated landing and will open the doors. After passengers have exited the elevator, the doors are closed. At this time the elevator is automatically allowed to continue service using the building-supplied standby power.
- E. Special Operation: Limited Access Operation: A key switch shall be provided to initiate the Limited Access Operation. The activation of this operation shall restrict the operation of the elevator car calls to selected floors on a per-floor, per elevator basis. Travel to the restricted floors shall be allowed after the entry of the required access code via a card reader device supplied by others. The card reader entry shall override the car call restrictions and allow entry of a car call to a restricted floor.

2.10 HALL STATIONS

- A. Hall Stations, General: Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction.
 - 1. Provide one pushbutton riser with faceplates having a No. 4 brushed stainless steel finish.
 - a. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.
- B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.
- C. Hall Position Indicator: Not Applicable
- D. Hall lanterns: Not Applicable
- E. Special Equipment: Not Applicable

2.11 MISCELLANEOUS ELEVATOR COMPONENTS

- A. Oil Hydraulic Silencer: Install multiple oil hydraulic silencers (muffler device) at the power unit location. The silencers shall contain pulsation absorbing material inserted in a blowout proof housing.
- B. Lockable three phase circuit breaker with auxiliary contact with shunt trip capability to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb and should be sized according to the National Electrical Code.
- C. Lockable single phase 110V circuit breaker for cab light and fan to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb should be sized according to the National Electrical Code

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.2 INSTALLATION

- A. Install elevator systems components and coordinate installation of hoistway wall construction.
 - 1. Work shall be performed by competent elevator installation personnel according to ASME A17.1, manufacturer's installation instructions and approved shop drawings.
 - 2. Comply with the National Electrical Code for electrical work required during installation.
- B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.
- C. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.
- D. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.
- E. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the contractor, to ensure dimensional coordination of the work.
- F. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.
- G. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.
- H. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.
- I. Lubricate operating parts of system, where recommended by manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.
- B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.4 ADJUSTING

- A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.5 CLEANING

- A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces according to manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; it shall not be cleaned with bleach-based cleansers.
- B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.
 - 1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.

3.6 PROTECTION

- A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

3.7 DEMONSTRATION

- A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.
- B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.

3.8 ELEVATOR SCHEDULE

- A. Elevator Qty. 1
 - 1. Elevator Model: enduraMRL Above-Ground (3-Stage)
 - 2. Elevator Type: Hydraulic Machine Room-Less, Passenger
 - 3. Rated Capacity: 3500 lbs.
 - 4. Rated Speed: 100 ft./min.
 - 5. Operation System: TAC32H
 - 6. Travel: 14'-0"
 - 7. Landings: 2 total
 - 8. Openings:
 - a. Front: 2
 - b. Rear: 0
 - 9. Clear Car Inside: 6' - 8" wide x 5' - 5 1/2" deep
 - 10. Cab Height: 8'-0" standard

11. Hoistway Entrance Size: 3' - 6" wide x 7'-0" high
12. Door Type: Side sliding, Single Speed
13. Power Characteristics: 460 volts, 3 Phase, 60 Hz.
14. Seismic Requirements: Zone 1
15. Hoistway Dimensions: 8' - 8" wide x 7' - 10 3/4" deep
16. Pit Depth: 5' - 0"
17. Button and Fixture Style: Traditional Signal Fixtures
18. Special Operations: Limited Access with card readers by others.

END OF SECTION 14 20 00

END OF DIVISION 14 – CONVEYING EQUIPMENT

DIVISION 22 – PLUMBING

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SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.1 SCOPE

- A. This section includes information common to two or more technical plumbing specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Lead Free Requirements
 - 6. Federal Bidding Requirements
 - 7. Quality Assurance
 - 8. Protection of Finished Surfaces
 - 9. Sleeves and Openings
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 1. Access Panels and Doors
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 11. Identification
 12. Lubrication
 13. Sleeves and Openings
 14. Sealing and Fire Stopping
 15. Agency Training
- 1.2 RELATED WORK
 - A. Section 07 84 00 – Fire Stopping
- 1.3 REFERENCE
 - A. Applicable provisions of Division 1 govern work under this section.
 - B. This section applies to all Division 22 00 00 sections of plumbing.
- 1.4 REFERENCE STANDARDS
 - A. Abbreviations of standards organizations referenced in this and other sections are as follows:
 - ABMA American Boiler Manufacturers Association
 - ACPA American Concrete Pipe Association
 - AGA American Gas Association
 - AMCA Air Movement and Control Association
 - ANSI American National Standards Institute
 - ARI Air Conditioning and Refrigeration Institute
 - ASME American Society of Mechanical Engineers
 - ASPE American society of Plumbing Engineers
 - ASSE American Society of Sanitary Engineering

ASTM American Society for Testing and Materials
 AWWA American Water Works Association
 AWS American Welding Society
 CISPI Cast Iron Soil Pipe Institute
 CGA Compressed Gas Association
 CS Commercial Standards, Products Standards Sections, Office of Eng. Standards Service, NBS
 DSPS State of Wisconsin Dept. of Safety and Professional Services, State Plumbing Code
 EPA Environmental Protection Agency
 FS Federal Specifications, Superintendent of Documents, U.S. Government Printing Office
 GAMA Gas Appliance Manufacturers Association
 IAPMO International Association of Plumbing & Mechanical Officials
 IEEE Institute of Electrical and Electronics Engineers
 ISA Instrument Society of America
 MCA Mechanical Contractors Association
 MICA Midwest Insulation Contractors Association
 MSS Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
 NBS National Bureau of Standards
 NEC National Electric Code
 NEMA National Electrical Manufacturers Association
 NFPA National Fire Protection Association
 NSF National Sanitation Foundation
 PDI Plumbing and Drainage Institute
 SMACNA Sheet Metal and Air Conditioning Contractors' National Association, Inc.
 STI Steel Tank Institute
 UL Underwriters Laboratories Inc.

B. Standards referenced in this section:

ACI 614 Recommended Practice for Measuring, Mixing and Placing of Concrete
 ASTM D1557 Standard Test Method for Moisture-Density Relations of Soils
 ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops
 ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
 D.O.T. Standard Specifications for Road and Bridge Construction, State of Wisconsin, Dept. of Transportation
 UL1479 Fire Tests of Through-Penetration Firestops
 UL723 Surface Burning Characteristics of Building Materials

1.5 LEAD FREE REQUIREMENTS

- A. All materials that contact potable water shall be lead free. Lead free refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per the Federal Safe Drinking Water Act as amended January 4, 2011, Section 1417.
- B. This requirement applies to all the subsequent Plumbing Specification Sections and Plumbing Drawings and supersedes any part or model number that may conflict with this requirement.

1.6 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.7 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.
- B. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.
- C. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed.

1.8 PROTECTION OF FINISHED SURFACES

- A. Refer to Division 1, General Requirements, Protection of Finished Surfaces.

1.9 SLEEVES AND OPENINGS

- A. Refer to Division 1, General Requirements, Sleeves and Openings.

1.10 SEALING AND FIRE STOPPING

- A. Sealing and firestopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section 07 84 00 Fire Stopping.

1.11 OFF SITE STORAGE

- A. Prior approval by DOT and the A/E will be needed. The contractor shall submit Storage Agreement Form for consideration of off site materials storage. Generally, sleeves, pipe/pipe fittings and similar rough-in material will not be accepted for off site storage. No material will be accepted for off site storage unless shop drawings for the material have been approved.

1.12 CODES

- A. Comply with requirements of Wisconsin Administrative Code.

1.13 CERTIFICATES AND INSPECTIONS

- A. Refer also to Division 1, General Conditions, Permits, Regulations, Utilities and Taxes.
- B. Obtain and pay for all required State installation inspections except those provided by the Architect/Engineer. Deliver the originals of inspection certificates and test records to the Owner's Project Representative. Include copies of the certificates and test records in the Operating and Maintenance Instructions.

1.14 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Shop drawing submittals are to be bound, labeled, contain the project manual cover page and a material index list page showing item designation, manufacturer and additional items supplied with the installation. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Include wiring diagrams of electrically powered equipment.
- C. The specific items that will be required for submittals shall be coordinated with the DOT Project Representative, the A/E, and the General Prime Contractor for inclusion in the project submittal log.
- D. Submit sufficient quantities of data sheets and shop drawings to allow the following distribution:
 - Operating and Maintenance Manuals 2 copies
 - Architect/Engineer 1 copy

1.15 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.
- B. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:
 - 1. Records of tests performed to certify compliance with system requirements
 - 2. Manufacturer's wiring diagrams for electrically powered equipment
 - 3. Certificates of inspection by regulatory agencies
 - 4. Valve schedules
 - 5. Lubrication instructions, including list/frequency of lubrication
 - 6. Parts lists for fixtures, equipment, valves and specialties.
 - 7. Manufacturers installation, operation and maintenance recommendations for fixtures, equipment, valves and specialties.
 - 8. Additional information as indicated in the technical specification sections

1.16 TRAINING OF OWNER PERSONNEL

- A. Instruct user agency personnel in the proper operation and maintenance of systems and equipment provided as part of this project. Include not less than 2 hours of instruction, using the Operating and Maintenance manuals during this instruction. Demonstrate startup, operation and shutdown procedures for all equipment. All training to be during normal working hours. Video record all instructions and provide Owner with copy.

1.17 RECORD DRAWINGS

- A. Refer to Division 1, General Requirements, Record Drawings.

PART 2 - PRODUCTS

2.1 ACCESS PANELS AND DOORS

- A. LAY-IN CEILINGS: Removable lay-in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Section 09500 are sufficient; no additional access provisions are required unless specifically indicated.
- B. CONCEALED SPLINE CEILINGS: Removable sections of ceiling tile held in position with metal slats or tabs compatible with the ceiling system used will be provided under Section 09500.

- C. METAL PAN CEILINGS: Removable sections of ceiling tile held in position by a pressure fit will be provided under Section 09500.
- D. MASONRY WALLS, GYPSUM BOARD AND PLASTER WALLS AND CEILINGS: 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch for general applications, key lock for use in public or secured areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the item needing service; minimum size is 12" by 12".

2.2 IDENTIFICATION

- A. STENCILS: Not less than 1 inch high letters/numbers for marking pipe and equipment.
- B. ENGRAVED NAME PLATES: White letters on a black background, 1/16 inch thick plastic laminate, beveled edges, screw mounting, Setonply Style 2060 by Seton Name Plate Company or Emedolite Style EIP by EMED Co., or equal by W. H. Brady.
- C. ADHESIVE LABELS: Pressure-sensitive, adhesive backed, vinyl pipe markers with applicable labeling, 3/4" min. size for lettering and surrounding tape on both ends. With flow arrows on piping. Conforming to ANSI, ANSI and NFPA standards. Seton Opti-Code, MSI, Brady or approved equal. Clean piping before application.
- D. SNAP-AROUND PIPE MARKERS: One-piece, preformed, vinyl construction, snap-around or strap-around pipe markers with applicable labeling and flow direction arrows, 3/4" min. size for lettering. Provide nylon ties on each end of pipe markers. Equal to Seton Setmark.
- E. VALVE TAGS: Round brass tags with 1/2 inch numbers, 1/4 inch system identification abbreviation, 1-1/4 inch minimum diameter, with brass jack chains, brass "S" hooks or one piece nylon ties around the valve stem, available from EMED Co., Seton Name Plate Company, or W. H. Brady.
- F. UNDERGROUND WARNING TAPE: Detectable underground warning tape, 5.0 mil overall thickness, 6" width, .0035" thick aluminum foil core with polyethylene jacket bonded to both sides. Color code tape and print caution along with name of buried service in bold letters on face of tape. Thor Enterprises Magnatec or equal by Carlton, MSI Marking Services, Seton.
- G. UNDERGROUND TRACER WIRE: All underground non-metallic sewers/mains and water services/mains shall be provided with tracer wire installations. Tracer wire installations shall conform with Section 182.0715(2r) of Wisconsin Statutes and prevailing DSPS Chapter 384 requirements. Tracer wire shall be continuous solid copper or steel plastic coated with split bolt or compression-type connectors.

2.3 BEDDING AND BACKFILL

- A. Bedding up to a point 12" inches above the top of the pipe shall be thoroughly compacted sand or crushed stone chips meeting the following gradations:

<u>Gradation for Bedding Sand</u>		<u>Gradation for Crushed Stone Chip Bedding</u>	
<u>Sieve Size</u>	<u>% Passing (by Wt)</u>	<u>Sieve Size</u>	<u>% Passing (by Wt)</u>
1 inch	100	1/2 inch	100
No. 16	45 - 80	No. 4	75 - 100
No. 200	2 - 10	No. 100	10 - 25

- B. Backfill above the bedding in lawn areas shall be thoroughly compacted excavated material free of large stones, organic, perishable, and frozen materials.
- C. Backfill above the bedding under existing and future utilities, paving, sidewalks, curbs, roads and buildings shall be granular materials, pit run sand, gravel, or crushed stone, free from large stones, organic, perishable, and frozen materials.

2.4 SEALING AND FIRE STOPPING

- A. FIRE AND/OR SMOKE RATED PENETRATIONS: Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section 07 84 00 "Fire Stopping".
- B. NON-RATED PENETRATIONS:
 - 1. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated pipe and the cored opening or a water-stop type wall sleeve. The operating bolts of the mechanical type seal shall be accessible from the interior of the building.
 - 2. At pipe penetrations of non-rated interior partitions, floors and exterior walls, use urethane caulk in annular space between pipe insulation and sleeve. For non-rated drywall, plaster or wood partitions where sleeve is not required use urethane caulk in annular space between pipe insulation and wall material

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL

- A. Perform all excavation and backfill work necessary to accomplish indicated plumbing systems installation. Excavate to bottom of pipe and structure bedding, 4" in stable soils, 6" in rock or wet trenches and 8" in unstable soil. Finish bottoms of excavations to true, level surface.
- B. At no time place excavated materials where they will impede surface drainage unless such drainage is being safely rerouted away from the excavation.
- C. Excavate whatever materials are encountered as required to place at the elevations shown, all pipe, manholes, and other work. Remove debris and rubbish from excavations before placing bedding and backfill material.
- D. Remove surplus excavated materials from site.
- E. Verify the locations of any water, drainage, gas, sewer, electric, telephone or steam lines which may be encountered in the excavation. Underpin and support all lines. Cut off service connections encountered which are to be removed at the limits of the excavation and cap.
- F. Provide and maintain all fencing, barricades, signs, warning lights, and/or other equipment necessary to keep all excavation pits and trenches and the entire subgrade area safe under all circumstances and at all times. No excavation shall be left unattended without adequate protection.
- G. Elevations shown on the plans are subject to such revisions as may be necessary to fit field conditions. No adjustment in compensation will be made for adjustments up to two (2) feet above or below the grades indicated on the plans.
- H. Install lines passing under foundations with minimum of 1-1/2 inch clearance to concrete and ensure there is no disturbance of bearing soil.
- I. Bed pipe up to a point 12" above the top of the pipe. Take care during bedding, compaction and backfill not to disturb or damage piping.
- J. Mechanically compact bedding and backfill to prevent settlement. The initial compacted lift to not exceed 24" compacted to 95% density per Modified Proctor Test (ASTM D-1557). Subsequent lifts under pavements, curbs, walks and structures are not to exceed 12" and be compacted to 95% density per Modified Proctor Test. In all other areas where construction above the excavation is not anticipated within 2 years, mechanically compact backfill in lifts not exceeding 24" to 90% density per Modified Proctor Test. Route the equipment over each lift of the material so that the compaction equipment contacts all areas of the surface of the lift.

3.2 SHEETING, SHORING AND BRACING

- A. Provide shoring, sheet piling and bracing in conformance with the Wisconsin Administrative Code to prevent earth from caving or washing into the excavation. Shore and underpin to properly support adjacent or adjoining structures. Abandon in place shoring, sheet piling and underpinning below the top of the pipe, or, if approved in advance by the engineer, maintained in place until other permanent support approved by the engineer is provided.

3.3 DEWATERING

- A. Provide, operate and maintain all pumps and other equipment necessary to drain and keep all excavation pits, trenches and the entire subgrade area free from water under all circumstances. Obtain general permit from the Wisconsin Department of Natural Resources district office for discharge of construction dewatering effluent. Obtain well permit from the Wisconsin Department of Natural Resources district office for dewatering wells discharging more than 70 GPM. Comply with permit requirements.

3.4 ROCK EXCAVATION

- A. Remove rock encountered in the excavation to a minimum dimension of six (6) inches outside the pipe. Rock excavation includes all hard, solid rock in ledges, bedded deposits and unstratified masses, all natural conglomerate deposits so firmly cemented as to present all the characteristics of solid rock; which material is so hard or so firmly cemented that in the opinion of the engineer it is not practical to excavate and remove same with a power shovel except after thorough and continuous drilling and blasting. Rock excavation includes rock boulders of $\frac{1}{2}$ cubic yard or more in volume.
- B. Rock excavation will be computed on the basis of the depth of rock removed and a trench width 2 feet larger than the outside diameter of the pipe where one pipe is laid in the trench and 3 feet larger than the combined outside diameter where two pipes are laid in the trench. Include 6" pipe and structure bedding in rock excavation. Include rock excavation shown on the plans in the Base Bid.

3.5 SURFACE RESTORATION

- A. Completely restore the surface of all disturbed areas to a like condition of the surface prior to the work. Level off all waste disposal areas and clean up all areas used for the storage of materials or the temporary deposit of excavated earth. Remove all surplus material, tools and equipment.

3.6 CONCRETE WORK

- A. Cast-in-place concrete within the building will be performed by the Division 3 Contractor unless otherwise noted. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for support or installation of plumbing piping, fixtures, specialties and equipment. Coordinate locations of equipment, pipe penetrations in wet areas, etc. with the Division 3 Contractor.
- B. Plumbing related cast-in-place concrete on the exterior of the building to be provided by this contractor in conformance with requirements of Division 3. This includes piping thrust restraints, pipe supports, hydrant supports, manholes, catch basins, grease traps, septic tanks, distribution boxes, valve pits, meter pits, cleanout cover pads, yard hydrant pads, etc.

3.7 CUTTING AND PATCHING

- A. Refer to Division 1, General Requirements, Cutting and Patching.

3.8 BUILDING ACCESS

- A. Arrange for the necessary openings in the building to allow for admittance or removal of all apparatus. When the building access was not previously arranged and must be provided by this contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.9 EQUIPMENT ACCESS

- A. Install all piping, conduit and accessories to permit access to equipment for maintenance and service. Coordinate the exact location of wall and ceiling access panels and doors with the General Prime Contractor, making sure that access is available for all equipment and specialties. Access doors in general construction are to be furnished by the Plumbing Contractor and installed by the General Prime Contractor.
- B. Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which do not require access panels.

3.10 COORDINATION

- A. Coordinate all work with other contractors prior to installation. Any work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
- B. Verify that all devices are compatible for the type of construction and surfaces on which they will be used.

3.11 IDENTIFICATION

- A. Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one coat of black enamel against a light background or white enamel against a dark background. Use a primer where necessary for proper paint adhesion.
- B. Where stenciling is not appropriate for equipment identification, engraved name plates may be used.
- C. Identify interior piping not less than once every 20 feet, not less than once in each room, adjacent to each access door or panel, and on both side of the partition where accessible piping passes through walls or floors. Place flow directional arrows at each pipe identification location. Use one coat of black enamel against a light background or white enamel against a dark background.
- D. Identify all exterior buried piping for entire length with underground warning tape except for sewer piping which is routed in straight lines between manholes or cleanouts. Place tape 6"-12" below finished grade along entire length of pipe. Extend tape to surface at building entrances, meters, hydrants and valves. Where existing underground warning tape is broken during excavation, replace with new tape identifying appropriate service and securely spliced to ends of existing tape.
- E. Identify valves with brass tags bearing a system identification and a valve sequence number. Identify medical gas and vacuum valves with brass tags and wall or cabinet mounted color coded engraved nameplate with the following "(Type of Gas) Shutoff Valve for (Location or Zone)". Valve tags are not required at a terminal device unless the valves are greater than ten feet from the device, located in another room or not visible from device. Provide a typewritten valve schedule and pipe identification schedule indicating the valve number and the equipment or areas supplied by each valve and the symbols used for pipe identification; locate schedules in mechanical room and in each Operating and Maintenance manual. Schedule in mechanical room to be framed under clear plastic.

3.12 LUBRICATION

- A. Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is operated for any reason. Once the equipment has been run, maintain lubrication according to the manufacturer's instructions until the work is accepted by the Owner. Maintain a log of all lubricants used and frequency of lubrication; include this information in the Operating and Maintenance Manuals at the completion of the project.

3.13 SLEEVES AND OPENINGS

- A. Pipe penetrations in new poured concrete horizontal construction requiring F and T rating: Form opening using hole form or core drill opening. Alternatively provide cast in place fire stopping devices/sleeves.
- B. Pipe penetrations in new poured concrete horizontal construction requiring F rating but no T rating: Same as pipe penetrations in new poured concrete construction requiring F and T ratings except that schedule 40 steel sleeves may also be used.

- C. Pipe penetrations in new poured concrete horizontal construction that do not require F or T ratings: Provide schedule 40 steel pipe sleeve, form opening using hole form or core drill opening.
- D. Pipe penetrations in existing concrete floors: Core drill openings.
- E. Where penetrating pipe or conduit weight is supported by floor, provide manufactured product or structural bearing collar designed to carry load.

3.14 SEALING AND FIRE STOPPING

- A. FIRE AND/OR SMOKE RATED PENETRATIONS: Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with section 07 84 00 Fire Stopping.
- B. NON-RATED PARTITIONS:
 - 1. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe and tighten in place, according to manufacturer's instructions. . The bolt heads for the mechanical seal shall face the inside of the building to facilitate repair or replacement of the seal.
 - 2. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.
- C. PENETRATIONS SUBJECT TO WATER INTRUSION:
 - 1. For penetrations (both rated and non-rated) in floors subject to water intrusion or in rooms housing electrical equipment (but not within walls) provide one of the following:
 - Pipe penetration where steel pipe sleeve is used extend steel sleeve 2" above the floor.
 - Pipe penetration where cast in place fire stopping device/sleeve is used, extend device/sleeve 2" above the floor (provided it meets the device's UL listing).
 - Pipe penetration where there is no steel sleeve or cast in place fire stopping device/sleeve, provide 2"x 2" x 1/8" galvanized steel angles fastened to floor surrounding the penetration or group of penetrations to prevent water from getting to penetration. Provide urethane caulk between angles and floor and fasten angles to floor minimum 8" on center. Seal corners water tight with urethane caulk.
 - 2. Floors subject to water intrusion or rooms housing electrical equipment include the following locations:
 - Restrooms
 - Janitor Rooms w/ Sinks
 - Mechanical/Plumbing Equipment Rooms
 - Vehicle Storage
 - Data/Telecommunications Rooms
 - Electrical Equipment Rooms
 - 3. Provide waterproof caulk sealant top coating on fire stopping system (or other approved means to protect the fire stopping system from water) in areas subject to wash down such as Food Service and Dish Washing Areas.

3.15 AGENCY TRAINING

- A. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 2 hours.

END OF SECTION 22 05 00

SECTION 22 05 14 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes specifications for floor drains, roof drains, cleanouts, backflow preventers, water hammer arrestors and other miscellaneous plumbing specialties.
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Documents
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Shop Drawings
 - 8. Operation and Maintenance Data
- C. PART 2 - PRODUCTS
 - 1. Floor Drains
 - 2. Open Site/Hub Drains
 - 3. Roof Drains
 - 4. Trench Drains
 - 5. Cleanouts
 - 6. Water Hammer Arrestors
 - 7. Backflow Preventers
 - 8. Wall Hydrants
 - 9. Hose Bibbs
 - 10. Garage Catch Basins
 - 11. Safings
 - 12. Vent Flashings
- D. PART 3 - EXECUTION
 - 1. Installation

1.2 RELATED DOCUMENTS

- A. Section 22 08 00 – Commissioning of Plumbing
- B. Section 22 11 00 - Facility Water Distribution C. Section 22 13 00 - Facility Sanitary Sewerage D. Section 22 14 00 - Facility Storm Drainage

1.3 REFERENCE

- A. Applicable provisions of Division 1 shall govern work under this section.

1.4 REFERENCE STANDARDS

- A. ANSI A112.14.1 - Backwater Valves
- B. ANSI A112.21.1 - Floor Drains.
- C. ANSI A112.21.2 - Roof Drains.
- D. ANSI A112.26.1/PDI WH-201 Water Hammer Arrestors.
- E. ASSE 1001 - Pipe Applied Atmospheric Type Vacuum Breakers.
- F. ASSE 1010 - Water Hammer Arrestors.

- G. ASSE 1011 - Hose Connection Vacuum Breakers.
- H. ASSE 1012 - Backflow Preventers with Intermediate Atmospheric Vent.
- I. ASSE 1013 - Reduced Pressure Principle Backflow Preventers.
- J. ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining, Anti-Backflow Type.

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.
- B. Plumbing products requiring approval by the State of Wisconsin Dept. of Safety and Professional Services must be approved or have pending approval at the time of shop drawing submission.

1.7 SHOP DRAWINGS

- A. Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

1.8 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS

- A. Manufacturer: Josam, Smith, Wade, Watts, Zurn.
 - 1. FD 1: 3" min. (2" min. for single shower drains) enameled cast iron two piece body with double drainage flange, weep holes, reversible clamping adjustable collar, adjustable 6"x6" min. square or round polished nickel bronze strainer with threaded collar, bottom outlet with the addition of the trap guard diaphragm called out below. Zurn ZN-415-S or B.
 - 2. FD 2: 3" enameled heavy duty cast iron two piece body with double drainage flange, weep holes, heavy duty adjustable round coated cast iron grate strainer, bottom outlet with the addition of the trap guard diaphragm called out below. Zurn ZN-415-B-HD.
- B. Trap Guards
 - 1. Manufacturer: ProSet Systems Trap Guard, JR Smith Quad Close, Sure Seal or approved equal.
 - 2. Flexible elastomeric PVC construction diaphragm trap guard for installation in new and existing floor drains, hub drains, and trench drains. Trap guard to prevent trap evaporation and waste backflow. Size as applicable to the drain outlet size, up to 4" size.

2.2 OPEN SITE/HUB DRAINS

- A. Manufacturer: Josam, Smith, Wade, Watts, Zurn.
 - 1. OS-1: cast iron hub section up 2" min. above floor level, with full-sized P-trap with the addition of the trap guard diaphragm called out above.

2. OS-2: min. enameled cast iron bottom outlet floor drain body with membrane clamp, adjustable collar and 3" high extension adapter (less threads on inlet) with the addition of the trap guard diaphragm called out above. Zurn Z-415-U (modified). (For use on above grade installations.) .

2.3 ROOF DRAINS

A. Manufacturer: Josam, Smith, Wade, Watts, Zurn.

1. RD 1: 4" min. bottom outlet roof drain, enameled cast iron body with flashing collar and gravel stop, cast iron dome strainer, adjustable extension, underdeck clamp, 15" diameter. Zurn ZC-100-C-EA

2.4 TRENCH DRAINS

A. Manufacturer: Aco, Josam, Neenah, Smith, Tyler, Watts, Zurn.

1. TD 1: Modular precast polymer concrete, cast iron or polyester fiberglass trench sections with presloped 4" wide radiused interior waterways, knockouts, endcaps, cast iron frame and slotted ductile iron grate, extra heavy duty rated, stainless steel grate holdowns.

2.5 CLEANOUTS

A. Manufacturer: Josam, Smith, Wade, Watts, Zurn.

1. FCO-1: Enameled cast iron body with round or square adjustable scoriated polished nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400- / ZN-1400-T.
2. FCO-2: Enameled cast iron body with round adjustable scoriated nickel bronze heavy duty cover, tapered threaded ABS closure plug. Zurn ZN-1400-HD.
3. WCO-1: Line type cleanout tee with tapered threaded ABS cleanout plug, round polished stainless steel access cover secured with machine screw. Zurn Z-1446- (Note: Screw shall not pass completely through the ABS plug, trim screw as necessary)
4. CO: Line type cleanout tee with tapered threaded ABS closure plug. Zurn Z-1445.

2.6 WATER HAMMER ARRESTORS

A. Manufacturer: PPP Industries, Sioux Chief, Wade, Watts.

B. ANSI A112.26.1, ASSE 1010; sized according to PDI WH 201, precharged piston type constructed of hard drawn Type K copper, threaded brass adapter, brass piston with o-ring seals, FDA approved silicone lubricant, suitable for operation in temperature range 35 to 150 degrees F, maximum 250 psig working pressure, 1500 psig surge pressure. Watts series 15.

2.7 BACKFLOW PREVENTERS

A. Manufacturers: Beeco, Cla-Val, Conbraco, Febco, Watts, Wilkins.

B. HOSE CONNECTION VACUUM BREAKERS: ASSE 1011, brass or bronze construction, EPDM diaphragm and seat, rated for 125 psig and 180oF. Watts 8 (interior application).

C. LAB FAUCET VACUUM BREAKERS: ASSE 1035, brass or bronze construction, chrome plated, EPDM diaphragm and seat, stainless steel internals, rated for 125 psig and 160oF. Watts NLF9.

D. PIPE APPLIED ATMOSPHERIC TYPE VACUUM BREAKERS: ASSE 1001, same size as pipe, brass or bronze construction, silicone disc, rated for 125 psig and 160oF. Watts 288A.

E. ANTI-SIPHON PRESSURE TYPE VACUUM BREAKERS: ASSE 1020, same size as pipe, brass or bronze construction, silicone disc, plastic seat, stainless steel spring, inlet and outlet ball shutoff valves, test port ball valves, rated for 150 psig and 110oF. Watts 800M4QT

- F. REDUCED PRESSURE ZONE BACKFLOW PREVENTERS: ASSE 1013 ½" reduced pressure zone backflow assembly complete with inlet strainer, inlet and outlet ball or non-rising stem gate isolation valves. Constructed of bronze or epoxy coated cast iron body with bronze and plastic internal parts, stainless steel springs, non-threaded vent outlet, 4 test cocks, rated for 175 psig and 210oF, with air gap apparatus on drain. Watts series 919-S-QT-AG, Wilkins #975 or approved equal.

2.8 WALL HYDRANTS

- A. Manufacturer: Josam, Smith, Wade, Watts, Woodford, Zurn.
 - 1. WH-1: Freezeproof automatic draining wall hydrant with exposed chrome plated bronze wall plate, ¾" inlet, ¾" hose thread ASSE 1019-93 backflow preventer outlet, copper or bronze casing, loose key operator. Woodford model 67 series

2.9 HOSE BIBBS

- A. HB-1: Bronze or brass construction hose faucet/valve, cast iron handwheel, replaceable disc, hose thread spout, with ASSE 1011 backflow preventer outlet, ¾" size. Watts model SC-8-3.

2.10 GARAGE CATCH BASINS

- A. Fiberglass basin, minimum code size 36 inch diameter x 48 inch deep. Provide push grommet, matching pipe size and number of inlets and outlet piping. Conforms to State of Wisconsin Uniform Plumbing code. See Schedule.
- B. Provide 6 inch pre-cast riser ring x 44 inch diameter with 27 inch round opening. Neenah Foundry Co. R-2540.

2.11 SAFINGS

- A. Manufacturers: Noble, Oatey.
- B. Chlorinated polyethylene sheeting, 40 mils thick, ASTM D4068, joined with CPE solvent; or 3 lb./sq. ft. sheet lead.

2.12 VENT FLASHINGS

- A. Manufacturers: Semco, Oatey.
- B. Formed 3 lb./sq. ft. lead flashing with minimum base size of 15"x17".
- C. Single Ply Membrane Roofs: Flashing boot of material compatible with roofing membrane with base flange for adhering to membrane and stainless steel drawband for securing to vent pipe.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate location and setting of plumbing specialties with adjacent construction. Install according to manufacturers recommendations.
- B. Set floor drains, roof drains, trench drains and cleanouts level and plumb adjusted to finished floor elevation, roof elevation or finished wall location. Locate where serviceable. Allow minimum of 18" clearance around cleanouts for rodding. Lubricate threaded cleanout plugs with graphite and oil, teflon tape or waterproof grease. Install trap primer connections where indicated. Provide deep seal traps on floor drains and hub drains installed in mechanical rooms, penthouses or rooms with excessive positive or negative pressure.
- C. Install water hammer arrestors where indicated and at quick closing valve installations.
- D. Install backflow preventers according to Wis. Dept. of Safety and Professional Services requirements maintaining minimum clearance distances for servicing and testing. Provide indirect waste piping with air gap installation from relief opening to above hub drain or floor drain.
- E. Install lab faucet vacuum breakers with Loctite 242 "blue" on threads.

- F. Where backflow preventers requiring Dept. of Safety and Professional Services registration are installed, provide initial registration, testing and report filing required by Dept. of Safety and Professional Services. List the name and address of the building that the backflow preventer installations occur in.
- G. Mount wall hydrants recessed in exterior wall construction with valve plug extended beyond interior side of building insulation. Slope to drain to exterior. Install so discharge is 18" min. above finished grade. Set wall box in grout or caulk and fill exterior wall penetration with insulation.
- H. Mount hose bibbs securely fastened to wall where indicated. Provide water hammer arrestor in line to hose bibb.
- I. Install safing at floor drains above grade. Extend 12" beyond drains in all directions. Cover entire floor in showers and extend 6" up in walls above curbs and to a height of 6' (3" wide each direction) in corners. Install on concrete floor that is smooth and free of debris. Seal all joints and connect to drain body clamp. Safing is subject to standing water leak test. Install safing at all built-up shower installations. (Note: spray-on and brush applied liquid safing is not acceptable).
- J. Flash vent penetrations through roof. Turn down top of lead flashing into vent pipe. Tighten drawband of membrane boot to vent pipe. Adhere base flashing to deck or membrane. Provide waterproof patch around penetration on existing roofs.

END OF SECTION 22 05 14

SECTION 22 05 15 - PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SCOPE

- A. This section contains specifications for plumbing piping specialties for all piping systems. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Shop Drawings
 - 8. Operation and Maintenance Data
 - 9. Design Criteria
- C. PART 2 - PRODUCTS
 - 1. Thermometers
 - 2. Thermometer Sockets
 - 3. Pressure Gauges
 - 4. Strainers
- D. PART 3 - EXECUTION
 - 1. Thermometers
 - 2. Thermometer Sockets
 - 3. Pressure Gauges
 - 4. Strainers

1.2 RELATED WORK

- A. Section 22 11 00 - Facility Water Distribution
- B. Section 22 13 00 - Facility Sanitary Sewerage
- C. Section 22 14 00 - Facility Storm Drainage
- D. Section 22 05 23 - General-Duty Valves for Plumbing Piping
- E. Section 22 07 00 - Plumbing Insulation
- F. Section 22 30 00 - Plumbing Equipment

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ASTM B650 Electrodeposited Engineering Chromium Coatings on Ferrous Substrates

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.

1.7 SHOP DRAWINGS

- A. Required for all items in this section. Include materials of construction, dimensional data, ratings/capacities/ranges, approvals, test data, pressure drop data where appropriate, and identification as referenced in this section and/or on the drawings.

1.8 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.9 DESIGN CRITERIA

- A. All piping specialties are to be rated for the highest pressures and temperatures in the respective system according to ANSI B31, but not less than 125 psig unless specifically indicated otherwise.

PART 2 - PRODUCTS

2.1 THERMOMETERS

- A. Ashcroft, Marsh, Taylor, H. O. Trerice, Ametek/U. S. Gauge, Weiss, Wika, Weksler.
- B. Stem Type: Cast aluminum case, nine inch scale, clear acrylic window. adjustable angle brass stem with stem of sufficient length so the end of the stem is near the middle of a pipe without reducing the thickness of any insulation, red indicating fluid, black lettering against a white background, with scale ranges as follows:

Service	Hot Water
Scale Range, oF	30 - 180
Increment, oF	2

2.2 THERMOMETER SOCKETS

- A. Brass with threaded connections suitable for thermometer stems and temperature control sensing elements in pipeline. Furnish with extension necks for insulated piping systems.

2.3 PRESSURE GAUGES

- A. Ametek/U. S. Gauge, Ashcroft, Marsh, Taylor, H. O. Trerice, Weiss, Wika, Weksler.
- B. Cast aluminum case of not less than 4.5 inches in diameter, double strength glass window, black lettering on a white background, phosphor bronze bourdon tube with bronze bushings, recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale, with scale range as follows:

Service	Cold Water
Scale Range, psig	0-100
Increment, psig	1

- C. Pressure Snubbers: Bronze construction, 300 psig working pressure, 1/4" size.
- D. Gauge Valves: Use ball valves as specified in Section 22 05 23 - General-Duty Valves for Plumbing Piping.

2.4 STRAINERS

- A. Armstrong, Illinois, Keckley, Metraflex, Mueller Steam, Sarco, Watts.
- B. Y type; cast bronze body, ASTM B62; 20 mesh stainless steel screens; bolted or threaded screen retainer tapped for a blowoff valve; sweat, threaded or flanged body rated at not less than 150 psi WOG.

- C. Y type; cast iron body, ASTM A126; 20 mesh stainless steel screens; bolted or threaded screen retainer tapped for a blowoff valve; threaded or flanged ends; rated at not less than 150 psi WOG.

PART 3 - EXECUTION

3.1 THERMOMETERS

- A. Stem Type: Install in piping systems as indicated on the drawings and/or details using a separable socket in each location.

3.2 THERMOMETER SOCKETS

- A. Install at each point where a thermometer or temperature control sensing element is located in a pipeline.

3.3 PRESSURE GAUGES

- A. Install in locations where indicated on the drawings and/or details, with scale range appropriate to the system operating pressures.
- B. Pressure Snubbers: Install in gauge piping for all gauges used on water services.
- C. Gauge Valves: Install at each gauge location as close to the main as possible and at each location where a gauge tapping is indicated.

3.4 STRAINERS

- A. Install all strainers where indicated allowing sufficient space for the screens to be removed. Install a ball valve in the tapped screen retainer.

END OF SECTION 22 05 15

SECTION 22 05 23 - GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes valve specifications for all plumbing systems except where indicated under Related Work. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Lead Free Requirements
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Operation and Maintenance Data
 - 9. Design Criteria
- C. PART 2 - PRODUCTS
 - 1. Water System Valves
 - a. Ball Valves
 - b. Butterfly Valves
 - c. Swing Check Valves
 - d. Spring Loaded Check Valves
 - e. Balance Valves
 - f. Drain Valves
 - 2. Natural Gas Systems
 - a. Shut-off Valves
 - b. Gas Pressure Regulators
 - 3. Specialty Valves and Valve Accessories
 - a. Safety Relief Valves
- D. PART 3 - EXECUTION
 - 1. General
 - 2. Shut-off Valves
 - 3. Balancing Valves
 - 4. Spring Loaded Check Valves
 - 5. Swing Check Valves
 - 6. Safety Relief Valves
 - 7. Gas Pressure Regulators

1.2 RELATED WORK

- A. Section 22 05 00 Common Work Results for Plumbing
- B. Section 22 05 14 - Plumbing Specialties
- C. Section 22 30 00 - Plumbing Equipment

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 LEAD FREE REQUIREMENTS

- A. All materials that contact potable water shall be lead free. Lead free refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per the Federal Safe Drinking Water Act as amended January 4th 2011 Section 1417.

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

1.7 SUBMITTALS

- A. Schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for all valves to be used on the project. Temperature ratings specified are for continuous operation.

1.8 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.9 DESIGN CRITERIA

- A. ANSI Z21.22 - Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.
- B. ASSE 1003 - Water Pressure Reducing Valves for Domestic Water Supply Systems.
- C. Where valve types (ball, butterfly, etc.) are specified for individual plumbing services (i.e. domestic water, gas, etc.), each valve type shall be of the same manufacturer unless prior written approval is obtained from the Owner.
- D. Valves to be line size unless specifically noted otherwise.

PART 2 - PRODUCTS

2.1 WATER SYSTEM VALVES

- A. All water system valves to be rated at not less than 125 water working pressure at 240 degrees F unless noted otherwise.
 - 1. BALL VALVES: 3" and smaller: Two piece bronze body; sweat, threaded or ASTM F1960 joint connection ends, full port stainless steel ball and stem; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 600 psig WOG. Provide valve stem extensions for valves installed in all piping with insulation. Nibco 585-70-66 LF or equal by Apollo, Milwaukee, Watts.

2. BUTTERFLY VALVES:
 - a. 2-1/2" and larger: Cast or ductile iron body; stainless steel shaft; bronze, copper or teflon bushings; EPDM resilient seat; EPDM seals; EPDM encapsulated ductile iron or stainless steel disc. 200 psig WOG through 12. Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe attached. Use tapped lug type valves with stud bolts or cap screws, or grooved end connection valves, permitting removal of downstream piping while using the valve for system shutoff. Nibco LD-2022 or GD-4765, or equal by Milwaukee, Victaulic or Watts.
 - b. Provide 10 position locking lever handle actuators for valves 6" and smaller. Provide worm gear operators with external position indication for valves 8" and larger.
3. SWING CHECK VALVES:
 - a. 3" and smaller: Bronze body, sweat or threaded ends, Y-pattern, regrindable bronze seat, renewable bronze disc, Class 125, suitable for installation in a horizontal or vertical line with flow upward. Hammond UP904, Milwaukee UP509, Nibco S413-Y-LF, Watts LFCV, Apollo equal.
 - b. 4" and larger: Cast iron body, flanged ends, bronze trim, bolted cap, renewable bronze seat and disc, Class 125, non-asbestos gasket, suitable for installation in a horizontal or vertical line with flow upward. Hammond IR 1124, Milwaukee F2974, Nibco F918B, Watts Series 411, Apollo equal.
4. SPRING LOADED CHECK VALVES:
 - a. 2" and smaller: Bronze body, sweat or threaded ends, bronze trim, stainless steel spring, stainless steel center guide pin, Class 125, teflon seat unless only bronze available. ConBraCo 61 series, Nibco S480-Y-LF, Watts LF600 or equal.
 - b. 2-1/2" and larger: Cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required, Class 125. Hammond IR9253 or IR9354, Milwaukee 1400 or 1800 series, Nibco W910-LF or F910-LF.
5. BALANCE VALVES: 2" and smaller: Brass body, 304 stainless steel ball, sweat or threaded ends, glass filled teflon seat, brass readout valves with EPT checks, with adjustable memory stop position indicator and extended handle stem, suitable for 300 psig water working pressure at 200 degrees F. B&G Xylem Circuit Setter Plus CB1SLF/CB-1LF, or equal by Nibco or Watts.
6. DRAIN VALVES: 3/4 inch ball valve with integral threaded hose adapter, sweat or threaded inlet connections, with threaded cap and chain on hose threads, Apollo 70LF-200-HC, Milwaukee BA-100H or BA-150H Hammond 8501H or 8511H or equal by Nibco, or Watts.

2.2 NATURAL GAS SYSTEMS

A. SHUT-OFF VALVES:

1. 4" and smaller: Ball or eccentric plug valve, bronze or cast iron body, 2" and under threaded ends, 2-1/2" and over flanged ends, chrome plated bronze ball, bronze or nickel plated cast iron plug, TFE or Hycar seats and seals, lever handle, 175 psi W.O.G., U.L listed for use as natural gas shut-off. Apollo 80-100, DeZurik 425, Milwaukee, Nibco and Watts equals.
2. 5" and larger: Cast iron body, flanged ends, stainless steel bearings, resilient faced plugs, totally enclosed hand wheel actuators, 175 psi W.O.G., U.L. listed for use as natural gas shut-off.

- B. Gas pressure regulators: 2" and smaller: Cast iron body, aluminum spring and diaphragm, Nitrile diaphragm, threaded ends, 150 psi W.O.G., -20 degrees F to 150 degrees F.

2.3 SPECIALTY VALVES AND VALVE ACCESSORIES

- A. SAFETY RELIEF VALVES: Bronze body, temperature and pressure actuated, stainless steel stem and spring, thermostat with non-metallic coating, test lever, suitable for 125 psig water working pressure at 240 degrees F, sized for full BTUH input and operating pressure of equipment, with valve capacity on metal label. For equipment less than or equal to 200,000 BTUH input, provide AGA, UL or ASME listed and labeled valve. Provide ASME listed and labeled valve for larger equipment. Bell & Gossett, A. W. Cash, Conbraco, Watts, Wilkins. Temperature and pressure relief valve shall be sized per AGA rating for BTUH input, Re: SPS 382.40(5)(d).

PART 3 - EXECUTION

3.1 GENERAL

- A. Properly align piping before installation of valves. Install and test valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping system on valve ends.
- B. Mount valves in locations which allow access for operation, servicing and replacement.
- C. Provide valve handle extensions for all valves installed in insulated piping.
- D. Install all valves with the stem in the upright or horizontal position. If possible, install butterfly valves with the stem in the horizontal position. Valves installed with the stems down will not be accepted.
- E. Prior to flushing of piping systems, place all valves in the full-open position.

3.2 SHUT-OFF VALVES

- A. Install shut-off valves at each piece of equipment, at each branch take-off from mains for isolation or repair and elsewhere as indicated.

3.3 BALANCING VALVES

- A. Install where indicated on the drawings and details for balancing of flow in pumped hot water recirculation piping systems.
- B. Upon project completion, adjust each valve and set position stop. Balance system to minimum flow in return piping branches needed to maintain even supply water temperature throughout building.

3.4 SPRING LOADED CHECK VALVES

- A. Install a spring loaded check valve in each circulating pump discharge line, each clearwater sump pump discharge line and elsewhere as indicated.

3.5 SWING CHECK VALVES

- A. Install swing check valves in recirculation branch lines and elsewhere as indicated. Provide weighted swing check valves at sanitary sump pump discharges.

3.6 SAFETY RELIEF VALVES

- A. Install relief valves on all pressure vessels and elsewhere as indicated. Inlet and outlet piping connecting to valves must be the same size as valve connections or larger. Pipe discharge to drain where indicated or to floor.

3.7 GAS PRESSURE REGULATORS

- A. When the gas pressure regulator is equipped with a vent connection, run a connection size vent to outside air according to codes. Use a larger size vent when required by the manufacturer's installation instructions.

END OF SECTION 22 05 23

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes specifications for supports of all plumbing equipment and materials as well as piping system anchors. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 5. Quality Assurance
 - 6. Description
 - 7. Shop Drawings
 - 8. Design Criteria
- C. PART 2 - PRODUCTS
 - 1. Manufacturers
 - 2. Structural Supports
 - 3. Pipe Hangers and Supports
 - 4. Beam Clamps
 - 5. Riser Clamps
 - 6. Concrete Inserts
 - 7. Continuous Concrete Insert Channels
 - 8. Anchors
 - 9. Equipment Stands
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Hanger and Support Spacing
 - 3. Riser Clamps
 - 4. Concrete Inserts and Continuous Insert Channels
 - 5. Anchors

1.2 RELATED WORK

- A. Section 03100 and 03300 - Concrete formwork and cast-in-place concrete for equipment pads.
- B. Section 22 07 00 - Plumbing Insulation for insulation protection at support devices.

1.3 REFERENCE

- A. Applicable provisions of Division 1 shall govern work under this section.

1.4 REFERENCE STANDARDS

- A. MSS SP-58

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00

- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

1.7 DESCRIPTION

- A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All support and installation procedures are to conform to the latest requirements of the ANSI Code for building piping.
- B. Do not hang any mechanical item directly from a metal deck or run piping so its rests on the bottom chord of any truss or joist.
- C. Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.
- D. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.
- E. Protect insulation at all hanger points; see Related Work above.

1.8 SHOP DRAWINGS

- A. Schedule of all hanger and support devices indicating attachment methods and type of device for each pipe size and type of service.
- B. All submittals are to comply with submission and content requirements specified with in section [17 00 00].

1.9 DESIGN CRITERIA

- A. Materials and application of pipe hangers and supports shall be according to MSS Standard Practice SP-58 unless noted otherwise.
- B. Piping connected to pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation supports for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond the 100 pipe diameter/3 support distance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Anvil, B-Line, FNW, G-Strut, Pate, Piping Technology, Roof Products & Systems or approved equal.

2.2 STRUCTURAL SUPPORTS

- A. Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically indicated on the drawings.

2.3 PIPE HANGERS AND SUPPORTS

- A. HANGERS FOR PIPE SIZES 1/2" THROUGH 2":
 - Carbon steel, adjustable swivel ring. B-Line B3170NF, Anvil 69 or 70.
 - Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.
- B. HANGERS FOR PIPE SIZES 2" AND LARGER: Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.

- C. MULTIPLE OR TRAPEZE HANGERS: Steel channels with welded spacers and hanger rods.
- D. WALL SUPPORT:
 - 1. Carbon steel welded bracket with hanger. B-Line 3068 Series, Anvil 194 Series.
 - 2. Perforated, epoxy painted finish, 16-12 gauge, min., steel channels securely anchored to wall structure, with interlocking, split-type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000 series clamps, Anvil type PS 200 H with PS 1200 clamps. When copper piping is being supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT series, Anvil PS 1400 series.
- E. VERTICAL SUPPORT: Carbon steel riser clamp. B-Line B3373, Anvil 261 for above floor use.
- F. FLOOR SUPPORT: Carbon steel pipe saddle, stand and bolted floor flange. B-Line B3088T/B3093.
- G. COPPER PIPE SUPPORTS: All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or polyvinylchloride coated. Where steel channels are used, provide isolation collar between supports/clamps/fasteners and copper piping.

2.4 PIPE HANGER RODS

- A. STEEL HANGER RODS:
 - 1. Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.
 - 2. Size rods for individual hangers and trapeze support as indicated in the following schedule.
 - 3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

Maximum Load (Lbs.) (650°F Maximum Temp.)	Rod Diameter (inches)
610	3/8
1130	1/2
1810	5/8
2710	3/4
3770	7/8
4960	1
8000	1-1/4

2.5 BEAM CLAMPS

- A. MSS SP-58 Types 19 and 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a retaining ring and threaded rod of 3/8, 1/2, and 5/8 inch diameter. Furnish with a hardened steel cup point set screw. B-Line B3036L/B3034, Anvil 86/92.
- B. MSS SP-58 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1-1/2 inch diameter. B-Line B3054, Anvil 228.

2.6 CONCRETE INSERTS

A. POURED IN PLACE:

1. MSS SP-58 Type 18 wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. Wedge design to allow the insert to be held by concrete in compression to maximize the load carrying capacity. B-Line B2505, Anvil 281.
2. MSS SP-58 Type 18 universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. B-Line B3014N, Anvil 282.

- B. DRILLED FASTENERS: Carbon steel drop-in type expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.

2.7 CONTINUOUS CONCRETE INSERT CHANNELS

- A. Steel inserts with an industry standard pre-galvanized finish, nominally 1-5/8 inch wide by 1-3/8 inch deep by length to suit the application, designed to be nailed to concrete forms and provide a linear slot for attaching other support devices. Installed channels to provide a load rating of 2000 pounds per foot in concrete. Manufacturer's standard brackets, inserts, and accessories designed to be used with the channel inserts may be used. Select insert length to accommodate all pipe in the area.

2.8 ANCHORS

- A. Use welding steel shapes, plates, and bars to secure piping to the structure.

2.9 EQUIPMENT STANDS

- A. Use structural steel members welded to and supported by pipe supports. Clean, prime and coat with three coat rust inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, treat with corrosive atmosphere coatings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Size, apply and install supports and anchors in compliance with manufacturers recommendations.
- B. Install supports to provide for free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
- C. Coordinate hanger and support installation to properly group piping of all trades.
- D. Trim steel hanger rods to within one inch of the final lock nut position. Hanger and support cutoff burrs shall be removed and sharp edges ground smooth.
- E. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used, and all data is submitted for prior approval.
- F. Size and install hangers and supports except for riser clamps, for installation on the exterior of piping insulation. Where a vapor barrier is not required, hangers may be installed either on the exterior of pipe insulation or directly on piping.
- G. Perform welding according to standards of the American Welding Society.

3.2 HANGER AND SUPPORT SPACING

- A. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.
- B. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
- C. Use hangers with 1-1/2 inch minimum vertical adjustment.
- D. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- E. Support riser piping independently of connected horizontal piping.
- F. Adjust hangers to obtain the slope specified in the piping section of these specifications.
- G. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Max. Horiz. Spacing	Max. Vert. Spacing
Cast Iron	2" and larger	5'-0"	15'-0"
Copper	1/2" through 3/4"	5'-0"	10'-0"
Copper	1" through 1-1/4"	6'-0"	10'-0"
Copper	1-1/2" through 2-1/2"	8'-0"	10'-0"
Copper	3"	10'-0"	10'-0"
Copper	4" and larger	12'-0"	10'-0"
Steel	1/2" through 1-1/4"	7'-0"	15'-0"
Steel	1-1/2" through 6"	10'-0"	15'-0"
Plastic	Drain and Vent	4'-0"	10'-0"
PEXa*	Tubing* 1/2" through 3/4"	6'-0"	4'-0"
PEXa*	Tubing* 1" through 1-1/2"	8'-0"	4'-0"

*PEXa Tubing shall have PEXa continuous pipe support with stainless steel strapping around insulated pipe. PEXa tubing without continuous channel (at fittings) shall be supported no less than every 32".

3.3 RISER CLAMPS

- A. Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor.

3.4 CONCRETE INSERTS AND CONTINUOUS INSERT CHANNELS

- A. Select size based on the manufacturer's stated load capacity and weight of material that will be supported. Locate continuous insert channels on 6'-0" maximum centers and 2'-0" from corners. Furnish inserts to the General Contractor for placement in concrete formwork. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inch size. Where concrete slabs form finished ceiling, provide inserts that are flush with the slab surface.

3.5 ANCHORS

- A. Install where indicated on the drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

END OF SECTION 22 05 29

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes insulation specifications for plumbing piping and equipment. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Description
 - 8. Definitions
 - 9. Shop Drawings
 - 10. Operation and Maintenance Data
- C. PART 2 - PRODUCTS
 - 1. Materials
 - 2. Insulation and Jackets
 - 3. Insulation Inserts and Pipe Shields
 - 4. Accessories
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Piping, Valve and Fitting Insulation
 - 3. Equipment Insulation

1.2 RELATED WORK

- A. Section 22 05 00 - Common Work Results for Plumbing
- B. Section 22 11 00 - Facility Water Distribution C. Section 22 13 00 - Facility Sanitary Sewerage D. Section 22 14 00 - Facility Storm Drainage E. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- C. Section 22 30 00 - Plumbing Equipment

1.3 REFERENCE

- A. provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate
- ASTM C165 Test Method for Compressive Properties of Thermal Insulations
- ASTM C177 Heat Flux and Thermal Transmission Properties
- ASTM C195 Mineral Fiber Thermal Insulation Cement
- ASTM C240 Cellular Glass Insulation Block
- ASTM C302 Density of Preformed Pipe Insulation
- ASTM C303 Density of Preformed Block Insulation
- ASTM C449 Mineral Fiber Hydraulic Setting Thermal Insulation Cement

ASTM C518	Heat Flux and Thermal Transmission Properties
ASTM C533	Calcium Silicate Block and Pipe Thermal Insulation
ASTM C534	Preformed Flexible Elastomeric Thermal Insulation
ASTM C547	Mineral Fiber Preformed Pipe Insulation
ASTM C552	Cellular Glass Block and Pipe Thermal Insulation
ASTM C553	Mineral Fiber Blanket and Felt Insulation
ASTM C578	Preformed, Block Type Cellular Polystyrene Thermal Insulation
ASTM C591	Preformed Rigid Cellular Polyurethane Thermal Insulation
ASTM C610	Expanded Perlite Block and Thermal Pipe Insulation
ASTM C612	Mineral Fiber Block and Board Thermal Insulation
ASTM C921	Properties of Jacketing Materials for Thermal Insulation
ASTM C1136	Flexible Low Permeance Vapor Retarders for Thermal Insulation
ASTM E84	Surface Burning Characteristics of Building Materials
MICA	National Commercial & Industrial Insulation Standards
NFPA 225	Surface Burning Characteristics of Building Materials
UL 723	Surface Burning Characteristics of Building Materials

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.
- B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.

1.7 DESCRIPTION

- A. Furnish and install all insulating materials and accessories as specified or as required for a complete installation. The following types of insulation are specified in this section:
 - Pipe Insulation
 - Equipment Insulation
- B. Install all insulation according to the latest edition of MICA (Midwest Insulation Contractors Association) Standard and manufacturer's installation instructions. Exceptions to these standards will only be accepted where specifically modified in these specifications, or where prior written approval has been obtained from the DOT Project Representative.

1.8 DEFINITIONS

- A. Concealed: shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.

1.9 SHOP DRAWINGS

- A. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, fitting materials along with material safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.10 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials or accessories containing asbestos will not be accepted.
- B. Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame spread rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:
- C. Insulation which is not located in an air plenum may have a flame spread rating not over 25 and a smoke developed rating no higher than 150.

2.2 INSULATION AND JACKETS

- A. Manufacturers: Armstrong, Certainteed Manson, Childers, Dow, Extol, Halstead, H.B. Fuller, Imcoa, Knauf, Owens-Corning, Pittsburgh Corning, Rubatex, Johns-Mansville, or approved equal.
- B. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.
- C. RIGID FIBERGLASS INSULATION:
 - 1. Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.
 - 2. White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.
- D. SEMI-RIGID FIBERGLASS INSULATION:
 - 1. Minimum nominal density of 3 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 75 degrees F, minimum compressive strength of 125 PSF at 10% deformation, rated for service to 450 degrees F. Insulation fibers perpendicular to jacket and scored for wrapping cylindrical surfaces.
 - 2. White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.
- E. ELASTOMERIC INSULATION: Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.27 at 75 degrees F, minimum compressive strength of 4.5 psi at 25% deformation, maximum water vapor transmission of 0.17 perm inch, maximum water absorption of 6% by weight, rated for service range of -20 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment.
- F. EXTRUDED POLYSTYRENE INSULATION: Rigid closed cell, minimum nominal density of 2.2 lbs. per cu. ft., thermal conductivity of not more than 0.2 at 75 degrees F, minimum compressive strength of 35 psi, maximum water vapor transmission of 1.1 perm inch, maximum water absorption of .1% by volume, rated for service range of -290 degrees F to 165 degrees F.
- G. CELLULAR GLASS INSULATION: Rigid closed cell, minimum nominal density of 8.5 lbs. per cu. ft., thermal conductivity of not more than 0.36 at 50 degrees F, minimum compressive strength of 100 psi, maximum water vapor transmission of 0.0 perm inch, maximum water absorption of .2% by volume, rated for service range of -450 degrees F to 900 degrees F.

H. FIREPROOFING INSULATION:

1. Mineral fiber with nominal density of 8 lbs. per cu. ft., flame spread index of 15, fuel contribution index of 0, and smoke developed index of 0, thermal conductivity of not more than 0.23 at 75 degrees F.
2. Jacket material shall be the same as jacket for adjacent insulation.

I. PVC FITTING COVERS AND JACKETS: White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be .02 inch (20 mil).

2.3 INSULATION INSERTS AND PIPE SHIELDS

- A. Manufacturers: B-Line, Pipe Shields, Value Engineered Products
- B. Construct inserts with calcium silicate, minimum 140 psi compressive strength. Piping 12" and larger, supplement with high density 600 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum 180 degree coverage on bottom of supported piping and full 360 degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate.
- C. Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered pre-manufactured product described above. On low temperature systems, extruded polystyrene may be substituted for calcium silicate provided insert and shield length and gauge are increased to compensate for lower insulation compressive strength.
- D. Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1"x 6" block for piping through 2-1/2" and three 1" x 6" blocks for piping through 4". Submit shield schedule to demonstrate equivalency to pre-engineered/pre-manufactured product described above.
- E. Wood blocks will not be accepted.

2.4 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be .015 inch for aluminum and .010 inch for stainless steel.
- D. Tack fasteners to be stainless steel ring grooved shank tacks.
- E. Staples to be clinch style.
- F. Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.
- G. Finishing cement to be ASTM C449.
- H. Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz./sq. yd.
- I. Bedding compounds to be non-shrinking and permanently flexible.
- J. Vapor barrier coatings to be non-flammable, fire resistant, polymeric resin.
- K. Fungicidal water base coating (Foster 40-20 or equal) to be compatible with vapor barrier coating.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install insulation, jackets and accessories according to manufacturers instructions and under ambient temperatures and conditions recommended by manufacturer. Surfaces to be insulated must be clean and dry.
- B. Do not insulate systems or equipment which are specified to be pressure tested or inspected, until testing, inspection and any necessary repairs have been successfully completed.
- C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Cover and seal exposed fiberglass insulation when insulation is terminated, no raw fiberglass insulation is allowed. Provide neat and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates. Install with longitudinal joints facing wall or ceiling.
- D. Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.
- E. Use full-length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.
- F. Insulation shall be continuous through sleeves and openings. Vapor barriers shall be maintained continuous through all penetrations.
- G. Provide a complete vapor barrier for insulation on the following systems:
 - Cold water (potable and non-potable)
 - Storm Water
 - Equipment piping with a surface temperature below 65 degrees F

3.2 PIPING, VALVE, AND FITTING INSULATION

- A. GENERAL:
 - 1. Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2" lap on jacket seams and 2" tape on butt joints, firmly cemented with lap adhesive. Additionally secure with staples along seams and butt joints. Coat staples with vapor barrier mastic on systems requiring vapor barrier.
 - 2. Water supply piping insulation shall be continuous throughout the building and installed adjacent to and within building walls to a point directly behind the fixture that is being supplied.
 - 3. Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior of insulation. Where a vapor barrier is not required, hangers and supports may be attached directly to piping with insulation completely covering hanger or support and jacket sealed at support rod penetration. Where riser clamps are required to be attached directly to piping requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamp.
- B. INSULATION INSERTS AND PIPE SHIELDS: Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.
- C. FITTINGS AND VALVES: Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up insulation of the same thickness as adjoining insulation. Cover insulation with fabric reinforcing and mastic or where temperatures do not exceed 150 degrees, PVC fitting covers. Secure PVC fitting covers with tack fasteners and 1-1/2" band of mastic over ends, throat, seams or penetrations. On systems requiring vapor barrier, use vapor barrier mastic.

- D. **ELASTOMERIC:** Where practical, slip insulation on piping during pipe installation when pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. For elastomeric insulation, apply full bed of adhesive to both surfaces. For polyolefin, seal factory preglued seams with roller and field seams and joints with full bed of hot melt polyolefin glue to both surfaces.
- E. **PROTECTIVE JACKETS:**
1. Provide a protective PVC jacket for the following insulated piping: located in wet areas, exposed piping, and piping located 10 ft. or less above floor.
 2. Lap seams and joints a minimum of 2 inches and continuously seal with welding solvent recommended by jacket manufacturer. Lap slip joint ends 4" without fasteners where required to absorb expansion and contraction. For sections where vapor barrier is not required and jacket requires routine removal, tack fasteners may be used.
- F. **PIPE INSULATION SCHEDULE:**
1. Provide insulation on new and existing remodeled piping as indicated in the following schedule:

Service	Insulation Types	Insulation Thickness by Pipe Size				
		1" and smaller	1-1/4" to 2"	2-1/2" to 4"	5" to 6"	8" and larger
Hot Water Supply	Rigid Fiberglass	1"	1"	1.5"	1.5"	1.5"
Hot Water Circulating	Rigid Fiberglass	1"	1"	1.5"		
Cold Water	Rigid Fiberglass	0.5"	0.5"	1"	1"	1"
Tempered Water	Rigid Fiberglass	0.5"	0.5"	1"		
Non-Potable Cold Water	Rigid Fiberglass *	0.5"	0.5"	1"		
Non-Potable Hot Water	Rigid Fiberglass *	1"	1"	1.5"		
All Horizontal Storm Piping and 4'-0" of vertical Piping thereafter, & Roof Drain bodies	Rigid Fiberglass	0.5"	0.5"	0.5"	0.5"	0.5"

* = Elastomeric and Phenolic types are acceptable

2. The following piping and fittings are not to be insulated:
 - Chrome plated exposed supplies and stops (except where specifically noted).
 - Water hammer arrestors.
 - Piping unions and flanges for systems not requiring a vapor barrier.

3.3 EQUIPMENT INSULATION

- A. Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.
- B. **SEMI-RIGID FIBERGLASS:** Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place. Fill all joints, seams and depressions with insulating cement to a smooth, even surface. Cover with reinforcing fabric and 2 coats of mastic. Use vapor barrier mastic on systems requiring a vapor barrier.

- C. ELASTOMERIC: Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints. Place insulation with edge joints firmly butted pressing to surface for full adhesion. Seal seams and joints vapor tight.
- D. EQUIPMENT INSULATION SCHEDULE:
1. Equipment insulation as follows:

Equipment	Insulation Type	Thickness	Remarks
Water Meter	Elastomeric	1/2"	Sheet type, fabricated for ease of removal and replacement when service is required.
R.P.B.P.	Elastomeric	1/2"	Sheet type, pipe size type or combination of both. Fabricated for ease of removal and replacement when testing and servicing is required

END OF SECTION 22 07 00

SECTION 22 10 13 - FACILITY FUEL PIPING

PART 1 - GENERAL

1.1 SCOPE

- A. This section contains specifications for fuel pipe and fuel pipe fittings for this project. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Shop Drawings
 - 8. Delivery, Storage, and Handling
 - 9. Design Criteria
 - 10. Welder Qualifications
 - 11. Natural Gas Service
- C. PART 2 - PRODUCTS
 - 1. Natural Gas
 - 2. Vents and Relief Valves
 - 3. Unions and Flanges
- D. PART 3 - EXECUTION
 - 1. Preparation
 - 2. Erection
 - 3. Welded Pipe Joints
 - 4. Threaded Pipe Joints
 - 5. Natural Gas
 - 6. Vents and Relief Valves
 - 7. Unions and Flanges
 - 8. Piping System Leak Tests
 - 9. Piping System Test Report

1.2 RELATED WORK

- A. Section 22 05 14 - Plumbing Specialties
- B. Section 22 05 19 - Meters and Gages for Plumbing Piping
- C. Section 22 5 23 - General-Duty Valves for Plumbing Piping
- D. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- E. Section 22 07 00 - Plumbing Insulation.

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- ANSI B16.3 Malleable Iron Threaded Fittings
- ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
- ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- ANSI B31.9 Pipe Material Requirements

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.
- B. Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and according to the appropriate ASTM specification.
- C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.7 SHOP DRAWINGS

- A. Refer to division 1, General Conditions, Submittals.
- B. Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.
- C. TYPE E OR S STEEL PIPE: Mill certification papers, also known as material test reports, for the pipe furnished for this project, in English. Heat numbers on these papers to match the heat numbers stenciled on the pipe. Chemical analysis indicated on the mill certification papers to meet or exceed the requirements of the referenced ASTM specification.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
- B. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

1.9 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system according to ANSI B31, but not less than 125 psig unless specifically indicated otherwise.
- C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in occupied spaces and ventilation plenum spaces, including plenum ceilings.

- D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- E. Where ASTM A53 grade A pipe is specified, ASTM A53 grade B pipe may be substituted at contractor's option. Where the grade or type is not specified, contractor may choose from those commercially available.

1.10 WELDER QUALIFICATIONS

- A. Before any metallic welding is performed, contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code and/or the National Certified Pipe Welding Bureau.
- B. Before any polyethylene fusion welding is performed, contractor to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures according to the Code of Federal Regulations, Title 49, Part 192, Section 192.285.
- C. The A/E or DOT reserves the right to test the work of any welder employed on the project, at the contractor's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

1.11 NATURAL GAS SERVICE

- A. All charges for the gas service as shown on the plans, including the connection from the main in the street or other location to the gas meter, shall be paid by this contractor, including setting of gas meter(s) and all work performed by the gas company.

PART 2 - PRODUCTS

2.1 NATURAL GAS

- A. 2" and Smaller: ASTM A53, type E or S, standard weight (schedule 40) black steel pipe with ASTM A197/ANSI B16.3 class 150 black malleable iron threaded fittings or ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.
- B. 2-1/2" and Larger: ASTM A53, type E or S, standard weight black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.

2.2 VENTS AND RELIEF VALVES

- A. Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

2.3 UNIONS AND FLANGES

- A. 2" and Smaller: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service but not less than 250 psi.
- B. 2-1/2" and Larger: ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding and of a pressure class compatible with that specified for valves, piping specialties and fittings of the respective piping service. Flanges smaller than 2-1/2" may be used as needed for connecting to equipment and piping specialties. Use raised face flanges ANSI B16.5 for mating with other raised face flanges on equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove all foreign material from interior and exterior of pipe and fittings.

3.2 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- C. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.
- D. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main.
- E. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment
- F. Install all valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

3.3 WELDED PIPE JOINTS

- A. Make all welded joints by fusion welding according to ASME Codes, ANSI B31, and State Codes where applicable.
- B. Electrodes shall be Lincoln, or approved equal, with coating and diameter as recommended by the manufacturer for the type and thickness of work being done.

3.4 THREADED PIPE JOINTS

- A. Use a Teflon based thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.5 NATURAL GAS

- A. Pitch horizontal piping down 1" in 60 feet in the direction of flow. Install a 4" minimum depth dirt leg at the bottom of each vertical run and at each appliance. When installing mains and branches, cap gas tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main. Teflon tape is acceptable for use on natural gas lines.
- B. Do not install gas pipe in a ventilation air plenum.
- C. If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least five feet above grade.
- D. Install a shut off valve at each appliance. Provide a valved connection at the main for equipment and appliances furnished by others.
- E. Piping through a roof shall be run through an approved roof penetration with flashing and counter flashing.
- F. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according to gas utility regulations.
- G. Clean all welded piping before all regulators and control valves. Test by placing target cloth over piping and blow with compressed air. Clean piping until target cloth is clean and free of debris.

3.6 VENTS AND RELIEF VALVES

- A. Install vent and relief valve discharge lines as indicated on the drawings, as detailed, and as specified for each specific valve or piping specialty item. In no event is a termination to occur less than six feet above a roof line.

3.7 UNIONS AND FLANGES

- A. Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

3.8 PIPING SYSTEM LEAK TESTS

- A. Verify that the piping system being tested is fully connected to all components and that all equipment is properly installed, wired, and ready for operation. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.
- B. Provide all piping, fittings, blind flanges, and equipment to perform the testing.
- C. Conduct pressure test with test medium of air or water unless specifically indicated. Minimum test time is indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by the Division's representative. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.
- D. Do not insulate pipe until it has been successfully tested.
- E. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
- F. For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. The piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking. After testing is complete, slowly release the pressure in a safe manner.
- G. Measure natural gas system test pressure with a water manometer or an equivalent device calibrated in increments not greater than 0.1 inch water column. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

System	Pressure	Medium	Duration
Natural gas	100 psig	Air	24 hr

- H. All pressure tests are to be documented on a Division of Facilities Development form included in this specification.
- I. On piping that can not be tested because of connection to an active line, provide temporary blind flanges and hydrostatically test new section of piping. After completion of test, remove temporary flanges and make final connections to piping. Die penetrate test pass weld or x-ray the piping that was not hydrostatically tested up to the active system.

3.9 PIPING SYSTEM TEST REPORT

State of Wisconsin

Department of Transportation

Date

Submitted: _____

Project Name: _____

Location: _____ DOT Project No: _____

Contractor: _____

☐ HVAC

☐ Refrigeration

☐ Controls

☐ Power Plant

☐ Plumbing

☐ Fire Sprinkler

Test Medium: ☐

Air

☐ Water

☐

Other__

Test performed per specification section No. _____

Specified Test Duration _____ Hours

Specified Test Pressure _____ PSIG

System Identification: _____

Describe Location: _____

TEST DATE: _____

Start Test Time: _____

Initial Pressure: _____ PSIG

Stop Test Time: _____

Final Pressure: _____ PSIG

Tested By: _____

Witnessed By: _____

Title: _____

Title: _____

Signed: _____

Signed: _____

Date: _____

Date: _____

Comments: _____

END OF SECTION 22 10 13

SECTION 22 11 00 - FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 SCOPE

- A. This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Delivery, Storage, and Handling
 - 8. Design Criteria
 - 9. Shop Drawings
 - 10. Welder Qualifications
- C. PART 2 - PRODUCTS
 - 1. Domestic Water
 - 2. Dielectric Unions and Flanges
 - 3. Unions and Flanges
 - 4. Mechanical Grooved Pipe Connections
- D. PART 3 - EXECUTION
 - 1. General
 - 2. Preparation
 - 3. Erection
 - 4. Copper Pipe Joints
 - 5. Welded Pipe Joints
 - 6. Threaded Pipe Joints
 - 7. Solvent Welded Pipe Joints
 - 8. Mechanical Hubless Pipe Connections
 - 9. Mechanical Joint Pipe Connections
 - 10. Mechanical Grooved Pipe Connections
 - 11. Domestic Water
 - 12. Flushing and Disinfection of Potable Water Systems
 - 13. Underground Pipe Wrap
 - 14. Dielectric Unions and Flanges
 - 16. Unions and Flanges
 - 16. Piping System Leak Tests
 - 17. Construction Verification Items

1.2 RELATED WORK

- A. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- B. Section 22 05 14 - Plumbing Specialties

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- ANSI A21.4
- ANSI A21.11
- ANSI A21.51
- ANSI B16.3 Malleable Iron Threaded Fittings
- ANSI B16.4 Cast Iron Threaded Fittings
- ANSI B16.5 Pipe Flanges and Flanged Fittings
- ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
- ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
- ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
- ASTM A105 Forgings, Carbon Steel, for Piping Components
- ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
- ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- ASTM B32 Solder Metal
- ASTM B88 Seamless Copper Water Tube
- ASTM B280 Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
- ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
- ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe
- ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
- ASTM D2464 Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
- ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40
- ASTM D2513 Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
- ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
- ASTM D2657 Heat Fusion Joining of Polyolefin Pipe and Fittings
- ASTM D2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping
- ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings
- ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- ASTM D3222 Unmodified Poly Vinylidene Fluoride (PVDF) Molding Extrusion and Coating Materials
- ASTM D4101 Propylene Plastic Injection and Extrusion Materials
- ASTM F437 Threaded Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80

ASTM F438	Socket Type Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F441	Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F493	Solvent Cements for Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe and Fittings
ASTM F656	Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
ASTM F876	Standard Specification for Crosslinked Polyethylene (PEX) Tubing
ASTM F877	Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water
Distribution Systems	
ASTM F1960	Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings
AWWA C904	Standard for Crosslinked Polyethylene (PEX) Pressure Pipe, 1/2-inch Through 3-inch, for Water Service
AWS A5.8	Brazing Filler Metal
AWWA C104	Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
AWWA C105	Polyethylene Encasement for Ductile Iron Piping for Water
AWWA C110	Ductile Iron and Gray Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids
AWWA C111	Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
AWWA C151	Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids
AWWA C153	Ductile Iron Compact Fittings, 3 In. Through 48 In., for Water and Other Liquids
AWWA C600	Installation of Ductile Iron Water Mains and Their Appurtenances
AWWA C651	Disinfecting Water Mains
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.
- B. Order all copper, cast iron, steel, PVC and polyethylene pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the State.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

1.8 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, and AWWA specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system.
- C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in ventilation plenum spaces, including plenum ceilings unless approved for this use.
- D. Where weld fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- E. Where ASTM A53 type F pipe is specified, grade A Type E or S, or grade B Type E or S may be substituted at contractor's option. Where the grade or type is not specified, contractor may choose from those commercially available.
- F. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at contractor's option.

1.9 SHOP DRAWINGS

- A. Schedule from the contractor indicating the ASTM, AWWA or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.
- B. Statement from manufacturer on his letterhead that pipe furnished meets the ASTM, AWWA or CISPI specification contained in this section.

1.10 WELDER QUALIFICATIONS

- A. Welding procedures, welders, and welding operators for all building service piping to be according to certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic welding is performed, contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.
- B. The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the State's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project and all defective welds replaced.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER

A. ABOVE GROUND:

1. Type L copper water tube, H (drawn) temper, ASTM B88; wrought copper pressure fittings, ANSI B16.22; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP. Copper mechanical grooved fittings and couplings on roll grooved pipe may be used in lieu of soldered fittings. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for branch takeoffs up to one-half (1/2) the diameter of the main.
2. Ductile iron pipe, thickness Class 53, AWWA C151/C115; with standard thickness cement mortar lining, AWWA C104; ductile iron mechanical grooved cement mortar lined fittings and couplings on cut grooved pipe, Class 350 12" and below, Class 250 above 12", AWWA C606; ductile iron or gray iron flanged cement mortar lined fittings, Class 250, AWWA C110; rubber gasket joints with non-toxic gasket lubricant, AWWA C111.
3. Stainless Steel pipe, all sizes: ASTM A312, Type 304, Schedule 10 or 40 pipe, dimensions conforming to ANSI/ASME B36.19M with threaded, welded or grooved joints. Systems used for potable water to include ANSI/NSF 61 lead free certification. Fittings: ASTM A276 and A312 outlets and austenitic stainless steel plain, threaded or grooved ends, Type 304 or 316. Grooved couplings may be standard painted ductile iron, with EPDM gaskets. 1 1/2" and larger: ASTM A312, Type 304/304L Schedule 10 stainless steel pipe, welded or roll grooved connections. Galvanic corrosion protection required when connecting to copper systems according to manufacturer recommendation. Schedule 10 pipe threaded joints and cut grooved joints are not permitted. Schedule 5 pipe and mechanical press-fit joints are not permitted.
4. Crosslinked Polyethylene (PEX-a Engel Method) plastic pipe and fittings, 1/2" to 2" sizes: ASTM F876, ASTM F877, AWWA C904, with ASTM F1960 cold expansion fittings, rated for a temperature of 180 degrees F at 100 psi, copper tube size (CTS). Transition fittings PEX-to-Metal, one-piece lead free, brass threaded or sweat adapter, with PEX-a reinforcing cold expansion ring. Fittings for PEXa to PEXa connection to be poly plastic. Multiport manifolds with valves shall be accessible. Multiport tees are not required to be accessible. Pipe and fittings by the same manufacturer, Uponor, Rehau, Sioux Chief or equal. Pipe system shall be installed and supported according to the manufacturer's instructions, and include full manufacturer warranty. Fixture connection stub-out piping shall transition to copper piping within wall, before entry into finished space, and include manufactured rigid support.
5. PEXa pipe 1" to 2" shall be provided in straight lengths, coil stock may be used for 1/2" and 3/4" sizes. 1/2" and 3/4" pipe sizes shall be color coded blue for cold water, and red for hot and hot water return water.

- B. THRUST RESTRAINTS FOR UNDERGROUND PIPING: Asphaltic or epoxy coated ductile iron follower gland mechanical joint restraint with gripping wedge restraints and torque limiting twist-off nuts around the pipe circumference, low alloy steel T-bolts and UL listing or Factory Mutual approval. For PVC pipe joint bells, use epoxy or primer coated ductile iron bell and serrated ring restraints or gripping wedge restraints and torque limiting twist-off nuts around the pipe circumference with low alloy steel tie bolts. Restraint to have minimum pressure rating and safety factor equal to or greater than pressure rating and safety factor of pipe and be designed specifically for the pipe material it's applied on.

2.2 DIELECTRIC UNIONS AND FLANGES

- A. Watts Regulator Company, Lochinvar, Wilkins or EPCO Sales, Inc., dielectric unions 2" and smaller; dielectric flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets, having a pressure rating of not less than 175 psig at 180 degrees.

2.3 UNIONS AND FLANGES

- A. Unions, flanges and gasket materials to have a pressure rating of not less than 150 psig at 180 degrees. Gasket material for flanges and flanged fittings shall be teflon type. Treated paper gaskets are not acceptable.
- B. 2" and Smaller Copper:
ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.
- C. 2-1/2" and Larger Copper: ANSI B15.24 Class 150 cast bronze flanges with full face teflon gaskets.

2.4 MECHANICAL GROOVED PIPE CONNECTIONS

- A. Mechanical grooved pipe couplings and fittings, ASTM F1476, as manufactured by Victaulic, Gruvlok or Grinnell may be used with cut groove galvanized steel pipe, cut groove ductile iron pipe or roll groove copper pipe where noted. Mechanical grooved components and assemblies to be rated for minimum 250 psi working pressure.
- B. All mechanical grooved pipe material including gaskets, couplings, fittings and flange adapters to be from the same manufacturer.
- C. Couplings to be malleable iron, ASTM A47, or ductile iron ASTM A536 with painted finish. Reducing couplings are not acceptable.
- D. Gaskets to be EPDM, ASTM D2000. Gaskets for hot water systems and dry pipe systems to be flush seal design. Heat treated carbon steel oval neck track bolts and nuts, ASTM A183, with zinc electroplated finish ASTM B633.
- E. Flange adapters to be ductile iron, ASTM A536; except at lug type butterfly valves where standard threaded flanges shall be used.
- F. Credit for the inherent flexibility of mechanical grooved pipe connections when used for expansion joints or flexible connectors may be allowed upon specific application by the contractor. Three flexible couplings at first three connection points both upstream and downstream of pumps may be used in lieu of flexible connectors. Request for expansion joints shall be made in writing and shall include service, location, line size, proposed application and supporting calculations for the intended service.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install pipe and fittings according to reference standards, manufacturers recommendations and recognized industry practices.

3.2 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.3 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Where copper, steel, or plastic piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Install underground warning tape 6"-12" below finished grade above all exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.
- D. Maintain piping in clean condition internally during construction.

- E. Provide clearance for installation of insulation, access to valves and piping specialties.
- F. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- G. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment
- H. PEXa pipe joint connections shall be installed per manufacturer's recommendations. Use manufacturer recommended cold-expansion tool for ASTM F 1960 connections.
- I. Do not expose PEXa piping to direct sunlight. Provide cover to portions of piping exposed to direct I. sunlight.
- J. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.4 COPPER PIPE JOINTS

- A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

3.5 WELDED PIPE JOINTS

- A. Make all welded joints by fusion welding according to ASME Codes, ANSI B31, and State Codes where applicable. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main.

3.6 THREADED PIPE JOINTS

- A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.7 SOLVENT WELDED PIPE JOINTS

- A. Install according to ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.
- B. Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle brushes about 1/2 the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4-5 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4" and larger. Hold joint for 30 seconds or until set. Reference manufacturers recommendations for initial set time before handling and for full curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when specifically approved by the DFD Project Representative.

3.8 MECHANICAL HUBLESS PIPE CONNECTIONS

- A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturers recommended torque.

3.9 MECHANICAL JOINT PIPE CONNECTIONS

- A. Comply with AWWA C600/C605 installation requirements. Clean pipe end and socket. Clean and lubricate pipe end, socket and gasket with soapy water or gasket lubricant. Place gland and gasket, properly oriented, on pipe end. Insert pipe end fully into socket and press gasket evenly into recess keeping joint straight. Press gland evenly against gasket, insert bolts and hand tighten nuts. Make joint deflection prior to tightening bolts. Evenly tighten bolts in sequence to recommended torque.

3.10 MECHANICAL GROOVED PIPE CONNECTIONS

- A. Use pipe factory grooved according to the coupling manufacturer's specifications or field grooved pipe according to the same specifications using specially designed tools specially designed for the application. Lubricate pipe and coupling gasket, align pipe, and secure joint according to the coupling manufacturer's specifications.

3.11 DOMESTIC WATER

- A. Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as work progresses. Cap open pipe ends where left unattended or subject to contamination.
- B. Install exterior water piping below predicted frost level according to DSPS Table 382.30-6, but in no case less than 6' bury depth to top of pipe. Maintain minimum of 8' horizontal distance between 2-1/2" and larger water piping and sanitary sewer piping. Maintain minimum of 30" horizontal and 12" vertical distance, water on top, between 2" and smaller water piping and sanitary sewer piping. Where water piping crosses a sanitary sewer, provide minimum 18" vertical clearance and waterproof PVC water pipe sleeve (reference sanitary sewer materials) sealed at both ends for distance of 10' from sewer in both directions.
- C. Provide thrust restraints for 3" and larger exterior water piping joints, hydrants, caps, plugs, fittings and bends of 22-1/2 degrees or more. Field apply continuous anti-corrosion coating to rodded restraint components. Protect mechanical joints, nuts and bolts from concrete cover. Cover with 8 mil sheet or tube polyethylene material sleeve.
- D. Install interior water piping with drain valves where indicated and at low points of system to allow complete drainage. Install shutoff valves where indicated and at the base of risers to allow isolation of portions of system for repair. Do not install water piping within exterior walls.

3.12 FLUSHING AND DISINFECTION OF POTABLE WATER SYSTEMS

- A. Prior to use, isolate and fill system with potable water. Allow to stand 24 hours. Flush each outlet proceeding from the service entrance to the furthest outlet for minimum of 1 minute and until water appears clear. Fill system with a solution of water and chlorine containing at least 10 parts per million of chlorine and allow to stand for 24 hours. Flush system with potable water until chlorine concentration is no higher than source water level.
- B. Wait 24 hours after final flushing. Take samples of water for lab testing. The number and location of samples shall be representative of the system size and configuration and are subject to approval by engineer. Test shall show the absence of coliform bacteria. If test fails, repeat disinfection and testing procedures until no coliform bacteria are detected. Submit test report indicating date and time of test along with test results.
- C. Piping that is pressure tested shall be drained completely dry. The piping system is not to be left full of

stagnant water. The piping system, water heaters and water softeners shall not be filled until within 10 days of occupancy to guard against microbial growth.

3.13 UNDERGROUND PIPE WRAP

- A. Use for steel piping encased in concrete or underground which is not in a conduit. Remove all dirt and other foreign material from exterior of pipe. Apply primer as recommended by the manufacturer. Use a spiral wrap process for applying tape to the pipe. Repair any breaks in the tape coating caused by the installation process.

3.14 DIELECTRIC UNIONS AND FLANGES

- A. Install dielectric unions or flanges at each point where a copper-to-steel pipe connection is required in domestic water systems.

3.15 UNIONS AND FLANGES

- A. Install a union or flange at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

3.16 PIPING SYSTEM LEAK TESTS

- A. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
- B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.
- C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
- D. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.

<u>System</u>	<u>Test Medium</u>	<u>Initial Test</u>		<u>Final Test</u>	
		<u>Pressure</u>	<u>Duration</u>	<u>Pressure</u>	<u>Duration</u>
*Below Ground Domestic Water	Water	N/A		200 psig	2 hr
Above Ground Domestic Water	Water	N/A		100 psig	8 hr
Above Ground Non-potable Water	Water	N/A		100 psig	8 hr

* Leakage on exterior mains 3" and larger may not exceed leakage calculated as follows:

$$\text{GPH Allowable Leakage} = \frac{(\text{Feet of Pipe}) (\text{Inches Dia. of Pipe}) (\text{Test Pressure})^5}{133,200}$$

3.17 PIPING SYSTEM TEST REPORT

State of Wisconsin

Department of Transportation

Date Submitted: _____

Project Name: _____

Location: _____ DOT Project No: _____

Contractor: _____

☐ Plumbing ☐ Fire Sprinkler

Test Medium: ☐ Air ☐ Water ☐ Other__

Test performed per specification section No. _____

Specified Test Duration _____ Hours Specified Test Pressure _____ PSIG

System Identification: _____

Describe Location: _____

Test Date: _____

Start Test Time: _____ Initial Pressure: _____ PSIG

Stop Test Time: _____ Final Pressure: _____ PSIG

Tested By: _____ Witnessed By: _____

Title: _____ Title: _____

Signed: _____ Signed: _____

Date: _____ Date: _____

Comments: _____

END OF SECTION 22 11 00

SECTION 22 13 00 - FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

1.1 SCOPE

- A. This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Delivery, Storage, and Handling
 - 8. Design Criteria
 - 9. Shop Drawings
 - 10. Welder Qualifications
- C. PART 2 - PRODUCTS
 - 1. Sanitary Waste and Vent
- D. PART 3 - EXECUTION
 - 1. General
 - 2. Preparation
 - 3. Erection
 - 4. Solvent Welded Pipe Joints
 - 5. Mechanical Hubless Pipe Connections
 - 6. Mechanical Joint Pipe Connections
 - 7. Push-On Gasketed Pipe Connections
 - 8. Mechanical Grooved Pipe Connections
 - 9. Mechanically Formed Tee Fittings
 - 10. Sanitary Waste and Vent
 - 11. Piping System Leak Tests

1.2 RELATED WORK

- A. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- B. Section 22 05 14 - Plumbing Specialties

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- ANSI A21.4
- ANSI A21.11
- ANSI A21.51
- ANSI B16.3 Malleable Iron Threaded Fittings

ANSI B16.4	Cast Iron Threaded Fittings
ANSI B16.5	Pipe Flanges and Flanged Fittings
ANSI B16.22	Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
ANSI B16.29	Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
ASTM A74	Cast Iron Soil Pipe and Fittings
ASTM A105	Forgings, Carbon Steel, for Piping Components
ASTM A126	Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A861	High Silicon Iron Pipe and Fittings
ASTM A888	Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B32	Solder Metal
ASTM B306	Copper Drainage Tube (DWV)
ASTM B813	Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM C76	Reinforced Concrete Culvert, Storm Drain and Sanitary Pipe
ASTM C564	Standard Specifications for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C1540	Standard Specifications for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings
ASTM D1785	Poly Vinyl Chloride (PVC) Plastic Pipe
ASTM D2241	Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2466	Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2564	Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
ASTM D2665	Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
ASTM D2729	Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
ASTM D2774	Recommended Practice for Underground Installation of Thermoplastic Pressure Piping
ASTM D2855	Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings
ASTM D3034	Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
ASTM D3139	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3222	Unmodified Poly Vinylidene Fluoride (PVDF) Molding Extrusion and Coating Materials
ASTM D3311	Drain, Waste and Vent (DWV) Plastic Fitting Patterns
ASTM F2618	CPVC Pipe and Fittings for Chemical Waste Drainage Systems

AWS A5.8 Brazing Filler Metal

CISPI 301 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain,
Waste and Vent Piping Applications

CISPI 310 Couplings For Use In Connection With Hubless Cast Iron Soil Pipe And
Fittings For Sanitary And Storm Drain, Waste And Vent Piping Applications

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.
- B. Order all copper, cast iron, steel, PVC and polyethylene pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the State.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

1.8 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, or CISPI specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system.
- C. Piping that is not according to ASTM E-84/UL723 for flame spread of <25 and smoke development of <50 shall not be utilized in ventilation plenum spaces, including plenum ceilings.
- D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- E. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at contractor's option. Where the grade or type is not specified, contractor may choose from those commercially available.

1.9 SHOP DRAWINGS

- A. Schedule from the contractor indicating the ASTM, or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.

- B. Statement from manufacturer on his letterhead that pipe furnished meets the ASTM, or CISPI specification contained in this section.

1.10 WELDER QUALIFICATIONS

- A. Welding procedures, welders, and welding operators for all building service piping to be according to certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic welding is performed, contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.
- B. Before any polyethylene fusion welding is performed, contractor to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures according to the Code of Federal Regulations, Title 49, Part 192, Section 192.285.
- C. The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the State's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project and all defective welds replaced.

PART 2 - PRODUCTS

2.1 SANITARY WASTE AND VENT

- A. INTERIOR ABOVE GROUND:
 - 1. Hubless cast iron soil pipe and fittings, ASTM A888; with no-hub couplings, CISPI 301, CISPI 310, ASTM A74. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Pipe Institute or receive prior approval of the engineer. Cast iron piping and fittings shall be of A B & I Foundry, Charlotte Pipe and Foundry, or Tyler Pipe manufacturers.
 - 2. PVC plastic pipe, Schedule 40, Class 12454 (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
- B. PRESSURIZED INTERIOR ABOVE GROUND: PVC Plastic pipe, Schedule 40, Class 12454, where temperature will not exceed 130 degrees F, ASTM D1784, ASTM D1785, with solvent cement joint fittings, pressure rated, ASTM D2466, medium or long sweep radius fittings; primer, ASTM F656; solvent cement, ASTM D2564.
- C. INTERIOR BELOW GROUND:
 - 1. Cast iron soil pipe and fittings, hub and spigot, service weight, ASTM A74, with neoprene rubber compression gaskets, ASTM C564, CISPI 301, and CISPI HSN 85. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Pipe Institute. Cast iron piping and fittings shall be of A B & I Foundry, Charlotte Pipe and Foundry, or Tyler Pipe manufacturers.
 - 2. PVC plastic pipe, Schedule 40, Class 12454 (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install pipe and fittings according to reference standards, manufacturers recommendations and recognized industry practices.

3.2 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.3 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Install underground warning tape 6"-12" below finished grade above all exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.
- D. Maintain piping in clean condition internally during construction.
- E. Provide clearance for installation of insulation, access to valves and piping specialties.
- F. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- G. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment
- H. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.4 THREADED PIPE JOINTS

- A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.5 SOLVENT WELDED PIPE JOINTS

- A. Install according to ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.
- B. Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle brushes about 1/2 the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4-5 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4" and larger. Hold joint for 30 seconds or until set. Reference manufacturer recommendations for initial set time before handling and for full curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when specifically approved by the DFD Project Representative.

3.6 MECHANICAL HUBLESS PIPE CONNECTIONS

- A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturers recommended torque.

3.7 MECHANICAL JOINT PIPE CONNECTIONS

- A. Comply with AWWA C600/C605 installation requirements. Clean pipe end and socket. Clean and lubricate pipe end, socket and gasket with soapy water or gasket lubricant. Place gland and gasket, properly oriented, on pipe end. Insert pipe end fully into socket and press gasket evenly into recess keeping joint straight. Press gland evenly against gasket, insert bolts and hand tighten nuts. Make joint deflection prior to tightening bolts. Evenly tighten bolts in sequence to recommended torque.

3.8 PUSH-ON GASKETED PIPE CONNECTIONS

- A. Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Ensure pipe is supported off the ground so lubricant does not pick up dirt. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

3.9 MECHANICAL GROOVED PIPE CONNECTIONS

- A. Use pipe factory grooved according to the coupling manufacturer's specifications or field grooved pipe according to the same specifications using specially designed tools specially designed for the application. Lubricate pipe and coupling gasket, align pipe, and secure joint according to the coupling manufacturer's specifications.

3.10 SANITARY WASTE AND VENT

- A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/4" per foot where possible and in no case less than 1/8" per foot for piping 3" and larger.
- B. Install exterior piping below predicted frost level and not less than 5' bury depth to top of pipe wherever possible. Where piping is located above predicted frost level, provide frost protection according to SPS 382.30(11)(c).
- C. Flush piping inlets (floor drains, hub drains, mop basins, fixtures, etc.) with high flow of water at completion of project to demonstrate full flow capacity. Remove blockages and make necessary repairs where flow is found to be impeded.

3.11 PIPING SYSTEM LEAK TESTS

- A. Isolate or remove components from system which are not rated for test pressure. Perform final testing for medical and lab gas with all system components in place. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
- B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.
- C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
- D. For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

- E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.

<u>System</u>	<u>Test</u>	<u>Initial Test</u>		<u>Final Test</u>	
	Medium	Pressure	Duration	Pressure	Duration
Sanitary Waste and Vent	Water	N/A		10' water	2 hr
Pressurized Sanitary Waste & Vent	Water	N/A		100 psig	2 hr

END OF SECTION 22 13 00

SECTION 22 14 00 - FACILITY STORM DRAINAGE

PART 1 - GENERAL

1.1 SCOPE

- A. This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Delivery, Storage, and Handling
 - 8. Design Criteria
 - 9. Shop Drawings
 - 10. Welder Qualifications
- C. PART 2 - PRODUCTS
 - 1. Storm and Clear Water Waste
- D. PART 3 - EXECUTION
 - 1. General
 - 2. Preparation
 - 3. Erection
 - 4. Threaded Pipe Joints
 - 5. Solvent Welded Pipe Joints
 - 6. Mechanical Hubless Pipe Connections
 - 7. Mechanical Joint Pipe Connections
 - 8. Push-On Gasketed Pipe Connections
 - 9. Mechanical Grooved Pipe Connections
 - 10. Mechanically Formed Tee Fittings
 - 11. Piping System Leak Tests

1.2 RELATED WORK

- A. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- B. Section 22 05 14 - Plumbing Specialties

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

ANSI A21.4

ANSI A21.11

ANSI A21.51

ANSI B16.3 Malleable Iron Threaded Fittings

ANSI B16.4 Cast Iron Threaded Fittings

ANSI B16.5	Pipe Flanges and Flanged Fittings
ANSI B16.22	Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
ANSI B16.29	Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
ASTM A74	Cast Iron Soil Pipe and Fittings
ASTM A105	Forgings, Carbon Steel, for Piping Components
ASTM A126	Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A861	High Silicon Iron Pipe and Fittings
ASTM A888	Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B32	Solder Metal
ASTM B88	Seamless Copper Water Tube
ASTM B306	Copper Drainage Tube (DWV)
ASTM B813	Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM C76	Reinforced Concrete Culvert, Storm Drain and Sanitary Pipe
ASTM C443	Joints for Circular Concrete Pipe Sewer and Culvert Pipe Using Rubber Gaskets
ASTM C564	Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C1540	Heavy Duty Shielded Couplings for Joining Hubless Cast Iron Soil Pipe and Fittings
ASTM D1785	Poly Vinyl Chloride (PVC) Plastic Pipe
ASTM D2321	Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM D2241	Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2464	Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2466	Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2513	Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D2564	Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
ASTM D2657	Heat Fusion Joining of Polyolefin Pipe and Fittings
ASTM D2665	Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings
ASTM D2729	Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
ASTM D2774	Recommended Practice for Underground Installation of Thermoplastic Pressure Piping
ASTM D2855	Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings
ASTM D3034	Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
ASTM D3139	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3311	Drain, Waste and Vent (DWV) Plastic Fitting Patterns

ASTM F2618	CPVC Pipe and Fittings for Chemical Waste Drainage Systems
ASTM D4101	Propylene Plastic Injection and Extrusion Materials
ASTM F405	Corrugated Polyethylene (PE) Tubing and Fittings
ASTM F437	Threaded Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F438	Socket Type Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F441	Chlorinated Poly Vinyl Chloride (CPVC Plastic Pipe, Schedules 40 and 80
ASTM F656	Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings
CISPI 301	Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications
CISPI 310	Couplings For Use In Connection With Hubless Cast Iron Soil Pipe And Fittings For Sanitary And Storm Drain, Waste And Vent Piping Applications

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.
- B. Order all copper, cast iron, steel, PVC and polyethylene pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the State.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

1.8 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, AWWA or CISPI specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system.
- C. Piping that is not according to ASTM E-84/UL723 for flame spread of <25 and smoke development of <50 shall not be utilized in ventilation plenum spaces, including plenum ceilings.

- D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- E. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at contractor's option. Where the grade or type is not specified, contractor may choose from those commercially available.

1.9 SHOP DRAWINGS

- A. Schedule from the contractor indicating the ASTM, AWWA or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.
- B. Statement from manufacturer on his letterhead that pipe furnished meets the ASTM, AWWA or CISPI specification contained in this section.

1.10 WELDER QUALIFICATIONS

- A. Welding procedures, welders, and welding operators for all building service piping to be according to certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic welding is performed, contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.
- B. Before any polyethylene fusion welding is performed, contractor to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures according to the Code of Federal Regulations, Title 49, Part 192, Section 192.285.
- C. The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the State's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project and all defective welds replaced.

PART 2 - PRODUCTS

2.1 STORM AND CLEARWATER WASTE and VENT

- A. INTERIOR ABOVE GROUND:
 - 1. Hubless cast iron soil pipe and fittings, ASTM A888; with no-hub couplings, CISPI 301, CISPI 310, ASTM A74. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Pipe Institute. Cast iron piping and fittings shall be of A B & I Foundry, Charlotte Pipe and Foundry, or Tyler Pipe manufacturers.
 - 2. PVC plastic pipe, Schedule 40, Class 12454 (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
- B. INTERIOR BELOW GROUND 15" AND SMALLER:
 - 1. Cast iron soil pipe and fittings, hub and spigot, service weight, CISPI 301, ASTM A74; ASTM A888 with neoprene rubber compression gaskets, ASTM C564 and CISPI HSN 85. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Pipe Institute. Cast iron piping and fittings shall be of A B & I Foundry, Charlotte Pipe and Foundry, or Tyler Pipe manufacturers.
 - 2. PVC plastic pipe, Schedule 40, Class 12454 (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install pipe and fittings according to reference standards, manufacturers recommendations and recognized industry practices.

3.2 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.3 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Where steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Maintain piping in clean condition internally during construction.
- D. Provide clearance for installation of insulation, access to valves and piping specialties.
- E. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- F. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment
- G. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.4 THREADED PIPE JOINTS

- A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.5 SOLVENT WELDED PIPE JOINTS

- A. Install according to ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.
- B. Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle brushes about 1/2 the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4-5 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4" and larger. Hold joint for 30 seconds or until set. Reference manufacturers recommendations for initial set time before handling and for full curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when specifically approved by the DFD Project Representative.

3.6 MECHANICAL HUBLESS PIPE CONNECTIONS

- A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturers recommended torque.

3.7 MECHANICAL JOINT PIPE CONNECTIONS

- A. Comply with AWWA C600/C605 installation requirements. Clean pipe end and socket. Clean and lubricate pipe end, socket and gasket with soapy water or gasket lubricant. Place gland and gasket, properly oriented, on pipe end. Insert pipe end fully into socket and press gasket evenly into recess keeping joint straight. Press gland evenly against gasket, insert bolts and hand tighten nuts. Make joint deflection prior to tightening bolts. Evenly tighten bolts in sequence to recommended torque.

3.8 PUSH-ON GASKETED PIPE CONNECTIONS

- A. Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Ensure pipe is supported off the ground so lubricant does not pick up dirt. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

3.9 MECHANICAL GROOVED PIPE CONNECTIONS

- A. Use pipe factory grooved according to the coupling manufacturer's specifications or field grooved pipe according to the same specifications using specially designed tools specially designed for the application. Lubricate pipe and coupling gasket, align pipe, and secure joint according to the coupling manufacturer's specifications.

3.10 PIPING SYSTEM LEAK TESTS

- A. Isolate or remove components from system which are not rated for test pressure. Perform final testing for medical and lab gas with all system components in place. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
- B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.
- C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
- D. For air or nitrogen tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.
- E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.

System	Test	Initial Test		Final Test	
	Medium	Pressure	Duration	Pressure	Duration
Storm	Water	N/A		10' water	2 hr

END OF SECTION 22 14 00

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes specifications for water heaters, water softeners, pumps and other equipment used for plumbing applications. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Documents
 - 3. Reference
 - 4. Federal Bidding Requirements
 - 5. Quality Assurance
 - 6. Shop Drawings
 - 7. Operation and Maintenance Data
- C. PART 2 - PRODUCTS
 - 1. Water Heaters
 - 2. Sumps
 - 3. Pumps
 - 4. In-Line Centrifugal Pumps
 - 5. Domestic Water Variable Speed Booster Pumps
 - 6. Expansion Tanks
- D. PART 3 - EXECUTION
 - 1. Installation

1.2 RELATED DOCUMENTS

- A. Section 22 05 23 - General-Duty Valves for Plumbing Piping
- B. Section 22 05 15 - Piping Specialties
- C. Section 22 07 00 - Plumbing Insulation
- D. Division 26 00 00 - Electrical

1.3 REFERENCE

- A. Applicable provisions of Division 1 shall govern work under this section.

1.4 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.5 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Article 7.
- B. Plumbing products requiring approval by the State of Wisconsin Dept. of Safety and Professional Services must be approved or have pending approval at the time of shop drawing submission.

1.6 SHOP DRAWINGS

- A. Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights, pump curves with net positive suction head requirements, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

1.7 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

2.1 HIGH EFFICIENCY STAINLESS STEEL COMMERCIAL GAS FIRED WATER HEATER

- A. Manufacturers: Heat Transfer Products, Hamilton Engineering, PVI Conquest.
- B. Type: Modulating gas fired sealed combustion condensing commercial water heater. Design to be AGA certified with 3 year tank warranty and 1 year parts warranty.
- C. Efficiency: Minimum Thermal Efficiency = 94%
or
Minimum Thermal Efficiency = 93% and
Maximum Standby Loss (btu/hr) = $.84 \times (Q/800 + 110\sqrt{V})$
Q=Input Btu/h, V=Volume Gallons
- D. Tank: 316L stainless steel or phase-balanced austenitic and ferritic duplex steel with minimum 21% chromium mill certified per ASTM A 923 Method A rated for 150 psig complete with stainless steel pipe fittings, submerged combustion chamber, 90/10 cupronickel or 316L stainless steel heat exchanger, insulation, plastic jacket, brass drain valve and temperature and pressure relief valve.
- E. Burner: Stainless steel power burner.
- F. Controls: 120 volt, 1 phase, 60 Hz self-diagnostic electronic microprocessor controls, intermittent spark or hot surface ignition, operating thermostat with 70o-180oF adjustable temperature control, F. energy cutoff with manual reset, blower pressure switch, gas valve and pressure regulator.
- G. Vent: Schedule 40 solid wall CPVC with DWV fittings for flue gas outlet and schedule 40 solid wall PVC with DWV fittings for combustion air intake with solvent weld fittings and vent termination fitting.
- H. Condensate Drain: PVC with solvent weld fittings. Drain neutralizer package.

2.2 SUMPS

- A. Fiberglass sump basin constructed of 25-30% fiberglass and 70-75% polyester resin with no fillers; minimum design safety factor of four; complete with tapped top flange; side hub fittings; bolted galvanized steel or aluminum (fiberglass) gasketed cover with inspection access plate, access plate with discharge pipe flange for each pump and control and vent flange where required. Minimum sump wall thickness as follows:

Diameter	Wall Thickness (Inches)						
	24	30	36	42	48	60	72
Max. 10' Depth	3/16	1/4	1/4	1/4	5/16	5/16	3/8
Max. 15' Depth	1/4	5/16	5/16	5/16	3/8	3/8	7/16
Max. 20' Depth	5/16	5/16	3/8	3/8	7/16	1/2	1/2

2.3 SUMP PUMPS

- A. Manufacturer: Aurora/Hydromatic, Gould, Little Giant, Myers, Paco, Stancor, Sta-Rite, Weil, Zoeller.

- B. Type: Submersible pumps constructed of epoxy coated cast iron shell, cast iron volute, two vane enclosed (semi-open) non-clog cast iron, bronze or thermoplastic impeller, stainless steel shaft, stainless steel fasteners, upper and lower ball bearings, oil lubricated or factory sealed grease lubricated, and ceramic mechanical seal.
- C. Motor: Hermetically sealed, capacitor start, with built-in thermal overload protection sized for non-overloading over the entire pump curve.
- D. CONTROLS:
 - Single On/Off float switch, UL listed.
 - NEMA 1 indoor alarm panel with warning light, horn, silence switch, test switch and high level alarm switch, UL listed.
- E. ACCESSORIES:
 - 10' power cord.
 - NEMA 4 junction box.
 - Discharge check valve, fullport ball valve and union for each pump.
 - Dual mechanical seals, seal leak detector probe and warning light in control panel.
 - Dual stainless steel lift out guide rails with stainless steel wall, pump and sump brackets, bronze and neoprene quick disconnect fitting and corrosion proof pull chain or cable.

2.4 IN-LINE CENTRIFUGAL PUMPS

- A. Manufacturer: Bell and Gossett, Gould, Grundfos, Taco.
- B. Type: Lead free potable water in-line pumps, 150 psig maximum working pressure at operating temperature of 205oF continuous. The manufacturer shall certify all pump ratings. All pumps to operate without excessive noise or vibration.
- C. Casing: Lead free bronze with sweat or FNPT threaded connection. Wet parts to be 316 stainless shaftless, seal-less construction.
- D. Impeller: Noryl/PPO.
- E. Bearings: Carbon/Alumina Ceramic lubricated by the system fluid.
- F. Electrical: 100-140v 60 HZ, 5 – 28 watts power consumption, automatic overload protection.
- G. Motor: Provide pump with motor with spherical permanent magnet electrically commutated motor (EMC) built-in adjustable thermostat from 68F to 158F, along with thermal overload protection sized for non-overloading over the entire pump curve. Furnish each pump and motor with a nameplate giving the manufacturer's name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current.

2.5 DOMESTIC WATER VARIABLE SPEED BOOSTER PUMPS

- A. Manufacturer: Aurora, Bell and Gossett, SyncroFlo, Taco, Tigerflow, Grundfos.
- B. General: Factory packaged and tested simplex domestic water booster pumps with all components fully frame mounted, piped, painted, wired and tested at factory. Entire booster pump skid to carry ANSI/NSF 61 certification for drinking water.
- C. Type: High efficiency vertical multi-stage pumps, 150 psig maximum working pressure at operating temperature of 225oF. continuous. The manufacturer shall certify all pump ratings. All pumps to operate without excessive noise or vibration.
- D. Casings: Top or rear pullout design with 304 or 316 stainless steel or gray iron volute, backplate and stainless steel or bronze wearing rings.
- E. Impellers: 304 or 316 stainless steel lead free brass or bronze, keyed to the shaft, hydraulically and dynamically balanced.

- F. Shafts: Stainless or carbon steel with stainless steel or bronze sleeve, integral thrust collar.
- G. Seals: Mechanical type, carbon rotating against a stationary ceramic seat, 225°F maximum continuous operating temperature.
- H. Motors: Provide pumps with open drip-proof motor sized for non-overloading over the entire pump curve. Furnish each pump and motor with a nameplate giving the manufacturer's name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current.
- I. Valves: Lead free butterfly or ball isolation valves at inlet and outlet of each pump and non-slam silent check valves at discharge of each pump. Pump casing discharge temperature relief valves piped to floor/open site drain.
- J. Pressure Gauges: One per pump piped with isolation valves to pump suction and discharge.
- K. Manifold Piping: 304 or 316 stainless steel rated for 300 psig, sized for maximum velocity of 10 ft/s.
- L. Variable Frequency Drives (VFD's):
 - 1. The unit shall be U.L. listed, solid state, microprocessor based with a pulse width modulated (PWM) output wave form (none others are acceptable).
 - 2. The VFD shall employ a full wave bridge rectifier and capacitors to minimize the ripple of the rectified voltage to maintain near constant DC voltage. Insulated gate bipolar transistors (IGBT's) shall be employed as the output switching device.
 - 3. The VFD package shall contain the equivalent of 5% impedance to reduce harmonic distortion. The 5% equivalent impedance shall be provided in the form of a DC bus choke, an input AC line reactor in each phase, or a combination of the two methods.
 - 4. Control circuitry shall be plug-in, plug-out modular basis with a corrosion resistant coating on printed circuit boards.
 - 5. Units to be suitable for an operating environment from 0°C to 40°C temperature and humidity up to 90% non-condensing.
 - 6. Units shall be suitable for input power of electrical system as scheduled on the drawings $\pm 10\%$, 3 phase, 60 Hertz nominal.
 - 7. Use a current limiting control device to limit output current to 110% continuous for one minute; also refer to Protection Features in this section. Full load output current available from drive shall not be less than motor nameplate amperage. The full load amp rating of the VFD shall not be less than the values indicated in the NEC Table 430-150.
 - 8. Output power shall be suitable for driving standard NEMA B design, three phase alternating current induction motors at full rated speed with capability of 6:1 turndown.
- M. Controls: Electronic programmable logic controller with non-volatile memory (no battery backup required), LED/OLED/LCD display of setpoints, pump status, speed, manual speed setting, flow rate GPM, suction and discharge pressure, low and high pressures, pump(s) currently running, pump run time, visual and audible alarms and event history. Controller to include virtual H-O-A switch for each pump and manual speed control, low and high pressure settings with adjustable on/off delays and manual-auto option reset, automatic and manual pump alternation, minimum pump runtimes, alarm silence. PID control algorithm capable of meeting ASHRAE 90.1 requirements. Equip with 4-20 mA suction and discharge pressure transducers. Provide VFD's as specified above for modulating the speed of each pump. Enclose in UL NEMA 1 control panel with the following components: VFD's, magnetic across the line motor starters with 3 leg overload protection and external resets, starter failure interlocks, single door interlocked disconnect with individual fuses, control circuit transformer with protected secondary.

2.6 EXPANSION TANKS

- A. Manufacturer: Amtrol, Bell and Gossett, Wessels.
- B. Vertical steel precharged hydro-pneumatic expansion tank, 125 psi ASME labeled construction, complete with replaceable flexible butyl rubber bladder, system connection fitting, Schrader type air charge fitting, steel base ring stand, factory prime and enamel painted exterior finish, ASME relief valve. Materials exposed to water to be NSF or FDA approved for potable water service.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install plumbing equipment where indicated according to manufacturer's recommendations.
- B. Coordinate equipment location with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- C. Set commercial water heaters and booster pumps on concrete housekeeping pads. Adjust and level equipment.
- D. Set sumps on compacted granular backfill adjusting for plumb and level. Backfill in even layers around sump with granular backfill.
- E. Connect equipment to water and drain piping using unions or flanges and isolation valves.
- F. Size temperature and relief valves per CSA ratings. Pipe temperature and pressure relief valves to floor drain or floor as indicated.
- G. Startup and test equipment adjusting operating and safety controls for proper operation.
- H. Lubricate pumps before startup. Adjust pumps for rated flow. Clean and blowdown strainers after 8 hours of operation.
- I. Adjust compression tank precharge to scheduled minimum operating pressure prior to connecting to system.

END OF SECTION 22 30 00

SECTION 22 42 00 - COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SCOPE

A. This section includes specifications for plumbing fixtures, faucets and trim.

B. PART 1 - GENERAL

1. Scope
2. Related Work
3. Reference
4. Federal Bidding Requirements
5. Quality Assurance
6. Shop Drawings
7. Operation and Maintenance Data
8. Design Criteria
9. Energy Efficiency Requirements

C. PART 2 - PRODUCTS

1. Plumbing Fixtures

D. PART 3 - EXECUTION

1. Installation

1.2 RELATED WORK

A. Section 22 11 00 - Facility Water Distribution B. Section 22 13 00 - Facility Sanitary Sewerage C. Section 22 14 00 - Facility Storm Drainage D. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment

B. Section 22 05 14 - Plumbing Specialties

1.3 REFERENCE

A. Applicable provisions of Division 1 shall govern work under this section.

1.4 FEDERAL BIDDING REQUIREMENTS

A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00

B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.5 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

B. Plumbing products requiring approval by the State of Wisconsin Dept. of Safety and Professional Services must be approved or have pending approval at the time of shop drawing submission.

1.6 SHOP DRAWINGS

A. Include data concerning sizes, utility sizes, rough in-dimensions, capacities, materials of construction, ratings, weights, trim, finishes, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

1.7 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.8 DESIGN CRITERIA

ANSI A112.6.1M-88 - Supports for Off-the Floor Plumbing Fixtures for Public Use.

ANSI A112.18.1-94 - Finished and Rough Brass Plumbing Fixture Fittings.

ANSI A112.19.1-90 - Enameled Cast Iron Plumbing Fixtures.

ANSI A112.19.2M-82 - Vitreous China Plumbing Fixtures.

ANSI A112.19.5-79(R1990) - Trim for Water Closet Bowls, Tanks and Urinals.

ANSI Z124.2-87 - Plastic Shower Receptors and Shower Stalls.

ARI-1010-94 - Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers.

ASSE 1011-93 - Hose Connection Vacuum Breakers.

ASSE 1014-90 - Handheld Showers.

1.9 ENERGY EFFICIENCY REQUIREMENTS

A. Plumbing fixtures must meet the following maximum water usage requirements which are based upon Federal Energy Management Program (FEMP) performance requirements.

- 1 Lavatory Faucets, flow of 2 gpm or less and .25 gallon per cycle or less (based on inlet pressure of 60 p.s.i.)
2. Showerheads, flow of 2.2 gpm or less (based on inlet pressure of 80 p.s.i.)
3. Urinal Flush Valves, 1.0 gallon per flush or less.
4. Water Closet Flush Valves, 1.6 gallon per flush or less.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. Manufacturers: Fixture descriptions establish fixture type, quality, materials, features and size. Products of the following manufacturers determined to be equal by the Architect/Engineer will be accepted. Plumbing Contractor is responsible to provide only products that meet the Buy American Act.

- Water Closets - American Standard, Zurn.
- Water Closet Seats - Bemis, Beneke, Centoco, Olsonite Sperzel.
- Urinals – American Standard, Zurn.
- Lavatories – American Standard, Zurn.
- Faucets - Chicago Faucet, Speakman, Symmons, Zurn.
- Drains - Chicago Faucet, Engineered Brass Co., McGuire.
- Stops and Supplies - Chicago Faucet Co., McGuire. (Heavy Duty Type Only)
- Flush Valves - Sloan Royal, Zurn AV.
- Traps - McGuire, Dearborn, Engineered Brass Co. (17 gauge Min.)
- Carriers and Supports - Josam, Smith, Wade, Watts Drainage, Zurn.
- Sinks - American Standard, Elkay, Just.
- Laundry Trays - Fiat, Mustee, Stern-Williams.
- Mop Basins - Fiat, Mustee, Stern-Williams.
- Showers - Leonard, Powers, Speakman, Symmons.
- Molded Tub and Shower Units – Aker, Aqua Glass, Fiat, Lasco.

- Electric Water Coolers - Elkay, Halsey Taylor, Haws, Filtrine, Oasis, Sunroc.
- Emergency Eyewash Fountains and Showers - Bradley, Chicago Faucet Co., Guardian, Haws, Speakman.

B. WATER CLOSETS

WC-1 - Wall hung back outlet white vitreous china siphon jet water closet with elongated bowl, 1-1/2" top spud, 2-1/4" passageway, mounted at ADA 16-1/2" rim height and 1.1 to 1.6 gallon flush capacity. Flush valve 1.6 gallon per flush, handle located to the wide (left) side of the stall and be ADA compliant for activation force.

- Fixture: American Standard 2257101.020.
- Flush Valve: Sloan Sloan Royal 111-1.6.
- Seat: Bemis 1655-SS/C white solid plastic open front.
- Carrier: Smith commercial grade adjusted for 16-1/2" bowl height.

WC-2 - Wall hung back outlet white vitreous china siphon jet water closet with elongated bowl, 1-1/2" top spud, 2-1/4" passageway, mounted at ADA 16-1/2" rim height and 1.1 to 1.6 gallon flush capacity. Flush valve 1.6 gallon per flush, handle located to the wide (right) side of the stall and be ADA compliant for activation force.

- * Fixture: American Standard 2257101.020.
- * Flush Valve: Sloan Sloan Royal 111-1.6.
- * Seat: Bemis 1655-SS/C white solid plastic open front.
- * Carrier: Smith commercial grade adjusted for 16-1/2" bowl height.

WC-3 - Wall hung back outlet white vitreous china siphon jet water closet with elongated bowl, 1-1/2" top spud, 2-1/4" passageway, mounted at 15" rim height and 1.1 to 1.6 gallon flush capacity. Flush valve 1.6 gallon per flush.

- * Fixture: American Standard 2257101.020.
- * Flush Valve: Sloan Sloan Royal 111-1.6.
- * Seat: Bemis 1655-SS/C white solid plastic open front.
- * Carrier: Smith commercial grade adjusted for 15" bowl height.

C. URINALS

U-1 - Wall mount white vitreous china washout urinal with 3/4" top inlet spud, 2" outlet, removable strainer, ADA 17" rim height. Handle operated flush valve, 0.5 gallon per flush or less.

- * Fixture: American Standard 659001.
- * Flush Valve: Sloan Royal 186-0.5.
- * Carrier: Smith commercial grade adjusted for 17" lip height.

D. LAVATORIES

L-1 - Wall mount barrier free white vitreous china lavatory drilled for concealed arm carrier with single faucet hole. Faucet with wrist blade operation and .5 gpm flow

- * Fixture: American Standard 9024001EC.020.
- * Faucet: American Standard 7075.104.
- * Drain: Zurn Z8746. perforated strainer and 1-1/4" offset tailpiece.
- * Trap: 1-1/4"x1-1/2" 17 ga. cast brass trap and tubular wall bend. With C.O. plug.
- * Supplies and Stops: Zurn Z8804-XL-LR-PC.
- * Under Lav Protection: Truebro 103 E-Z
- * Carrier: Smith floor mounted concealed arm adjusted for 34" height.

L-2 - Counter mount with undermount bowl with single faucet hole, and front overflow. Faucet with wrist blade operation and .5 gpm flow.

- * Fixture: Elkay ELUH1511.
- * Faucet: American Standard 7075.104.
- * Drain: Zurn Z8746. perforated strainer and 1-1/4" offset tailpiece.
- * Trap: 1-1/4"x1-1/2" 17 ga. cast brass trap and tubular wall bend. With C.O. plug.

- * Supplies and Stops: Zurn Z8804-XL-LR-PC.
- * Under Lav Protection: Truebro 103 E-Z

E. LAUNDRY TRAYS

LT-1 - Wall mounted molded polyester resin and stone single compartment laundry tray with wall bracket and painted steel legs. Secure to wall and floor.

- * Fixture: Fiat L-1.
- * Faucet: Chicago Faucet No. 891-317ABCP
- * Supplies and Stops: Zurn Z8804-XL-LRLK-PC w/ 3/8" risers, length as necessary.
- * Trap: 1-1/2"x1-1/2" 17 ga. cast brass trap and tubular wall bend, with tailpiece.

F. MOP BASINS

MS-1 - Floor mounted molded polyester resin and stone mop basin, 24"x24"x10" H, with 3" drain, stainless steel strainer and vinyl bumper guards.

- * Fixture: Fiat MSB-2424.
- * Faucet: Chicago Faucet No.897RCF with Watts 8BC vacuum breaker.
- * Hose: Fiat 832-AA.
- * Stops: (Integral with faucet)
- * Wall Panels: Fiat MSG2424
- * Mop Hanger: Fiat 889CC

G. SINKS

S-1 - Counter mounted 18 ga. type 304 stainless steel double compartment sink with faucet openings to match faucet. Deck mounted faucet with 8" gooseneck, wrist blade handle and 1.5 gpm laminar flow outlet, chrome finish.

- * Fixture: Elkay LR3322.
- * Faucet: Elkay LKGT4083.
- * Drains: Elkay LK99.
- * Waste: McGuire No. 113C16G17, Center outlet, 17 ga.
- * Traps: 1-1/2"x1-1/2" 17 ga. cast brass trap and tubular wall bend.
- * Supplies and Stops: Zurn Z8804-XL-LR-PC w/ 3/8" riser, length as necessary.

S-2 - Counter mounted 18 ga type 304 stainless steel single compartment sink with integrated drain and faucet openings. Deck mounted faucet with 5½" gooseneck, wrist blade handle and 1.5 gpm laminar flow outlet, chrome finish.

- * Fixture: Elkay LR2219PD.
- * Faucet: Elkay LKGT4083.
- * Drain: Elkay LK-99.
- * Trap: 1-1/2"x1-1/2" 17 ga. cast brass trap and tubular wall bend, With C.O. plug.
- * Supplies and Stops: Zurn Z8804-XL-LR-PC w/ 3/8" riser, length as necessary.

H. HAND SINK

HS-1 - Wall mount barrier free white vitreous china lavatory drilled for concealed arm carrier with single faucet hole. Faucet with wrist blade operation and .5 gpm flow

- * Fixture: American Standard 9024001EC.020.
- * Faucet: American Standard 7075.104.
- * Drain: Zurn Z8746. perforated strainer and 1-1/4" offset tailpiece.
- * Trap: 1-1/4"x1-1/2" 17 ga. cast brass trap and tubular wall bend. With C.O. plug.
- * Supplies and Stops: Zurn Z8804-XL-LR-PC.
- * Under Lav Protection: Truebro 103 E-Z
- * Carrier: Smith floor mounted concealed arm adjusted for 34" height.

I. ELECTRIC WATER COOLERS

EWC-1 - Dual level, wall mounted, barrier free and standard height, stainless steel finish water cooler/drink fountain station with front push bar operators and bottle fill. Single recessed steel mounting box with refrigeration system and stainless steel removable front grille for access. Rated for 8.0 GPH at 80 degree inlet water at 90 degree ambient temperature and 50 degree outlet water., 1/5 HP compressor, 380 watt, 120/60/1. Sensor operated bottle fill.

- * Fixture: Elkay LZSTL8WSLK
- * Traps: 1 1/4"x1 1/4" 17 ga. cast brass, with C.O. plug.
- * Stops: 1/2" ball valve with 1/2" riser (concealed).

J. EMERGENCY EYEWASH FOUNTAINS AND SHOWERS

EW-1 - Wall mounted barrier-free emergency eye/face wash with plastic bowl and dust cover, eye and face wash fittings, 1/2" ball valve with push flag operator, dome strainer and wall bracket.

- * Fixture: Bradley S19224PDCFW.
- * Trap: 1-1/4"x1-1/4" 17 ga. cast brass trap with tubular wall return.
- * Mixing Valve: Surface mounted with white enameled cabinet see schedule.

EW/SH-1 - Floor mounted barrier-free emergency eyewash and shower with plastic shower head and stainless-steel bowl with dust cover, brass eyewash fittings, 1" spring return shower valve with pull handle, 1/2" eyewash ball valve with push flag operator, 1-1/4" galvanized steel pipe stand with floor flange.

- * Fixture: Bradley S19314DCBF.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install plumbing fixtures according to manufacturers instructions. Set level and plumb. Secure in place to counters, floors and walls providing solid bearing and secure mounting. Bolt fixture carriers to floor and wall. Secure rough-in fixture piping to prevent movement of exposed piping.
- B. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.
- C. Install barrier free fixtures in compliance with IBC 1108 and 3408, SPS 352, 369 and Federal ADA Accessibility Guidelines. Install barrier free lavatory traps parallel and adjacent to wall and supplies and stops elevated to 27" above floor to avoid contact by wheelchair users.
- D. Provide unions at water connections to electric water coolers.
- E. Each fixture shall have a stop valve installation to control the fixture. Stop valves shall be heavy duty type with brass stems and screwed or sweat inlet connections. Compression type inlets are not acceptable.
- F. Cover pipe penetrations with escutcheons. Exposed traps, stops, piping and escutcheons to be chrome plated brass, same items in concealed locations may be of rough brass finish.
- G. Set floor mounted water closets, floor mounted service sinks; counter mounted lavs and sinks; lav and sink faucets and drains with full setting bed of flexible non-staining plumber's putty. Cover exposed water closet bolts with bolt covers.
- H. Set mop basins to floor and wall with grout or silicone sealant.
- I. Seal openings between walls, floors and fixtures with mildew-resistant silicone sealant same color as fixture.

- J. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components. Adjust valves for intended water flow rate to fixtures without splashing, noise or overflow. Adjust self-closing lavatory faucets to 15 second cycle. Adjust shower valve temperature limit stops to 110 degree maximum outlet temperature.
- K. Protect fixtures during construction. At completion clean plumbing fixtures and trim using manufacturer's recommended cleaning methods and materials.

END OF SECTION 22 42 00

END OF DIVISION 22 - PLUMBING

60. SWEF\Post Building, Heating & Ventilation (HVAC), Item SPV.0060.102.

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 00 00 – HEATING, VENTILATING, AND AIR CONDITIONING TABLE OF CONTENTS

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END OF INDEX

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes information common to two or more technical specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Protection of Finished Surfaces
 - 8. Sleeves and Openings
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- C. PART 2 - Products
 - 1. Access Panels and Doors
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 - 10. Sealing and Firestopping
 - 11. Cleaning Equipment, Ductwork, and Premises
 - 12. Guarantee
 - 13. Certification of Tests and Adjustments

1.2 RELATED WORK

- A. Section 23 05 13 - Common Motor Requirements for HVAC
- B. Section 23 33 00 - Air Duct Accessories

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. Abbreviations of standards organizations referenced in other sections are as follows:

AABC	Associated Air Balance Council
ABMA	American Boiler Manufacturers Association
ADC	Air Diffusion Council
AGA	American Gas Association
AMCA	Air Movement and Control Association
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
EPA	Environmental Protection Agency
GAMA	Gas Appliance Manufacturers Association
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrument Society of America
MCA	Mechanical Contractors Association
MICA	Midwest Insulation Contractors Association
MSS	Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association. Inc.
UL	Underwriters Laboratories Inc.
ASTM E814	Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
UL1479	Fire Tests of Through-Penetration Firestops
UL723	Surface Burning Characteristics of Building Materials

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00

- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.
- B. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the performance from the system into which these items are placed. This may include changes found necessary during the testing, adjusting, and balancing phase of the project.

1.7 PROTECTION OF FINISHED SURFACES

- A. Refer to Division 1, General Requirements, Protection of Finished Surfaces.
- B. Furnish one can of touch up paint for each different color factory finish which is to be the final finished surface of the product. Deliver touch up paint with other "loose and detachable parts" as covered in the General Requirements.

1.8 SLEEVES AND OPENINGS

- A. Refer to Division 1, General Requirements, Sleeves and Openings.

1.9 SEALING AND FIRESTOPPING

- A. Sealing and firestopping of sleeves/openings between ductwork, piping, etc. and the sleeve, structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening. Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations.

1.10 EQUIPMENT SUBSTITUTIONS

- A. Contractors and/or manufacturers may submit catalog data on material proposed for substitution to the engineer for evaluation up to 10 days prior to the date for opening bids. The engineer will render an opinion on whether or not the material can be bid as a substitute based on the information received. Final approval for the use of substitute equipment will not be given until complete shop drawings, samples or other information deemed necessary by the engineer has been submitted.

1.11 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents.
- C. Before submitting electrically powered equipment, verify that the electrical power and control requirements for the equipment are in agreement with the motor starter schedule on the electrical drawings. Starters and disconnects which are not explicitly defined as the responsibility of any contractor shall be provided by the Division 23 contractor. Include a statement on the shop drawing transmittal to the architect/engineer that the equipment submitted and the motor starter schedule are in agreement or indicate any discrepancies. See related comments in Section 23 05 13 in Part 1 under Electrical Coordination.
- D. Include wiring diagrams of electrically powered equipment.
- E. Submit sufficient quantities of shop drawings to allow the following distribution:
 - Operating and Maintenance Manuals 3 copies
 - Testing, Adjusting and Balancing Contractor 1 copy
 - A/E 1 copy

- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.12 OFF-SITE STORAGE

- A. Prior approval by General Contractor/Construction Manager and the A/E will be needed.
- B. Generally, ductwork, metal for making ductwork, duct lining, sleeves, pipe/pipe fittings and similar rough in material will not be accepted for off-site storage. For material that can be stored off site, no material will be accepted for off-site storage unless shop drawings for that material have been approved.

1.13 CERTIFICATES AND INSPECTIONS

- A. Refer also to Division 1, General Conditions, Permits, Regulations, Utilities and Taxes.
- B. Contractors installing heating, ventilating, and air conditioning systems or equipment in the State of Wisconsin must be licensed. The contractor must provide proof of current and valid license upon request and maintain license through project completion.
- C. Obtain and pay for all required State installation inspections except those provided by the Architect/Engineer according to Wis Adm Code SPS 302. Deliver originals of these certificates to the A/E. Include copies of the certificates in the Operating and Maintenance Instructions.
- D. All utility connection fees shall be paid by the respective contractor.

1.14 OPERATING AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.
- B. Assemble material in three ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment. In addition to the data indicated in the General Requirements, include the following information:
 - Copies of all approved shop drawings
 - Manufacturer's wiring diagrams for electrically powered equipment
 - Records of tests performed to certify compliance with system requirements
 - Certificates of inspection by regulatory agencies
 - Temperature control record drawings and control sequences
 - Parts lists for manufactured equipment
 - Valve schedules
 - Lubrication instructions, including list/frequency of lubrication done during construction
 - Warranties
 - Additional information as indicated in the technical specification sections
 - A copy of signed Certification of Tests and Adjustments Form
 - Final Testing, Adjusting, and Balance Report

1.15 TRAINING OF OWNER PERSONNEL

- A. Instruct Owner personnel in the proper operation and maintenance of systems and equipment provided as part of this project; video tape all training sessions. Include not less than 8 hours of instruction, using the Operating and Maintenance manuals during this instruction. Demonstrate startup and shutdown procedures for all equipment. All training to be during normal working hours.

1.16 RECORD DRAWINGS

- A. Refer to Division 1, General Requirements, Record Drawings.
- B. In addition to the data indicated in the General Requirements, maintain temperature control record drawings on originals prepared by the installing contractor/subcontractor. Include copies of these record drawings with the Operating and Maintenance manuals.

PART 2 - PRODUCTS

2.1 ACCESS PANELS AND DOORS

- A. LAY IN CEILINGS: Removable lay in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Section 09500 are sufficient; no additional access provisions are required unless specifically indicated.
- B. PLASTER WALLS AND CEILINGS: 16-gauge frame with not less than a 20-gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch for general applications, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 12" by 12".

2.2 IDENTIFICATION

- A. STENCILS: Not less than 1 inch high letters/numbers for marking pipe and equipment.
- B. SNAP-ON PIPE MARKERS: Cylindrical self-coiling plastic sheet that snaps over piping insulation and is held tightly in place without the use of adhesive, tape or straps. Not less than 1 inch high letters/numbers and flow direction arrows for piping marking. W. H. Brady, Seton, Marking Services, or equal.
- C. ENGRAVED NAME PLATES: White letters on a black background, 1/16 inch thick plastic laminate, beveled edges, screw mounting, Setonply Style 2060 by Seton Name Plate Company or Emedolite- Style EIP by EMED Co., or equal by Marking Services, or W. H. Brady.
- D. VALVE TAGS: Round brass tags with 1/2 inch numbers, 1/4 inch system identification abbreviation, 1 1/4 inch minimum diameter, with brass jack chains or brass "S" hooks around the valve stem, available from EMED Co., Seton Name Plate Company, Marking Services, or W. H. Brady.

2.3 SEALING AND FIRESTOPPING

- A. FIRE AND/OR SMOKE RATED PENETRATIONS:
 - 1. Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with UL and ASTM.
 - 2. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
- B. NON-RATED PENETRATIONS:
 - 1. Pipe Penetrations: At pipe penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between pipe insulation and sleeve. For non-rated drywall, plaster or wood partitions where sleeve is not required use urethane caulk in annular space between pipe insulation and wall material.
 - 2. Duct Penetrations: Annular space between duct (with or without insulation) and the non-rated partition or floor opening shall not be larger than 2". Where existing openings have an annular space larger than 2", the space shall be patched to match existing construction to within 2" around the duct.
 - 3. Where shown or specified, pack annular space with fiberglass batt insulation or mineral wool insulation. Provide 4" sheet metal escutcheon around duct on both sides of partition or floor to cover annular space.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL

- A. Perform all excavation and backfill work to accomplish indicated mechanical systems installation according to Division 31 Earthwork. Blasting will not be allowed without written permission of the Architect/Engineer and the Owner.
- B. Install lines passing under foundations with minimum of 1½ inch clearance to concrete and ensure there is no disturbance of bearing soil.

3.2 CONCRETE WORK

- A. All cast in place concrete will be performed by the Division 3 Contractor unless otherwise noted. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for support of mechanical equipment.

3.3 CUTTING AND PATCHING

- A. Refer to Division 1, General Requirements, Cutting and Patching.

3.4 BUILDING ACCESS

- A. Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access was not previously arranged and must be provided by this contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.5 EQUIPMENT ACCESS

- A. Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance and service. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Access doors in general construction are to be furnished by the Mechanical Contractor and installed by the General Contractor.
- B. For equipment that is accessed above acoustical lay in ceilings or access doors, label the ceiling tile grid at the ceiling tile that is to be removed for access to the equipment or the access door. The label shall be pre-printed using clear polyester tape with black bold 28 size font for ceilings under 12 feet. For ceilings over 12 feet high, use bold 40 size font. For accessible ceilings, use an arrow to point at ceiling tile to be removed for access. Label shall match equipment tag designation used on mechanical plans.
- C. Ductwork, equipment, and piping below 7'-6" above finished floor shall have a resilient material (foam rubber, etc.) attached to all potentially dangerous edges.
- D. Suspended equipment in public motor vehicle areas to be mounted a minimum of 8' above finished floor or 12" higher than tallest vehicle garage door opening; whichever is greater, unless equipment is protected from motor vehicle impact.
- E. A guard is required on roof mounted equipment, including exhaust fans, located within 10' of roof edge and containing an open side that is greater than 30" above the floor, roof, or grade below. Guard must be at least 30" beyond side of unit.

3.6 COORDINATION

- A. Mechanical systems are shown on drawings that were coordinated with the architectural drawings; however, variations may occur. Contractor shall verify all information critical to the placement of devices with the architectural drawings to assure proper installation. Field measurements shall take precedence over drawing dimensions and shall be verified. Plans shall not be scaled to locate equipment. It shall be the contractor's responsibility to become acquainted with all conditions, and ascertain the extent of work involved in installing equipment, ductwork, air distribution devices, piping, controls and all other appurtenances pertaining to the above. The contractor shall provide all labor, materials, etc., required for the complete, new installation required for the completion of the project. By the act of submitting a price; or in the case of time and material project, begin work, the contractor shall be deemed to have performed such an examination, to have accepted such conditions, and to have made allowances therefore preparing his price and resolving questions regarding work required.

- B. Plans of piping and ductwork shown on scale drawings are diagrammatic only. They are intended to indicate size and/or capacity where stipulated, approximate location and/or direction and approximate general arrangement of one phase of work to another, but not the exact detail or arrangement of construction. Plans are based on equipment scheduled. Contractor shall be responsible for changes resulting from equipment other than scheduled.
- C. Verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to, diffusers, register, grilles, and recessed or semi recessed heating and/or cooling terminal units installed in/on architectural surfaces.
- D. Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
- E. Cooperate with the test and balance agency in ensuring Section 23 05 93 specification compliance. Verify system completion to the test and balance agency (flushing, pressure testing, chemical treatment, filling of liquid systems, proper pressurization and air venting of hydronic systems, clean filters, clean strainers, duct and pipe systems cleaned, controls adjusted and calibrated, controls cycled through their sequences, etc.), ready for testing, adjusting and balancing work. Install dampers, shutoff and balancing valves, flow measuring devices, gauges, temperature controls, etc., required for functional and balanced systems. Demonstrate the starting, interlocking and control features of each system so the test and balance agency can perform its work.

3.7 IDENTIFICATION

- A. Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one coat of black enamel against a light background or white enamel against a dark background. Use a primer where necessary for proper paint adhesion. Do not label equipment such as cabinet heaters and ceiling fans in occupied spaces.
- B. Where stenciling is not appropriate for equipment identification, engraved name plates may be used.
- C. Identify piping not less than once every 30 feet, not less than once in each room, adjacent to each access door or panel, and on both side of the partition where exposed piping passes through walls, floors or roofs. Place flow directional arrows at each pipe identification location. Use one coat of black enamel against a light background or white enamel against a dark background for stenciling, or provide Snap-On pipe markers as specified in Part 2 – Products.
- D. Identify valves with brass tags bearing a system identification and a valve sequence number. Valve tags are not required at a terminal device unless the valves are greater than ten feet from the device or located in another room not visible from the terminal unit. Provide a typewritten valve schedule indicating the valve number and the equipment or areas supplied by each valve; locate schedules in each mechanical room and in each Operating and Maintenance manual. Schedules in mechanical rooms to be framed under clear plastic.
- E. Use engraved name plates to identify control equipment.
- F. Label fire, smoke and combination fire smoke dampers on the exterior surface of ductwork directly adjacent to access doors using a minimum of 0.5 inch height lettering reading, "SMOKE DAMPER" or "FIRE DAMPER". Smoke and combination fire smoke dampers shall also include a second line listing the individual damper tag. The tags must be coordinated with the mechanical schedules. Utilize stencils or manufactured labels. All other forms of identification are unacceptable. All labels shall be clearly visible from the ceiling access point.

3.8 LUBRICATION

- A. Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is operated for any reason. Once the equipment has been run, maintain lubrication according to the manufacturer's instructions until the work is accepted by Owner. Maintain a log of all lubricants used and frequency of lubrication; include this information in the Operating and Maintenance Manuals at the completion of the project.

3.9 SLEEVES AND OPENINGS

A. PIPE SLEEVES:

1. Pipe penetrations in new poured concrete horizontal construction requiring F and T rating: Form opening using hole form or core drill opening. Alternatively provide cast in place fire stopping devices/sleeves.
2. Pipe penetrations in new poured concrete horizontal construction requiring F rating but no T rating: Same as pipe penetrations in new poured concrete construction requiring F and T ratings except that schedule 40 steel sleeves may also be used.
3. Pipe penetrations in new poured concrete horizontal construction that do not require F or T ratings: Provide schedule 40 steel pipe sleeve, form opening using hole form or core drill opening.
4. Pipe penetrations in existing concrete floors: Core drill openings.
5. Where penetrating pipe or conduit weight is supported by floor, provide manufactured product or structural bearing collar designed to carry load.

B. DUCT SLEEVES:

1. Duct sleeves are not required in non-rated partitions or floors.
2. Provide sleeve required for fire dampers in fire-rated partitions and floors. Reference fire damper details on drawings.

3.10 SEALING AND FIRESTOPPING

A. FIRE AND/OR SMOKE RATED PENETRATIONS:

1. Provide all fire stopping of fire rated penetrations and sealing of smoke rated penetrations in compliance with UL and ASTM.

B. NON-RATED PARTITIONS:

1. At all interior walls and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.
2. Duct penetrations through non-rated partitions shall require sheet metal escutcheons with fiberglass or mineral wool insulation fill for spaces that include evidence rooms, breakrooms, classrooms, janitor closets, toilet rooms, mechanical rooms, conference rooms, private consultation rooms, quiet rooms, where ducts are exposed, and where noted on drawings elsewhere.

C. PENETRATIONS SUBJECT TO WATER INTRUSION:

1. For penetrations (both rated and non-rated) in floors subject to water intrusion or in rooms housing electrical equipment (but not within walls) provide one of the following:
 - Pipe penetration where steel pipe sleeve is used extend steel sleeve 2" above the floor.
 - Pipe penetration where cast in place fire stopping device/sleeve is used, extend device/sleeve 2" above the floor (provided it meets the device's UL listing).
 - Pipe penetration where there is no steel sleeve or cast in place fire stopping device/sleeve, provide 2" x 2" x 1/8" galvanized steel angles fastened to floor surrounding the penetration or group of penetrations to prevent water from getting to penetration. Provide urethane caulk between angles and floor and fasten angles to floor minimum 8" on center. Seal corners water tight with urethane caulk.
 - Duct penetrations. Provide 2" x 2" x 1/8" galvanized steel angles fastened to floor surrounding the penetration or group of penetrations to prevent water from getting to penetration. Provide urethane caulk between angles and floor and fasten angles to floor minimum 8" on center. Seal corners water tight with urethane caulk.

2. Floors subject to water intrusion or rooms housing electrical equipment include the following locations:

- Food Service/Kitchen Areas
- Restrooms
- Janitor Rooms w/ Sinks
- Mechanical/Plumbing Equipment Rooms
- Vehicle Storage and Parking Ramps
- Data/Telecommunications Rooms
- Electrical Equipment Rooms

3.11 CLEANING EQUIPMENT, DUCTWORK AND PREMISES

- A. Thoroughly clean all parts of the piping, valves, ductwork, grilles and equipment. Exposed parts which are to be painted shall be thoroughly cleaned of cement, plaster and other materials and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metal work shall be carefully brushed down with steel brushes to remove rust and other spots and left smooth and clean.
- B. Clean filters shall be installed in all equipment specified with filters.
- C. Remove all construction debris, excess materials and equipment.

3.12 GUARANTEE

- A. All materials and workmanship shall be guaranteed for a period of one year after substantial completion. Where extended warranties are required, they shall be provided by the manufacturer or contractor as specified, in the equipment specification.

3.13 CERTIFICATION OF TESTS AND ADJUSTMENTS

- A. Contractor _____
- B. Division of Work _____
- C. Project Name _____
- D. Project Number _____
- E. The contractor named above certifies that the tests and adjustments indicated below have been completed according to the specifications on the date indicated. Start-up of all HVAC equipment installed in this project is the responsibility of this contractor unless otherwise indicated.

F. Tests:	Date
1. Heating Piping	_____
2. Cooling Piping	_____
3. Geothermal Piping	_____
4. Start-up of Heating Piping Systems and Pumps	_____
5. Start-up of Cooling Piping Systems and Pumps	_____
6. Start-up of Geothermal Piping Systems and Pumps	_____
7. Start-up of Air Systems	_____
8. Air Handling Unit Start-up	_____
9. Water-to-Water Heat Pump Start-up	_____
10. Boiler Start-up	_____
11. Refrigeration Piping	_____
12. Ductless AC Start-up	_____

13. Glycol Systems

a. % of glycol in solution

b. Freeze point of solution

G. Contact _____

H. Signed By _____

I. Date _____

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes requirements for single and three phase motors that are used with equipment specified in other sections. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Off-site Storage
 - 8. Operating and Maintenance Data
 - 9. Electrical Coordination
 - 10. Product Criteria
- C. PART 2 - Products
 - 1. Three Phase, Single Speed Motors
 - 2. Single Phase, Single Speed Motors
 - 3. Motors Used on Variable Frequency Drives
- D. PART 3 - EXECUTION
 - 1. Installation

1.2 RELATED WORK

- A. Section 23 05 14 - Variable Frequency Drives
- B. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC
- C. Division 26 - Electrical

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ANSI/IEEE 112 Test Procedure for Polyphase Induction Motors and Generators
- B. ANSI/NEMA MG-1 Motors and Generators
- C. ANSI/NFPA 70 National Electrical Code

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Include with the equipment which the motor drives the following motor information: motor manufacturer, horsepower, voltage, phase, hertz, rpm, full load efficiency. Include project wiring diagrams prepared by the contractor specifically for this work.

1.8 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.
- B. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:
 - 1. Lubrication instructions, including list/frequency of lubrication.
 - 2. Table noting full load power factor, service factor, NEMA design designation, insulation class and frame type for each motor provided.

1.9 ELECTRICAL COORDINATION

- A. All starters, overload relay heater coils, disconnect switches and fuses, relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment are furnished and installed by the Electrical Contractor, except as specifically noted elsewhere in this division of specifications.
- B. Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this contractor, together with their actuating devices if these devices are furnished by the Electrical Contractor. Should any discrepancy in size, horsepower rating, electrical characteristics or means of control be found for any motor or other electrical equipment after contracts are awarded, contractor is to immediately notify the architect/engineer of such discrepancy. Costs involved in any changes required due to equipment substitutions initiated by this contractor will be the responsibility of this contractor. See related comments in Section 23 05 00 - Common Work Results for HVAC, under Shop Drawings.
- C. Electrical Contractor will provide all power wiring and control wiring, except temperature control wiring.
- D. Furnish project specific wiring diagrams to Electrical Contractor for all equipment and devices furnished by this contractor and indicated to be wired by the Electrical Contractor.

1.10 PRODUCT CRITERIA

- A. Motors to conform to all applicable requirements of NEMA, IEEE, ANSI, and NEC standards and shall be listed by U.L. for the service specified.
- B. Select motors for conditions in which they will be required to perform; i.e., general purpose, splashproof, explosion proof, standard duty, high torque or any other special type as required by the equipment or motor manufacturer's recommendations.
- C. Furnish motors for starting according to utility requirements and compatible with starters as specified.

PART 2 - PRODUCTS

2.1 THREE PHASE, SINGLE SPEED MOTORS

- A. Use NEMA rated, three phase, 60 hertz motors for all motors 3/4 HP and larger unless specifically indicated.
- B. Use NEMA general purpose, continuous duty, Design B, normal starting torque, T-frame or U-frame motors with Class B or better insulation unless the manufacturer of the equipment on which the motor is being used has different requirements. Use open drip-proof motors unless totally enclosed fan-cooled, totally enclosed non-ventilated, explosion-proof, or encapsulated motors are specified in the equipment sections.

- C. Use grease lubricated anti-friction ball bearings with housings equipped with plugged/capped provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at the end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- D. All open drip-proof motors to have a 1.15 service factor. Other motor types may have minimum 1.0 service factors.
- E. All motors 1 HP and larger, except specially wound motors and inline pump motors 56 frame and smaller, to be high efficiency design with full load efficiencies which meet or exceed the values listed below when tested according to NEMA MG 1.

FULL LOAD NOMINAL MOTOR EFFICIENCY BY MOTOR SIZE AND SPEED			
<i>Open Drip Proof Motors</i>			
Nominal Motor Speed			
MOTOR HP	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	77.0
1½	86.5	86.5	84.0
2	87.5	86.5	85.5
3	88.5	89.5	85.5
5	89.5	89.5	86.5
7½	90.2	91.0	88.5
10	91.7	91.7	89.5
15	91.7	93.0	90.2

FULL LOAD NOMINAL MOTOR EFFICIENCY BY MOTOR SIZE AND SPEED			
<i>Totally Enclosed Fan-Cooled Motors</i>			
Nominal Motor Speed			
MOTOR HP	1200 RPM	1800 RPM	3600 RPM
1	82.5	85.5	77.0
1½	87.5	86.5	84.0
2	88.5	86.5	85.5
3	89.5	89.5	86.5
5	89.5	89.5	88.5
7½	91.0	91.7	89.5
10	91.0	91.7	90.2
15	91.7	92.4	91.0

2.2 SINGLE PHASE, SINGLE SPEED MOTORS

- A. Use NEMA rated 115 volt, single phase, 60 hertz motors for all motors 3/4 HP and smaller.
- B. Use electronically commutated motor, permanent split capacitor or capacitor start, induction run motors, as indicated, equipped with permanently lubricated and sealed ball or sleeve bearings and Class A insulation. Service factor to be not less than 1.35.

2.3 MOTORS USED ON VARIABLE FREQUENCY DRIVES

- A. In addition to the requirements specified above, the motor must be suitable for use with the drive specified in Section 23 05 14, including but not limited to motor cooling. Motor shall comply with NEMA MG1 Part 31 to provide windings capable to withstand up to 1600 peak Volts with a rise time of 0.1 µs. Provide brush style bearing protection to bleed current from the motor shaft to the motor casing to suit motor application. Brushes shall be field replaceable. Manufacturers: Shaft Grounding Systems (SGS), Helwig Carbon Bearing Protection Kits (BPK), or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount motors on a rigid base designed to accept a motor, using shims if required under each mounting foot to get a secure installation.
- B. When motor will be flexible coupled to the driven device, mount coupling to the shafts according to the coupling manufacturer's recommendations. Using a dial indicator, check angular misalignment of the two shafts; adjust motor position as necessary so that the angular misalignment of the shafts does not exceed 0.002 inches per inch diameter of the coupling hub. Again, using the dial indicator, check the shaft for run-out to assure concentricity of the shafts; adjust as necessary so that run-out does not exceed 0.002 inch.
- C. When motor will be connected to the driven device by means of a belt drive, mount sheaves on the appropriate shafts according to the manufacturer's instructions. Use a straight edge to check alignment of the sheaves; reposition sheaves as necessary so that the straight edge contacts each sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so that the belt(s) can be added and tighten the base so that the belt tension is according to the drive manufacturer's recommendations. Frequently recheck belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.
- D. Verify the proper rotation of each three-phase motor as it is being wired or before the motor is energized for any reason.
- E. Lubricate all motors requiring lubrication. Record lubrication material used and the frequency of use. Include this information in the maintenance manuals.

END OF SECTION 23 05 13

SECTION 23 05 14 - VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes variable frequency drives, bypass starters, and line reactors. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Submittals
 - 7. Operating and Maintenance Data
 - 8. Equipment Startup
 - 9. Warranty
- C. PART 2 - Products
 - 1. Manufacturers
 - 2. Design and Construction
 - 3. Performance Requirements
 - 4. Control Features
 - 5. Protection Features
 - 6. Diagnostics
 - 7. Quality Assurance Tests
 - 8. Bypass Equipment
 - 9. AC Input Line Reactors
- D. PART 3 - EXECUTION
 - 1. Variable Frequency Drives (VFD)
 - 2. Owner Training

1.2 RELATED WORK

- A. Section 23 05 13 - Common Motor Requirements for HVAC
- B. Section 23 21 23 - Hydronic Pumps
- C. Section 23 34 00 - HVAC Fans
- D. Section 23 73 13 - Modular Indoor Central-Station Air-Handling Units
- E. Section 26 05 26 - Grounding and Bonding for Electrical Systems
- F. Section 26 05 29 - Hangers and Supports for Electrical Systems
- G. Section 26 05 53 - Identification for Electrical Systems
- H. Section 26 27 02 - Equipment Wiring Systems

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ANSI/IEEE 519 Guide for Harmonic Control and Reactive Compensation of Static Power Converters

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 1, General Conditions of the Contract, and Division 26.
- B. Include physical, electrical, and performance characteristics of each variable frequency drive and associated components, including dimensions; weight; input and output performance; voltage, phase, current and overcurrent characteristics; installation instructions; protective features; wiring and block diagrams indicating specified options; electrical noise attenuation equipment where required to meet the criteria specified; line side voltage notch wave form and line side current harmonics; certified efficiency versus load and speed curves; and required operating environment.

1.7 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.8 EQUIPMENT STARTUP

- A. Provide the services of a factory trained and certified technician to approve the installation; start-up, test, and adjust for proper operation of the unit(s). Upon completion of the equipment startup, submit a complete manufacturer's field report, including startup and test log, signed by the factory trained technician. Coordinate with the Temperature Control Contractor and the Balancing Contractor. The startup shall be coordinated with Division 26, Electrical and shall be completed within ten (10) working days from the startup date.

1.9 WARRANTY

- A. The warranty shall be for a period of twenty-four (24) months from the date of project Substantial Completion. Further, the warranty shall include all parts, labor, travel time, administrative costs, overhead, travel expenses, technical support and any and all other costs to provide the warranty service.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. ABB, Siemens, Toshiba, Danfoss, Trane/Danfoss, Yaskawa, Eaton/Cutler Hammer, Mitsubishi, Allen Bradley, Square D.

2.2 DESIGN AND CONSTRUCTION

- A. The unit shall be variable torque, modular design for control of the motors as specified in Division 23 and rated at the motor full load nameplate amps.
- B. The unit, including bypass starter (if provided), shall be U.L. or ETL listed, solid state, microprocessor-based with a pulse width modulated (PWM) output wave form (none others are acceptable).
- C. The VFD shall employ a full wave bridge rectifier and capacitors to minimize the ripple of the rectified voltage to maintain near constant DC voltage. Insulated gate bipolar transistors (IGBT's) shall be employed as the output switching device.
- D. EMI/RFI filters to meet EMC Immunity IEC 61800 – 3 first and second environment.
- E. The VFD package shall contain the equivalent of 5% impedance to reduce harmonic distortion. The 5% equivalent impedance shall be provided in the form of a DC bus choke, an input AC line reactor in each phase, or a combination of the two methods.

- F. Control circuitry shall be plug-in, plug-out modular basis with a corrosion resistant coating on printed circuit boards.
- G. Units to be suitable for an operating environment from 0°C to 40°C temperature and humidity up to 90% non-condensing.
- H. Electrically and physically isolate control circuitry and conductors from power circuitry and power conductors. Control conductors and power conductors shall not be run in the same pathway.
- I. The unit enclosure shall be NEMA Type 1, 3R, or 12 as required for the application minimum and all components shall be fully factory assembled and tested prior to leaving the manufacturing facility.
- J. Include the following operating and monitoring devices mounted on the front cover:
 - A disconnect switch or circuit breaker to de-energize both the drive and bypass circuit with door interlocked handle and lock-open padlocking provisions.
 - Operating mode selector switch marked "hand-off-auto".
 - Manual speed adjustment via keypad, mounted on the door.
 - Manual bypass selector switch to select power through drive or bypass (if a bypass is provided).
- K. Provide a manual bypass circuit and bypass starter to transfer from variable frequency drive operation to bypass operation (if a bypass is provided).
- L. Drives shall have SCCR (short circuit current rating) of 65 amps.

2.3 PERFORMANCE REQUIREMENTS

- A. Units shall be suitable for input power of electrical system as scheduled on the drawings $\pm 10\%$, 3 phase, 60 Hertz nominal.
- B. Use a current limiting control device to limit output current to 110% continuous for one minute; also refer to Protection Features in this section. Full load output current available from drive shall not be less than motor nameplate amperage. The full load amp rating of the VFD shall not be less than the values indicated in the NEC Table 430-150.
- C. Output power shall be suitable for driving standard NEMA B design, three phase alternating current induction motors at full rated speed with capability of 6:1 turndown.
- D. Additional performance capabilities to include the following:
 - Ride through a momentary power outage of 15 cycles.
 - Start into a rotating load without damage to drive components or motor.
 - Capable of automatic restart into a rotating load after a preset, adjustable time delay following a power outage.
 - Input displacement power factor: Min 0.95 throughout the speed range.
 - Minimum efficiency: 95% at 100% speed, 85% at 50% speed

2.4 CONTROL FEATURES

- A. Use control circuits compatible with input signal from temperature control system in the automatic mode and from manual speed control in the manual mode. Vary motor speed in response to the input control signal. Include components necessary to accept the signal from the temperature control system in the form that it is sent.
- B. Include the following additional control features:
 - Hand-Off-Automatic (HOA) selector to select local or remote start/stop and speed control.
 - Analog input, selectable 0-10v or 4-20 mA, for automatic control from the temperature control system.
 - Local speed control at the VFD.

- Adjustable acceleration and deceleration rate so that the time period from start to full speed and from full speed to stop can be field adjusted
- Adjustable minimum and maximum speed settings for both automatic and manual modes of operation.
- Manual transfer bypass circuit (if bypass option is provided).
- Field adjustment of minimum and maximum output frequency.
- Two (2) sets of programmable form “A” contacts for remote indication of variable frequency drive condition. Note: default programming to be set for “Drive Run & Fault”.
- When specified in the 23 09 93 sequence of operations, provide a VFD input and output for shutoff damper control that shall operate as follows: When the fan is remotely or locally commanded to start, VFD contact shall energize the shutoff damper to open the damper. The damper position end switch shall be wired to a run permissive input on the VFD and enable the VFD to start when the damper end switch provides the damper is open. This feature shall be provided for both inverter and bypass operation (if bypass option is provided).
- Illuminated display keypad.
- External Fault indicator.
- One (1) input for a N.O. dry contact type input for a 2-wire remote start/stop.
- One (1) input for a N.C. dry contact type input for external faults: (freezestats, fire alarm, smokes, etc). This input shall be factory wired to prevent both the VFD and bypass starter operation when external fault is present.
- PID control loop capable of VFD control from an external device connected to a VFD analog input.

C. The VFD controller shall convert VFD information into the BACnet MSTP protocol that will be compatible with the building direct digital energy management system (EMS) supplied on the project. This output shall be through a serial interface port capable of two-way communication with the building EMS provided on this project. Final connection shall not require any additional intermediate gateway devices to provide throughput of data. The following data shall be provided at a minimum:

- Fault condition
- Speed
- Amperage
- Frequency
- Voltage
- Bypass status (if supplied)

2.5 PROTECTION FEATURES

A. Use electronic protection circuitry in the power circuits to provide an orderly shutdown of the drive without blowing fuses or tripping circuit breakers and prevent component loss under the following abnormal conditions:

- Activation of any safety device
- Instantaneous overcurrent and/or over voltage of output
- Power line overvoltage and undervoltage protection
- Phase loss
- Single and three phase short circuiting
- Ground faults

- Control circuit malfunction
- Overtemperature
- Output current over limit

B. Provide the following additional protective features:

- Input transient overvoltage protection up to 3000 volts per ANSI 37.90A
- Input transient overvoltage protection up to 3000 volts per ANSI 37.90A;
- DC bus fusing or other electronic controls which limit the rate of rise of the DC bus current and de-energizes the drive at a predetermined current level
- Fusing for the control circuit transformer
- Grounded control chassis
- Devices and/or control circuitry to ensure that the variable frequency drive and bypass starter are not both energized and driving motor simultaneously

2.6 DIAGNOSTICS

A. Provide an English character display (no error codes) with indicators for the following:

- Phase loss
- Ground fault
- Overcurrent
- Overvoltage
- Undervoltage
- Over temperature
- Overload
- DC bus status

2.7 QUALITY ASSURANCE TESTS

A. Use a factory heat stress test to verify proper operation of all functions and components under full load.

B. Field performance test of variable frequency drives to determine compliance with this specification will be performed at the Owner's discretion and may include any specified feature, including operation of protective devices through a simulated fault. Contractor will pay for initial testing. Should drive be found deficient by this testing, drive manufacturer will be required to make any and all changes necessary to bring unit(s) into compliance with the specified performance and demonstrate this performance by retesting. Cost of changes and retest will be by this contractor.

C. Variable frequency drive manufacturer or designated representative to perform a field test of each drive, in the presence of the Owner's representative, for the following items:

- Provide general inspection to verify proper installation
- Demonstrate adequate protection during switching from variable frequency drive operation to bypass starter operation and back again

2.8 BYPASS EQUIPMENT

A. Bypass Starters:

1. The bypass starters shall be across-the-line magnetic starter type, unless otherwise noted.

- B. Bypass Configuration:
 - 1. Provide one main disconnect switch or circuit breaker to de-energize both the drive and bypass circuit. Provide a drive input disconnect switch or fuse block to allow the drive to be isolated while the bypass circuit is energized. Provide one output drive contactor and one output bypass contactor. The two output contactors shall be electrically interlocked to allow only one contactor to be closed at any one time.
 - C. Provide motor overload protection in the bypass circuit.
 - D. Provide bypass equipment in a common enclosure with the VFD or, if not available, in a separate enclosure.
- 2.9 AC INPUT LINE REACTORS
- A. When needed to comply with the requirement for 5% equivalent impedance, furnish and factory install AC input line reactors.
 - B. Line reactors shall be installed in each phase of the AC input side of the VFD and mounted within a common enclosure with the VFD
 - C. Line reactor shall be a three-phase inductor, iron core, 600V, Class H insulation, 115 degree C rise, copper windings with screw type terminal blocks.

PART 3 - EXECUTION

3.1 VARIABLE FREQUENCY DRIVES

- A. Install where indicated on drawings and according to approved submittals and manufacturer's published recommendations. Installation to be by the Division 26 00 00 - Electrical contractor.
- B. Input power wiring shall be installed in a separate conduit, output power wiring shall be installed in a separate conduit and control wiring shall be installed in a separate conduit. Do not mix input power, output power, or control wiring in a common conduit. Separate conduits for input and output power wiring shall be provided for each motor. Input and output power wiring for more than one motor shall not share a common conduit. Power wiring shall be furnished and installed by the Div. 26 contractor. If provided, do not mount output line filter below the drive.
- C. Control signal for drive will be provided under Division 23.
- D. Temperature Control Contractor will furnish and install the required temperature control wiring in metal conduit and according to Division 26 00 00 - Electrical of this specification.

3.2 OWNER TRAINING

- A. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of two hours.

END OF SECTION 23 05 14

SECTION 23 05 15- - PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section contains specifications for HVAC piping specialties for all piping systems. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Quality Assurance
 - 5. Federal Bidding Requirements
 - 6. Submittals
 - 7. Operation and Maintenance Data
 - 8. Design Criteria
- C. PART 2 - Products
 - 1. Thermometers
 - 2. Thermometer Sockets
 - 3. Test Wells
 - 4. P/T (Pressure/Temperature) Test Plugs
 - 5. Hose Connection Caps
 - 6. Pressure Gauges
 - 7. Strainers
 - 8. Coalescing Air and Dirt Separators
 - 9. Hydraulic Separators
 - 10. Expansion Tanks
 - 11. Buffer Tanks
 - 12. Air Vents
 - 13. Suction Diffusers
 - 14. Flow Sensing Devices
 - 15. Cold Water Meters
- D. PART 3 - EXECUTION
 - 1. Thermometers
 - 2. Thermometer Sockets
 - 3. Test Wells
 - 4. P/T (Pressure/Temperature) Test Plugs
 - 5. Hose Connection Caps
 - 6. Pressure Gauges
 - 7. Expansion Loops
 - 8. Strainers
 - 9. Coalescing Air and Dirt Separators and Hydraulic Separators
 - 10. Buffer Tanks

- 11. Air Vents
- 12. Suction Diffusers
- 13. Flow Sensing Devices
- 14. Cold Water Meters

1.2 RELATED WORK

- A. Section 23 21 13 - Hydronic Piping
- B. Section 23 83 16 - Radiant-Heating Hydronic Piping
- C. Section 23 05 23 - General-Duty Valves for HVAC Piping
- D. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- E. Section 23 07 00 - HVAC Insulation

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Required for all items in this section. Include materials of construction, dimensional data, ratings/capacities/ranges, pressure drop data where appropriate, and identification as referenced in this section and/or on the drawings.

1.7 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.8 DESIGN CRITERIA

- A. All piping specialties are to be rated for the highest pressures and temperatures in the respective system according to ANSI B31, but not less than 125 psig unless specifically indicated otherwise.

PART 2 - PRODUCTS

2.1 THERMOMETERS

- A. Manufacturers: Ashcroft, Marsh, Taylor, H. O. Trerice, U. S. Gauge, Weiss, Weksler, Winters.
- B. Stem Type, cast aluminum case, nine inch scale, clear acrylic window. adjustable angle brass stem with stem of sufficient length so the end of the stem is near the middle of a pipe without reducing the thickness of any insulation, red indicating fluid, black lettering against a white background, with scale ranges as follows:

Service Scale Range, °F		Min. Increment, °F
Hot Water	30 - 180	2
Chilled Water	0 - 100	1
Glycol Water	0 - 100	1

2.2 THERMOMETER SOCKETS

- A. Brass with threaded connections suitable for thermometer stems and temperature control sensing elements in pipeline. Furnish with extension necks for insulated piping systems.

2.3 TEST WELLS

- A. Similar to thermometer sockets except with a brass cap that thread into the inside of the test well to prevent dirt from accumulating. Secure cap to body with a short chain. Furnish with extension necks, where appropriate, to accommodate the pipeline insulation.

2.4 P/T (PRESSURE/TEMPERATURE) TEST PLUGS

- A. Brass plug with 1/4" NPT threads, EPDM or neoprene valve core, knurled cap with cap strap. Use extended length plugs to clear insulated piping. Adaptors shall have 1/4" FPT connection for standard pressure gauges.

2.5 HOSE CONNECTION CAPS

- A. Hose connection caps shall be pressure rated for 150 psig at 180 deg F.

2.6 PRESSURE GAUGES

- A. Manufacturers: Ametek/U. S. Gauge Division, Ashcroft, Marsh, Taylor, H. O. Trerice, Weiss, Weksler, Winters.
- B. Cast aluminum case of not less than 4.5 inches in diameter, double strength glass window, black lettering on a white background, phosphor bronze bourdon tube with bronze bushings, recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale, with scale range as follows:

Service Scale Range, psig		Min. Increment, psig
Hot Water	0-60	1
Chilled Water	0-60	1
Glycol Water	0-60	1

- C. Pressure Snubbers: Bronze construction, suitable for system working pressure, 1/4" size.
- D. Gauge Valves: Use valves as specified in Section 23 05 23 - General-Duty Valves for HVAC Piping. For water systems, use 1/4" ball valves.

2.7 STRAINERS

- A. Manufacturers: Armstrong, Mueller Steam, Sarco, or Victaulic Company.
- B. Water Systems:
 - 1. Y type; cast ductile iron body; stainless steel screens; bolted or threaded screen retainer tapped for a blowoff valve; threaded body in sizes through 2 inch and rated at not less than 175 psi WOG; grooved end or flanged body in sizes over 2 inch and rated at not less than 300 psi WOG at 230°F. Screen to be 20 mesh for line sizes 2 inch and less, 0.125 inch perforations for line sizes 2-1/2 inch through 4 inch, and 0.25 inch perforations for line sizes 5 inch and larger. Equal to Victaulic Style 732 / W732.

2.8 COALESCING AIR AND DIRT SEPARATORS

- A. Manufacturers: Bell & Gossett, Caleffi, Spirotherm, Inc., Wessels.

- B. 2 inch and larger: Welded steel construction, ASME Section VIII, Division 1 constructed and stamped for a working pressure not less than 150 psig at 250°F, threaded or flanged connections for 2 inch size, flanged or grooved connections if grooved piping is allowed for all sizes over 2 inch. Provide unit with factory installed automatic air vent on the top, blow down connection at the bottom of the unit, and a skimming connection to remove floating dirt. Unit size shall be suitable for the system flow rates as indicated on the drawings.
- C. Internal coalescing material shall be constructed of copper or 304 stainless steel. Unit shall include internal structured elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% entrained air, and 99% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes.

2.9 HYDRAULIC SEPARATORS

- A. Manufacturers: Bell & Gossett, Caleffi, Spirotherm, Inc., Wessels.
- B. Welded steel construction, ASME Section VIII, Division 1 constructed and stamped for a working pressure not less than 150 psig at 250°F, flanged or grooved connections if grooved piping is allowed for all sizes over 2 inch. Provide unit with factory installed automatic air vent on the top, blow down connection at the bottom of the unit. Unit size shall be suitable for the system flow rates as indicated on the drawings.
- C. Internal coalescing material shall be constructed of copper or 304 stainless steel. Unit shall include internal structured elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% entrained air, and 99% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes.

2.10 EXPANSION TANKS

- A. Manufacturers: American Wheatley, Amtrol, Armstrong Pumps, Bell and Gossett, Taco, Thrush.
- B. Diaphragm/Bladder Type: Steel construction, tested and stamped according to Section 8D of the ANSI/ASME Code and furnished with the National Board Form U-1, rated for not less than 125 psig working pressure, precharged with air to the initial fill pressure indicated on the drawings, heavy duty butyl diaphragm suitable for fluid temperatures to 240°F, and furnished with a tank drain connection, system connection, mounting saddles for horizontal installation or base for vertical installation, prime coated, size/capacity as indicated on the drawings. Tank and bladder construction must allow field replacement of the bladder on its failure.

2.11 BUFFER TANKS

- A. Manufacturers: American Wheatley, Amtrol, Boiler Buddy, Taco, Wessels.
- B. Carbon steel construction, tested and stamped according to ASME Section VIII, Division 1, rated for not less than 125 psig working pressure and fluid temperatures to 450°F, and furnished with a baffle, tank drain connection, air vent connection, system connections, immersion type control well(s), base for vertical installation, prime coated, size/capacity as indicated on the drawings.

2.12 AIR VENTS

- A. Manual Key Type Vents:
 - 1. Bell and Gossett Model 4V; Eaton/Dole Model 9, 9B, or 14A.
 - 2. Bronze body with nonferrous internal parts, screwdriver operated, designed to relieve air from the system when vent is opened, rated at not less than 125 psig at 220°F.
- B. Manual Ball Valve Vents: Provide 1/4" ball valves for manual venting of air handling unit coils and where indicated elsewhere on drawings and details. Reference specifications section 23 05 23.

- C. Automatic Vents:
 - 1. Thrush Model 720, Bell and Gossett Model 107, Watson McDaniel Model AV813W.
 - 2. Cast iron body with nonferrous internal parts, designed to vent air automatically with float principle without allowing air to enter the system, rated at not less than 125 psig at 220°F.

2.13 SUCTION DIFFUSERS

- A. Manufacturers: Amtrol/Thrush, Armstrong Pumps, Bell and Gossett, Taco, Victaulic.
- B. Designed to replace the suction line strainer and the long entrance pipe at a pump suction; constructed with a strainer blowdown connection, provisions for a field supplied support foot, and bolted flange for strainer removal and cleaning; rated at not less than 250 psi working pressure at not less than 230°F.
- C. Closed Systems: Body constructed of cast iron, ductile iron or carbon steel; cast iron or stainless steel straightening vanes; stainless steel, galvanized steel or stainless steel strainer; brass or bronze fine mesh startup strainer, strainer blowdown connection, inlet pressure gauge connection, provisions for a field supplied support foot, and bolted flange for strainer removal and cleaning; rated at not less than 125 psi working pressure at not less than 250°F.

2.14 FLOW SENSING DEVICES

- A. For water flow sensing devices 2 inch and smaller, use balance valves as specified in Section 23 05 23 - General-Duty Valves for HVAC Piping:
 - 1. Bell & Gossett Flow Meter – Type A, Flo-Pac, Oventrop, or approved equal.
 - 2. Water type orifice insert installed between flanges with valved taps and chart for conversion of differential pressure readings to flow rate to monitor flow with a minimum friction head loss.
 - 3. Victaulic Koil-Kits Series 799, 79V, 79A, and 79B may be used at coil connections. The kit shall include a Series 786/787/78K circuit balancing valve, Series 78Y Strainer-Ball or Series 78T Union-Ball valve combination, Series 78U Union-Port fitting, and required coil hoses. A Style 793 and/or 794 differential pressure controller shall be provided as required. A meter shall be provided by the valve manufacturer that shall remain with the building owner after balancing/commissioning.

2.15 COLD WATER METERS

- A. Bronze body, minimum 3/4" NPT ends, positive displacement disc type meter with built-in strainer, magnetic drive and thermoplastic disc/register gearing. Meters shall meet ANSI/AWWA Standard C700. Sealed register shall be odometer type totalization display having 10,000,000 gallon capacity. Register shall also have 360 degree sweep hand with 10 gallon range and 0.1 per gallon increments. Meters shall be suitable for 150 psig pressure at 80 degrees F. Badger Recordall Disc Meter, Carlon Meter Co., Neptune, Hersey, Venture Measurement Niagara.

PART 3 - EXECUTION

3.1 THERMOMETERS

- A. Stem Type: Install in piping systems as indicated on the drawings and/or details using a separable socket in each location.
- B. Dial Type for Air Temperature Measurement: Install in ductwork where detailed or specified. Support capillary inside duct so it measures a uniform sample of air. Mount readout so it is readily visible on a portion of ductwork that is not externally insulated or on a sheet metal angle support secured to a nearby structural element.

3.2 THERMOMETER SOCKETS

- A. Install at each point where a thermometer or temperature control sensing element is located in a pipeline.

3.3 TEST WELLS

- A. Install in piping systems as indicated on the drawings and/or details wherever provisions are needed for inserting a thermometer at a later date.

3.4 P/T (PRESSURE/TEMPERATURE) TEST PLUGS

- A. Install in piping systems as indicated on the drawings and/or details. Do not insulate over test plugs.

3.5 HOSE CONNECTION CAPS

- A. Install in locations where indicated on the drawings and details.

3.6 PRESSURE GAUGES

- A. Install in locations where indicated on the drawings and/or details, including any gauge piping, with scale range appropriate to the system operating pressures.
- B. Pressure Snubbers: Install in gauge piping for all gauges used on water services.
- C. Gauge Valves: Install at each gauge location as close to the main as possible and at each location where a gauge tapping is indicated.

3.7 STRAINERS

- A. Install all strainers where indicated on the project details, allowing sufficient space for the screens to be removed. Rotate screen retainer where required by the installation so blowdown can remove accumulated dirt from the strainer body.
- B. Water Systems: Install a ball valve for blowdown in the tapped screen retainer; valve to be the same size as the tapping.

3.8 COALESCING AIR AND DIRT SEPARATORS AND HYDRAULIC SEPARATORS

- A. Mount in hot and/or chilled water lines as indicated on the drawings/details. Install ball valve with hose adapter in bottom blowdown connection and skimming connection.
- B. Open the drain/blowdown valve after system cleaning and again after 30 days of operation.

3.9 EXPANSION TANK

- A. Install tanks where indicated on the drawings, coordinating concrete base installation with the General Contractor or fabricating steel supports to suit the application. Install all specified tank accessories.
- B. Bladder Tanks: Verify proper air charge; recharge as necessary. Install an isolation valve in the piping connecting the tank to the system. In the piping between the tank and the isolation valve, install a pressure gauge and a drain valve with a hose adapter. Install a drain valve with hose adapter in the drain connection of the tank. Make sure that all drains are accessible and a hose can be attached.

3.10 BUFFER TANKS

- A. Install tanks where indicated on the drawings, coordinating concrete base installation with the General Contractor or fabricating steel supports to suit the application. Install all specified tank accessories.
- B. Install a drain valve with hose adapter in the drain connection of the tank. Make sure that all drains are accessible and a hose can be attached.

3.11 AIR VENTS

- A. Manual Key Type Vents: Install at all high points where air may collect and not be carried by the system fluid. Use a soft Type L copper "pigtail" so the vent can be positioned for venting and collecting any water that might escape.
- B. Manual Ball Valve Vents: Install on air handling coils and where indicated elsewhere as shown on drawings and details.
- C. Automatic Vents: Install on the top of air separators on systems using bladder type expansion tanks. Install at other locations as indicated on the drawings or details. All locations to have a ball valve installed upstream of the vent for maintenance purposes.

3.12 SUCTION DIFFUSERS

- A. Install at each pump suction connection for end suction pumps where shown. Provide sufficient space for removal of the strainer. Install a capped drain valve in the blowdown connection. Install support below the suction diffuser so the weight of the suction piping does not rest on the pump suction connection.
- B. Install a pressure gauge across the suction diffuser, valved so that a single gauge can be used to read the inlet pressure and the outlet pressure across the strainer. Use gauge valves as specified with the gauges. This gauge can be the same one used to read pressures across the pump. Select gauge range appropriate to the system pressures.
- C. Open the drain valve and blowdown the strainer after system cleaning and again after 30 days of operation. If the unit is furnished with a fine mesh startup strainer, remove this strainer after the system has been flushed and cleaned.

3.13 FLOW SENSING DEVICES

- A. Install where indicated on the drawings and details for flow sensing in hydronic piping systems. Butterfly valves installed at the location of a flow sensing device are to have a memory stop.

3.14 COLD WATER METERS

- A. Install water meters on makeup water line to hot water and chilled water systems ahead of water pressure reducing valve.

END OF SECTION 23 05 15

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes valve specifications for all HVAC systems except where indicated under Related Work. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Quality Assurance
 - 5. Federal Bidding Requirements
 - 6. Submittals
 - 7. Operation and Maintenance Data
 - 8. Design Criteria
- C. PART 2 - Products
 - 1. Manufacturers
 - 2. Water System Valves
 - a. Gate Valves
 - b. Ball Valves
 - c. Butterfly Valves
 - d. Globe Valves
 - e. Spring Loaded Check Valves
 - f. Balance Valves
 - g. Automatic Flow Control Valves
 - h. Drain Valves
 - i. Combination Shut-off, Check, and Balancing Valves
 - j. Water Pressure Reducing Valves
 - k. Water Relief Valves
 - 3. Specialty Valves and Valve Accessories
 - a. Gauge Valves
 - b. Stem Extensions
- D. PART 3 - EXECUTION
 - 1. General
 - 2. Shut-off Valves
 - 3. Balancing Valves
 - 4. Calibrated Balancing Valves
 - 5. Automatic Flow Control Valves
 - 6. Drain Valves
 - 7. Safety Relief Valves

- 8. Spring Loaded Check Valves
 - 9. Combination Shut-off, Check, and Balancing Valves
 - 10. Pressure Reducing Valves
- 1.2 RELATED WORK
 - A. Section 23 05 15 - Piping Specialties
 - B. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC
- 1.3 REFERENCE
 - A. Applicable provisions of Division 1 govern work under this section.
- 1.4 QUALITY ASSURANCE
 - A. Refer to Division 1, General Conditions, Equals and Substitutions.
- 1.5 FEDERAL BIDDING REQUIREMENTS
 - A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
 - B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.
- 1.6 SUBMITTALS
 - A. Refer to Division 1, General Conditions, Submittals.
 - B. Contractors shall submit a schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for all valves to be used on the project. Temperature ratings specified are for continuous operation.
- 1.7 OPERATION AND MAINTENANCE DATA
 - A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.
- 1.8 DESIGN CRITERIA
 - A. Where valves are specified for individual mechanical services (i.e. hot water heating, chilled water, steam, etc.) all valves shall be of the same manufacturer.

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS
 - A. Anvil, Apollo, Armstrong, Bell & Gossett, Crane, Danfoss-Flomatic, DeZurik, Durco, Fisher, Grinnell, Griswold, Hoffman, Kitz, Kunkle, Leslie, Lunkenheimer/Cincinnati, Metraflex, Milwaukee, Mueller, Newco, Nexus, Nibco, Red-White Valve Corp, Sarco, Stockham, Taco, Thrush-Amtrol, Victaulic, Watts, or approved equal.
- 2.2 WATER SYSTEM VALVES
 - A. Gate Valves:
 - 1. 2" and smaller: Use ball valves; gate valves will not be accepted in sizes 2" and smaller.
 - 2. 2-1/2" and larger: Use butterfly valves; gate valves will not be accepted in sizes 2-1/2" and larger.
 - B. Ball Valves:
 - 1. 2" and smaller: Two piece bronze or forged brass body; Vic-Press, threaded or soldered ends, as appropriate to the pipe material; stainless steel or chrome plated brass/bronze ball; conventional port; glass filled teflon seat; threaded packing gland follower; blowout-proof stem; 300 psig WOG.

2. Valve stems shall allow operators to clear insulation without interference. Provide stem extensions when valve operators interfere with pipe insulation.
 3. Victaulic Series P589, Apollo 70-100/200 series, Hammond 8301/8311, Milwaukee BA100/150, Nibco T/S 585-70, Stockham S206/216.
 4. 2-1/2" and over: Ball valves will not be accepted in sizes over 2 inch.
- C. Butterfly Valves:
1. 2" and smaller: Use ball valves; butterfly valves will not be accepted in sizes 2 inch and smaller.
 2. 2-1/2" and larger: Cast ductile iron body; stainless steel shaft; Teflon, nylatron, or acetal bearings; EPDM resilient seat (pressure responsive in sizes through 12"). Shaft shall be offset from the disc centerline to allow complete 360 degree circumferential seating. Disk to be bronze, aluminum-bronze, stainless steel, electroless-nickel plated or polyphenylene-sulfide coated ductile iron, cast iron with welded nickel edge, or stainless steel. Pressure rated to 300 psig. Valve assembly to be bi-directionally bubble tight to 300 psig with no downstream flange/pipe attached. Polymid or polyamide coated valves are not acceptable.
 3. Valve stems shall allow operators to clear insulation without interference. Provide stem extensions when valve operators interfere with pipe insulation.
 4. Use threaded lug type valves for installation with class 125/150 flanges.
 5. Centerline Series 200, DeZurik BOS-CL, Keystone Fig. 222, Nibco LD2000 (2-1/2"-12")/LD1000 (14" and above), Victaulic MasterSeal 300 series (2-1/2"-12") / AGS-Vic300 series (14"-24").
 6. Provide ten-position lever actuators for valves 6" and smaller.
 7. Where butterfly valves are indicated or specified to be installed at the location of a flow sensing device, provide the butterfly valves with a memory stop.
- D. Globe Valves: Do not use globe valves for water service.
- E. Spring Loaded Check Valves:
1. 2" and smaller: Class 125, bronze body, threaded, solder or wafer ends, bronze trim, stainless steel spring, teflon seat unless only bronze available.
 2. APCO 300 series, ConBraCo 61 series, Mueller 303BP, Nibco T-480-Y/S-480-Y, Val-Matic 1400 series.
 3. 2-1/2" and larger: Class 125, cast iron or semi-steel body, wafer or globe flanged type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required. Valves with ductile iron in contact with the working fluid will not be accepted.
 4. APCO 600 series, Metraflex 900 series, Milwaukee 1800 series, Mueller Steam 101M-AP/105M-AP, Nibco F910 series, Val-Matic 1800 series, Victaulic series 716 (2"-12") and Series W715 (14" – 24").
- F. Balance Valves:
1. 2" and smaller: Multi-turn handwheel style balance valve, DZR brass (Ametal®), bronze or copper alloy body with calibrated ball, globe or venturi/valve arrangement, integral pointer and calibrated scale to register degree of valve opening, memory stop, drain tapping, threaded or soldered ends, with or without integral unions, P/T or Shraeder pressure taps with integral check valves and seals, adjustable memory stop, suitable for 250 psig water working pressure at 230°F.
 2. Armstrong CBV, Griswold SpeedSet, Nexus Ultra MB, Tour & Anderson STAS/STAD, Victaulic series 786/787, Oventrop VTR.

3. Victaulic Koil-Kits Series 799, 79V, 79A, and 79B may be used at coil connections. The kit shall include a Series 786/787/78K circuit balancing valve, Series 78Y Strainer-Ball or Series 78T Union-Ball valve combination, Series 78U Union-Port fitting, and required coil hoses. A Style 793 and/or 794 differential pressure controller shall be provided as required. A meter shall be provided by the valve manufacturer that shall remain with the building owner after balancing/commissioning.
 4. 2-1/2" and larger: Use butterfly valves as specified in this section along with a flow sensing device as specified in Section 23 05 15.
- G. Automatic Flow Control Valves (Automatic Flow Regulating Device):
1. 3" and smaller: Valve bodies shall be cast or forged brass with threads, flanges or sweat connections compatible to the piping system. Internal parts shall be non-corrosive plastic or stainless steel materials. Select valves for pressure, temperature and fluid conditions to be encountered in the system. Flow rate shall be controlled at factory set rate by a perforated cup operating against a spring. Furnish test tapping for field measurement of flow. Valve accuracy shall be plus or minus 5% and sized for 2 psi (max.) pressure drop.
 2. Valves shall be Victaulic 76 Series, Griswold, K Valve, or equal.
- H. Drain Valves: Use 3/4 inch ball valve with threaded hose adapter except strainer blowdown valves to be the same size as the blowdown connection.
- I. Combination Shut-Off, Check, and Balance Valves:
1. 2 inch and larger: Cast or ductile iron body, threaded or flanged or grooved end connections, stainless steel spring, bronze disc with EPDM seat, calibrated memory stop, backseating valve stem, inlet and outlet pressure tapings, capable of being repacked under full line pressure, and suitable for a minimum working pressure of 175 psig at 240°F when used in hot water heating systems.
 2. Armstrong Flo-Trex, Bell & Gossett Triple Duty, Taco Multi-Purpose Valve, Thrush-Amtrol Tri-Flow.
 3. Tri-Service Valve Assembly: Combination shut-off, throttling and non-slam check valve. Vic®-300 MasterSeal™ butterfly valve with memory stop feature assembled with Series 716 (2-1/2" and 3") (DN65 and DN75) or Style 779 Venturi Check (4" – 12") (DN100-DN300). Series 779 check valve with venturi like taps for flow measurement. Working pressures to 300 psi (2065 kPa).
- J. Water Pressure Reducing Valves:
1. Brass or bronze body, diaphragm operated, with an integral anti-syphon check valve, inlet strainer, and adjustable reduced pressure range but pre-set for the scheduled pressure, 125 psig at 225°F.
 2. Bell & Gossett, Cash-Acme, or Watts.
- K. Water Relief Valves:
1. Iron or bronze body, direct pressure actuated, teflon seat, stainless steel stem and spring, suitable for 125 psig water working pressure at 240°F and ASME stamped, with capacity and set point as detailed.
 2. Bell & Gossett, Cash-Acme, Consolidated, Kunkle, Watts.

2.3 SPECIALTY VALVES AND VALVE ACCESSORIES

- A. Gauge Valves:
1. Water Service: Use 1/4" ball valves.
- B. Stem Extensions: Provide stem extensions when valve operators interfere with pipe insulation.

PART 3 - EXECUTION

3.1 GENERAL

- A. Properly align piping before installation of valves in an upright position; operators installed below the valves will not be accepted.
- B. Install valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping system on valve ends.
- C. Install all temperature control valves.
- D. Install all valves with the stem in the upright position. Valves may be installed with the stem in the horizontal position only where space limitations do not allow installation in an upright position. Valves installed with the stems down, will not be accepted.
- E. Install stem extensions when shipped loose from valve.
- F. Prior to flushing of piping systems, place all valves in the full-open position.

3.2 SHUT-OFF VALVES

- A. Install shut-off valves at all equipment, at each branch take-off from mains, and at each automatic valve for isolation or repair.
- B. Water System: Butterfly valves installed at the location of a flow sensing device are to have a memory stop.

3.3 BALANCING VALVES

- A. Provide balancing valves for all major equipment and at each major branch takeoff and at the discharge of each pump as indicated on drawings and details.

3.4 CALIBRATED BALANCE VALVES

- A. Install where indicated on the drawings and details for balancing of hydronic systems.

3.5 AUTOMATIC FLOW CONTROL VALVES

- A. Install where indicated on the drawings and details for balancing of hydronic systems.

3.6 DRAIN VALVES

- A. Provide drain valves for complete drainage of all systems. Locations of drain valves include low points of piping systems, equipment locations specified or detailed including reheat coils, other locations required for drainage of systems.

3.7 SAFETY RELIEF VALVES

- A. Use air pressure to clean piping prior to installation of safety relief valves.
- B. Install relief valves in locations indicated on drawings, and on all boilers.
- C. Inlet and outlet piping connecting to valves must be the same size as valve connections or larger.
- D. Pipe discharge from water system relief valves to nearest drain.

3.8 SPRING LOADED CHECK VALVES

- A. Install a spring loaded check valve in each pump discharge line where two pumps operate in parallel and no combination shutoff, check and balancing valve is being used.

3.9 COMBINATION SHUT-OFF, CHECK, AND BALANCING VALVES

- A. Contractor may use combination shut-off, check and balancing valves where separate shut-off valve, check valve, and balancing valve are specified or detailed in pump discharge piping.

3.10 PRESSURE REDUCING VALVES

- A. Provide ball valve and strainer at inlet. Provide ball valve at outlet.
- B. Install pressure gauges to indicate inlet and outlet pressure at each pressure reducing valve according to Section 23 05 15 - Piping Specialties.
- C. Use eccentric reducers at inlet and outlet of reducing valves where connections are not the same size as adjacent piping.

END OF SECTION 23 05 23

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for supports of all HVAC equipment and materials as well as piping system anchors. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Description
 - 8. Submittals
 - 9. Design Criteria
- C. PART 2 - Products
 - 1. Pipe Hanger and Support Manufacturers
 - 2. Structural Supports
 - 3. Pipe Hangers and Supports
 - 4. Beam Clamps
 - 5. Concrete Inserts
 - 6. Equipment Curbs
 - 7. Pipe Penetrations through Roof
 - 8. Corrosive Atmosphere Coatings
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Hanger and Support Spacing
 - 3. Vertical Riser Clamps
 - 4. Equipment Curbs
 - 5. Pipe Penetration through Roof

1.2 RELATED WORK

- A. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
- B. Section 23 07 00 - HVAC Insulation

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. MSS SP-58 Pipe Hangers and Supports - Materials, Design and Manufacture.
- B. MSS SP-59 Pipe Hangers and Supports - Selection and Application.

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.7 DESCRIPTION

- A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for pressure piping.
- B. Do not hang any mechanical item directly from a metal deck or run piping so it rests on the bottom chord of any truss or joist.
- C. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.
- D. Protect insulation at all hanger points; see Related Work above.

1.8 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Schedule of all hanger and support devices indicating shields, attachment methods, and type of device for each pipe size and type of service. Reference section 23 05 00.

1.9 DESIGN CRITERIA

- A. Materials and application of pipe hangers and supports shall be according to MSS Standard Practice SP-58 and SP-69 unless noted otherwise.
- B. Piping flexible connections and vibration isolation supports are required for piping connected to coils that are in a fan assembly where the entire assembly is mounted on vibration supports; the vibration isolation supports are required for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Piping flexible connection and vibration isolation supports are not required when the fan section is separately and independently isolated by means of vibration supports and duct flexible connections. Standard pipe hangers/supports as specified in this section are required when there are no vibration isolation devices in the piping and beyond the 100 pipe diameter/3 support distance.
- C. Piping supported by lying on the bottom chord of joists or trusses will not be accepted.
- D. Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.
- E. Allow sufficient space between adjacent pipes and ducts for insulation, valve operation, routine maintenance, etc.

PART 2 - PRODUCTS

2.1 PIPE HANGER AND SUPPORT MANUFACTURERS

- A. Anvil, B-Line, Fee and Mason, Kindorf, Michigan Hanger, Unistrut, or approved equal. Anvil figure numbers are listed below; equivalent material by other manufacturers is acceptable.

2.2 STRUCTURAL SUPPORTS

- A. Provide all supporting steel required for the installation of mechanical equipment and materials, whether or not it is specifically indicated or sized, including angles, channels, beams, etc. to suspend or floor support tanks and equipment.

2.3 PIPE HANGERS AND SUPPORTS

- A. Hangers for Steel Pipe Sizes 1/2" through 2": Carbon steel, adjustable, clevis, black finish. Anvil figure 65 or 260.
- B. Hangers for Steel Pipe Sizes 2-1/2" and Over:
 - 1. Carbon steel, adjustable, clevis, black finish. Anvil figure 260.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods if calculations are submitted.
- D. Wall Support:
 - 1. Welded steel bracket with hanger. B-Line 3068 Series, Anvil 194 Series.
 - 2. Perforated epoxy painted finish, 16-12 gauge min., steel channels securely anchored to wall structure with interlocking, split type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000 series clamps, Anvil type AS200 H with AS 1200 clamps. When copper piping is being supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT series, Anvil cushion clamp assembly.
- E. Vertical Riser Support: Carbon steel riser clamp, copper plated when used with copper pipe. Anvil figure 261 for steel pipe, figure CT121 for copper pipe.
- F. Floor Support for Pipe Sizes through 4": Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
- G. Copper Pipe Support: Carbon steel ring, adjustable, copper plated or polyvinylchloride coated.
- H. Insulation Protection Shields: Galvanized carbon steel of not less than 18 gauge for use on insulated pipe 2-1/2" and larger. Minimum shield length is 12". Equal to Anvil figure 167.
- I. Steel Hanger Rods:
 - 1. Threaded both ends, threaded one end, or continuous threaded, black finish.
 - 2. Size rods for individual hangers and trapeze support as indicated in the following schedule.
 - 3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

Maximum Load (Lbs.)	Rod Diameter
(650°F Maximum Temp.)	(inches)
610	3/8
1130	1/2
1810	5/8
2710	3/4
3770	7/8
4960	1
8000	1-1/4

- 4. Provide rods complete with adjusting and lock nuts.

2.4 BEAM CLAMPS

- A. MSS SP-69 Type 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick for single threaded rods of 3/8", 1/2", and 5/8" diameter, for use with pipe sizes 4" and less. Furnish with a hardened steel cup point set screw. Anvil figure 86.
- B. MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1-1/2" diameter but limited in application to pipe sizes 8" and less without prior approval. Anvil figure 228.

2.5 CONCRETE INSERTS

- A. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.

2.6 EQUIPMENT CURBS

- A. Prefabricated Metal Curb: Constructed of not less than 18 gauge galvanized steel reinforced so it is structurally capable of supporting the intended load with no penetrations through the curb flashing, inside and outside corner sections that are mitered and continuously welded, filled with 3 pound density rigid fiberglass insulation, integral deck mounting flange, nominal two inch wood nailer, galvanized steel counter flashing. Do not use built-in metal base flashings or cants. Use 18" high equipment curbs where the curb completely surrounds the perimeter of the equipment and there is no roof exposed to the weather.

2.7 PIPE PENETRATIONS THROUGH ROOF

- A. Multiple Pipe Penetrations: Refer to acceptable Equipment Curb types listed above for curb specifications. An 8" high (minimum) curb height is required. The coping cap shall be constructed from laminated acrylic clad thermoplastic (ABS) with graduated step boots to accommodate various size pipes, stainless steel fastening screws for cover, stainless steel band clamps for securing boots around the pipe, and stainless steel band clamp or mechanical locking seal for securing boots around the ABS coping cap flanges.
- B. Single Pipe Penetrations:
 - 1. A stack flashing penetration may be utilized for single pipe penetrations through built up roofs and single ply membrane roofs. Utilize high temperature sealant for all high temperature applications. This includes but is not limited to steam condensate vent piping, steam safety relief piping, and flues.
 - 2. A single pre-manufactured boot may be utilized for single pipe penetrations through single ply membrane roofs only.

2.8 CORROSIVE ATMOSPHERE COATINGS

- A. Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM A123, 1.5 ounces/square foot of surface, each side. Mechanical galvanize threaded products, ASTM B695 Class 150, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory coating.
- B. Corrosive atmospheres include the following locations:
 - Exterior locations

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install supports to provide for free expansion of the piping and duct system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
- B. Piping shall be supported independently from ductwork and all other trades.
- C. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes for the supporting steel.

- D. Perform all welding according to standards of the American Welding Society. Clean surfaces of loose scale, rust, paint or other foreign matter and properly align before welding. Use wire brush on welds after welding. Welds shall show uniform section, smoothness of weld metal and freedom from porosity and clinkers. Where necessary to achieve smooth connections, joints shall be dressed smooth.

3.2 HANGER AND SUPPORT SPACING

- A. Place a hanger within 12" of each horizontal elbow, valve, strainer, or similar piping specialty item.
- B. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- C. Support riser piping independently of connected horizontal piping.
- D. Adjust hangers to obtain the slope specified in the piping section of this specification.
- E. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Horizontal Max. Spacing	Vertical Max Spacing
Steel	1/2" through 1-1/4"	6'-6"	15'-0"
Steel	1-1/2" through 6"	10'-0"	15'-0"
Thermoplastic	All sizes	4'-0"	10'-0"
Copper	1/2" through 1-1/4"	5'-0"	10'-0"
Copper	1-1/2" and larger	8'-0"	10'-0"
CPVC	1" and smaller	3'-0"	10'-0"
CPVC	1-1/4" and larger	4'-0"	10'-0"
PE-RT	1" and smaller	2'-8"	10'-0"
PE-RT	1-1/4" and larger	4'-0"	10'-0"
PEX	All Sizes	2'-8"	10'-0"
Polypropylene	1" and smaller	2'-8"	10'-0"
Polypropylene	1-1/4" and larger	4'-0"	10'-0"

3.3 VERTICAL RISER CLAMPS

- A. Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor. Mid-story supports may be necessary to meet the requirements listed above.

3.4 EQUIPMENT CURBS

- A. Secure bottom of support flat on roof deck. Secure equipment to curb according to equipment manufacturer's instructions. Flashing and counterflashing by the General Contractor.
- B. Fill the entire void space with compressible fiberglass insulation.

3.5 PIPE PENETRATION THROUGH ROOF

- A. Install at points where pipes penetrate roof. Install as shown on the drawings, as detailed and according to the manufacturer's installation instructions. Flashing and counterflashing by the General Contractor.

END OF SECTION 23 05 29

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for vibration isolation material for equipment, piping systems, and duct systems. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Federal Bidding Requirements
 - 5. Quality Assurance
 - 6. Design Criteria
 - 7. Submittals
- C. PART 2 - Products
 - 1. Materials
 - 2. Vibration Isolation Manufacturers
 - 3. Type 1: Neoprene Pad
 - 4. Type 2: Neoprene Pad
 - 5. Type 3: Unhoused Spring with Neoprene
 - 6. Type 5: Spring Hanger with Neoprene
 - 7. Type T: Horizontal Thrust Restraint
 - 8. Performance
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Air Handling Units and Centrifugal Fans
 - 3. Isolation Devices Outdoors or in High Humidity Areas

1.2 RELATED WORK

- A. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- B. Section 23 21 23 - Hydronic Pumps
- C. Section 23 33 00 - Air Duct Accessories
- D. Section 23 34 00 - HVAC Fans
- E. Section 23 73 13 - Modular Indoor Central-Station Air-Handling Units

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 FEDERAL BIDDING REQUIREMENTS

- C. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- D. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.5 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.6 DESIGN CRITERIA

- A. Isolate all motor driven mechanical equipment from the building structure and from the systems which they serve to prevent equipment vibrations from being transmitted to the structure. Consider equipment weight distribution to provide uniform isolator deflections.
- B. For equipment with variable speed capability, select vibration isolation devices based on the lowest speed.
- C. Provide flexible piping connections for all piping to rotating or reciprocating equipment mounted on vibration isolators except do not use flexible piping connectors on any type of gas piping or with inline pumps. Piping connected to a coil which is in an assembly mounted on vibration isolators is to have flexible piping connections and piping vibration hangers as specified below. Piping connected to a coil which is in an assembly where the fan is separately isolated by means of vibration isolators and duct flexible connections does not require flexible piping connectors or piping vibration hangers.
- D. Credit will be given for the inherent flexibility and vibration absorption characteristics of mechanical grooved pipe connections providing that supporting calculations are submitted for approval.
- E. Coordinate the selection of devices with the isolator and equipment manufacturers.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Include isolator type, materials of construction, isolator free and operating heights, and isolation efficiency based on the lowest operating speed of the equipment supported.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Use materials that will retain their isolation characteristics for the life of the equipment served. Use industrial grade neoprene for elastomeric materials.
- B. Treat all isolators to resist corrosion. For isolation devices exposed to the weather or used in high humidity areas, hot dip galvanized steel parts, apply a neoprene coating on all steel parts, or use stainless steel parts; include limit stops to resist wind.
- C. Provide pairs of neoprene side snubbers or restraining springs where side torque or thrust may develop.
- D. Use isolators with a ratio of lateral to vertical stiffness not less than 1.0 or greater than

2.2 VIBRATION ISOLATOR MANUFACTURERS

- A. Mason Industries, Amber/Booth Co., Vibration Mounting & Controls, Peabody Noise Control, or approved equal.

2.3 TYPE 1: NEOPRENE PAD

- A. Neoprene waffle pad, 40 durometer with 16 gauge shims between layers.

2.4 TYPE 2: NEOPRENE PAD

- A. Double deflection neoprene mount having a minimum static deflection of 0.35 inches. Cover all metal surfaces with neoprene to resist corrosion. Include friction pads on both top and bottom surfaces so mounts need not be bolted to the floor but include bolt holes for those areas where bolting is required. For equipment such as small vent sets and close coupled pumps, include steel rails for use between the isolator and the equipment to accommodate equipment overhang.

2.5 TYPE 3: UNHOUSED SPRING WITH NEOPRENE

- A. Combination freestanding, unhooused spring and neoprene with rib molded antifriction base. Include leveling bolts for securing to the equipment. Springs to be laterally stable under load and selected so they have an additional travel to solid equal to 50% of the rated deflection. Use height saving brackets when appropriate to the application.

2.6 TYPE 5: SPRING HANGER WITH NEOPRENE

- A. Vibration hanger with a steel spring and 0.3" deflection neoprene element in series. Use neoprene element molded with a rod isolation bushing that passes through the hanger box. Select spring diameters and size hanger box lower holes large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Select springs so they have a minimum additional travel to solid equal to 50% of the rated deflection.

2.7 TYPE T: HORIZONTAL THRUST RESTRAINT

- A. Spring element in series with a neoprene pad as described for Type 3 mount with the same deflection as specified for the mounting or hanger. Design the assembly so the spring element is contained within a steel frame, so it can be preset for thrust at the factory, and adjusted in the field for a maximum of 1/4" movement at start and stop. Include threaded rod and angle brackets for attachment to both equipment and ductwork or equipment and structure.

2.8 PERFORMANCE

- A. Select vibration isolation devices to provide not less than 95% isolation efficiency.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install vibration isolation devices for motor driven equipment according to the manufacturer's installation instructions.
- B. Do not allow installation practices to short circuit any isolation device.

3.2 AIR HANDLING UNITS AND CENTRIFUGAL FANS

- A. Attach horizontal thrust restraints at the centerline of thrust and symmetrically on either side of the unit. Thrust restraints are not required when the fan section is not isolated from the remainder of the air handling unit by means of duct flexible connections.

3.3 ISOLATION DEVICES OUTDOORS OR IN HIGH HUMIDITY AREAS

- A. Use only hot dip galvanized, stainless steel, or neoprene coated steel parts.

END OF SECTION 23 05 48

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes air and water testing, adjusting and balancing for the entire project. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Description
 - 6. Quality Assurance (Qualifications)
 - 7. Pre-Installation Meeting and Scheduling
 - 8. Pre-Balance Conference
 - 9. Submittals
- C. PART 2 - Products
 - 1. Instrumentation
- D. PART 3 - EXECUTION
 - 1. Daily Reports
 - 2. Preliminary Procedures
 - 3. Performing Testing, Adjusting, and Balancing
 - 4. Deficiencies

1.2 RELATED WORK

- A. Section 23 05 00 Common Work Results for HVAC
- B. Section 23 07 00 HVAC Insulation
- C. Section 23 09 14 Pneumatic and Electric Instrumentation and Control Devices for HVAC
- D. Section 23 09 23 Direct Digital Control System for HVAC

1.3 REFERENCE

- A. Applicable provisions of the General Conditions, Supplementary General Conditions and General Requirements in Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. AABC National Standards for Total System Balance, Sixth Edition, 2002.
- B. ASHRAE ASHRAE Handbook, 2007 HVAC Applications, Chapter 37, Testing Adjusting and Balancing.
- C. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems, Seventh Edition, 2005.
- D. TABB Tab Procedural Guide, First Edition, 2003.

1.5 DESCRIPTION

- A. The contractor will separately contract with an independent test and balance agency to perform all testing, adjusting, and balancing of air and hydronic systems required for this project. Work related to the testing, adjusting, and balancing that must be performed by the installing mechanical contractor is specified in other section of these specifications.

- B. Provide total mechanical systems testing, adjusting and balancing. Requirements include the balance of air and water distribution, adjustment of new and existing systems and equipment to provide design requirements indicated on the drawings, electrical measurement and verification of performance of all mechanical equipment, all according to standards published by AABC, NEBB, or TABB.
- C. Test, adjust and balance all air and hydronic systems so that each room, piece of equipment or terminal device meets the design requirements indicated on the drawings and in the specifications.
- D. Accomplish testing, adjusting and balancing work in a timely manner that allows partial occupancy of major buildings, occupancy of one building when the project involves many buildings, and completion of the entire project in the time stated in the Instruction to Bidders and according to the completion schedule established for this project.
- E. Verify that provisions are being made to accomplish the specified testing, adjusting and balancing work. If problems are found, handle as specified in Part 3 under Deficiencies.

1.6 QUALITY ASSURANCE (QUALIFICATIONS)

- A. An independent Firm specializing in the Testing and Balancing of HVAC systems for a minimum of 5 years. A Firm not engaged in the commerce of furnishing or providing equipment or material generally related to HVAC work other than that specifically related to installing Testing and Balancing components necessary for work in this section such as, but not limited to sheaves, pulleys, and balancing dampers.
- B. A certified member of AABC or certified by NEBB or TABB in the specific area of work performed. Maintain certification for the entire duration of the project.
- C. Technicians on this project must have satisfactorily completed work on a minimum of (5) five projects of at least 50% in size, and of similar complexity. Size is defined as the quantity of each specific individual item requiring testing and balancing such as, but not limited to, equipment, devices, terminal devices, and grilles/diffusers.
- D. Submit Qualifications of firm and project staff to A/E upon request.

1.7 PRE-INSTALLATION MEETING AND SCHEDULING

- A. The test and balance agency is required to attend a pre-installation meeting with all other project contractors before the construction process is started. The test and balance agency shall give the Lead Contractor a detailed schedule of testing and balancing tasks for incorporation into the project schedule.

1.8 PRE-BALANCE CONFERENCE

- A. 90 days prior to beginning testing, adjusting and balancing, schedule and conduct a conference with the Architect/Engineer, Owner's Project Representative and the mechanical system and temperature control system installing contractors. Provide A/E with a complete copy of the TAB plan for the project. The objective is final coordination and verification of system operation and readiness for testing, adjusting and balancing procedures and scheduling procedures with the above-mentioned parties. Indicate work required to be completed prior to testing, adjusting, and balancing and identify the party responsible for completion of that work.

1.9 SUBMITTALS

- A. See also Related Work in this section.
- B. Submit testing, adjusting and balancing reports bearing the seal and signature of the NEBB, AABC, or TABB Certified Test and Balance Supervisor. The reports certify that the systems have been tested, adjusted and balanced according to the referenced standards; are an accurate representation of how the systems have been installed and are operating; and are an accurate record of all final quantities measured to establish normal operating values of the systems.

1. Submission:
 - a. Distribute electronic copies of the Report to the Mechanical Contractor and the Prime A/E.
 - b. Provide three hard copies of Final Report to be included in O&M Manuals.
2. Format: Cover page identifying project name, project number and descriptive title of contents. Divide the contents of the report into the below listed divisions:
 - General Information
 - Summary
 - Air Systems
 - Hydronic Systems
 - Special Systems
3. Contents: Provide the following minimum information, forms and data:
 - a. General Information: Inside cover sheet identifying Test and Balance Agency, Contractor, Architect, Engineer, Project Name and Project Number. Include addresses, contact names and telephone numbers. Also include a certification sheet containing the seal and signature of the Test and Balance Supervisor.
 - b. Summary: Provide summary sheet describing mechanical system deficiencies. Describe objectionable noise or drafts found during testing, adjusting and balancing. Provide recommendations for correcting unsatisfactory performances and indicate whether modifications required are within the scope of the contract, are design related or installation related. List instrumentation used during testing, adjusting and balancing procedures.
 - c. The remainder of the report to contain the appropriate standard NEBB, AABC, or TABB forms for each respective item and system. Fill out forms completely. Where information cannot be obtained or is not applicable indicate same.

PART 2 - PRODUCTS

2.1 INSTRUMENTTION

- A. Provide all required instrumentation to obtain proper measurements. Application of instruments and accuracy of instruments and measurements to be according to the requirements of NEBB, AABC, or TABB Standards and instrument manufacturer's specifications.
- B. All instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination by A/E upon request. Calibration and maintenance of all instruments to be according to the requirements of NEBB, AABC, or TABB Standards.

PART 3 - EXECUTION

3.1 DAILY REPORTS

- A. Submit to Owner's Project Representative daily work activity reports for each day on which testing and balancing work is performed. Reports shall include description of day's activities and description of any system deficiencies.

3.2 PRELIMINARY PROCEDURES

- A. Review preconstruction meeting report, applicable construction bulletins, applicable change orders and approved shop drawings of equipment, outlets/inlets and temperature controls.

- B. Check filters for cleanliness, dampers and valves for correct positioning, equipment for proper rotation and belt tension, temperature controls for completion of installation and hydronic systems for proper charge and purging of air.
- C. Notify Owner's Project Representative on a daily basis during balancing. Identify deficiencies preventing completion of testing, adjusting and balancing procedures. Do not proceed until systems are fully operational with all components necessary for complete testing, adjusting and balancing. Installing Contractors are required to provide personnel to check and verify system completion, readiness for balancing and assist Balancing Agency in providing specified system performance.

3.3 PERFORMING TESTING, ADJUSTING, AND BALANCING

- A. Perform testing, adjusting and balancing procedures on each system identified, according to the detailed procedures outlined in the referenced standards except as may be modified below.
- B. Unless specifically instructed in writing, all work in this specification section is to be performed during the normal workday.
- C. In areas containing ceilings, remove ceiling tile to accomplish balancing work; replace tile when work is complete and provide new tile for any tile that are damaged by this procedure. If the ceiling construction is such that access panels are required for the work of this section and the panels have not been provided, inform the owner's project representative.
- D. Cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary for adequate performance of procedures. Patch using materials identical to those removed, maintaining vapor barrier integrity and pressure rating of systems.
- E. In air systems employing filters, blank off sufficient filter area to simulate a pressure drop that is midway between that of a clean filter and that of a dirty filter.
- F. Measure and record system measurements at the fan and/or pump to determine total flow. Adjust equipment as required to yield specified total flow at terminals. Proceed taking measurements in mains and branches as required for final terminal balancing. Perform terminal balancing to specified flows balancing branch dampers, deflectors, extractors and valves prior to adjustment of terminals.
- G. Measure and record static air pressure conditions across fans, coils and filters. Indicate in report if cooling coil measurements were made on a wet or dry coil and if filter measurements were made on a clean or dirty filter. Spot check static air pressure conditions directly ahead of terminal units.
- H. Adjust outside air, return air and relief air dampers for design conditions at both the minimum and maximum settings and record both sets of data. Balance modulating dampers at extreme conditions and record both sets of data. Balance variable air volume systems at maximum air flow rate, full cooling, and minimum flow rate, full heating; record all data.
- I. Adjust register, grille and diffuser vanes and accessories to achieve proper air distribution patterns and uniform space temperatures free from objectionable noise and drafts within the capabilities of the installed system.
- J. Provide fan and motor drive sheave adjustments necessary to obtain design performance. Provide drive changes specifically noted on drawings, if any. If work of this section indicates that any drive or motor is inadequate for the application, advise the owner's project representative by giving the representative properly sized motor/drive information (according to manufacturers original service factor and installed motor horsepower requirements); Confirm any change will keep the duct/piping system within its design limitations with respect to speed of the device and pressure classification of the distribution system. Required motor/drive changes not specifically noted on drawings or in specifications will be considered an extra cost and will require an itemized cost breakdown submitted to owner's project representative. Prior authorization is needed before this work is started.

- K. Areas or rooms designed to maintain positive, negative or balanced air pressures with respect to adjacent spaces, as indicated by the design air quantities, require special attention. Adjust fan drives, distribution dampers, terminals and controls to maintain indicated pressure relationship.
- L. Final air system measurements to be within the following range of specified cfm:

Fans	0% to +10%
Supply grilles, registers, diffusers	0% to +10%
Return/exhaust grilles, registers	0% to -10%
- M. Final water system measurements must be within the following range of specified gpm:

Heating flow rates	0% to +10%
Cooling flow rates	-5% to +5%
- N. Contact the Temperature Control Contractor for assistance in operation and adjustment of controls during testing, adjusting and balancing procedures. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation and any deficiencies found.
- O. Permanently mark equipment settings, including damper and valve positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.
- P. Leave systems in proper working order, replacing belt guards, closing access doors and electrical boxes, and restoring temperature controls to normal operating settings.
- Q. Verify and record, in the T&B Report, "K" factors for all VAV air terminal devices and air flow stations.
- R. Verify and record, in the T&B Report, values of damper positions and fan speeds for all characterization curves required in the 23 09 93 control sequences.
- S. Coordinate air handling unit minimum outside air set points with the Temperature Control Contractor.
- T. VAV Supply Duct System Static Pressure Set Point: For VAV supply systems with VAV air terminal devices, determine the minimum required duct static pressure at the DDC static pressure sensor location(s) needed to ensure that all VAV air terminals are operating at their design airflows with the most demanding VAV terminal wide open. Provide these static pressure numbers to the DDC temperature controls contractor and record them in the T&B report for each system.
- U. Hydronic System Differential Pressure Control Set Point: For hydronic systems with variable speed pumping, determine the minimum required system differential pressure set point needed to ensure that all terminal devices are operating at their design water flows with the most demanding terminals device control valve wide open. Provide the differential control setting set point to the DDC temperature control contractor and record them in the T&B report for each system.
- V. Hydronic Systems
 1. For HVAC pumps 10 horsepower or less, valve throttling alone may be used for hydronic system balancing.
 2. Throttling of triple-duty valves shall not exceed 50% closed. Where additional throttling would be necessary to achieve the system design flow, the impeller shall be trimmed.
 3. Verify Triple duty valve utilized on systems with Variable Frequency Drives are 100% open when balancing work is complete.
 4. The pressure drop across triple duty valves shall not exceed 25 ft. w.g. Where additional throttling would be necessary to achieve the system design flow, the impeller shall be trimmed.

5. Verify butterfly valves utilized for hydronic system balancing are provided with position-lock operators (memory stops) according to Section 23 05 23. The adjustment and marking of lever-lock operators that use throttling notches will not be accepted. Lock all memory stops so the valves can be reopened to their balanced positions if they are used for isolation purposes.

3.4 DEFICIENCIES

- A. Division 23 00 00 contractor to correct any installation deficiencies found by the test and balance agency that were specified and/or shown on the Contract Documents to be performed as part of that division of work. Test and balance agency will notify the Owner's Project Representative of these items and instructions will be issued to the Division 23 00 00 contractor for correction of the deficient work. All corrective work to be done at no cost to the Owner. Retest mechanical systems, equipment, and devices once corrective work is complete as specified.

END OF SECTION 23 05 93

SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes insulation specifications for heating, ventilating and air conditioning piping, ductwork and equipment. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Description
 - 8. Definitions
 - 9. Submittals
 - 10. Operation and Maintenance Data
 - 11. Environmental Requirements
- C. PART 2 - Products
 - 1. Materials
 - 2. Insulation Types
 - 3. Adhesives, Mastics, Sealants, and Reinforcing Materials
 - 4. Jackets
 - 5. Insulation Inserts and Pipe Shields
 - 6. Accessories
- D. PART 3 - EXECUTION
 - 1. Examination
 - 2. Installation
 - 3. Protective Jacket Installation
 - 4. Piping, Valve and Fitting Insulation
 - 5. Piping Protective Jackets
 - 6. Pipe Insulation Schedule
 - 7. Duct Insulation
 - 8. Ductwork Protective Coverings
 - 9. Duct Insulation Schedule
 - 10. Equipment Insulation
 - 11. Equipment Insulation Schedule

1.2 RELATED WORK

- A. Section 23 05 00 - Common Work Results for HVAC
- B. Section 23 21 13 - Hydronic Piping
- C. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- D. Section 23 31 00 - HVAC Ducts and Casings

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

ASTM B209	Aluminum and Aluminum Alloy Sheet and Plate
ASTM C165	Test Method for Compressive Properties of Thermal Insulations
ASTM C177	Heat Flux and Thermal Transmission Properties
ASTM C195	Mineral Fiber Thermal Insulation Cement
ASTM C240	Cellular Glass Insulation Block
ASTM C302	Density of Preformed Pipe Insulation
ASTM C303	Density of Preformed Block Insulation
ASTM C355	Test Methods for Test for Water Vapor Transmission of Thick Materials
ASTM C449	Mineral Fiber Hydraulic Setting Thermal Insulation Cement
ASTM C518	Heat Flux and Thermal Transmission Properties
ASTM C533	Calcium Silicate Block and Pipe Thermal Insulation
ASTM C534	Preformed Flexible Elastomeric Thermal Insulation
ASTM C547	Mineral Fiber Preformed Pipe Insulation
ASTM C552	Cellular Glass Block and Pipe Thermal Insulation
ASTM C553	Mineral Fiber Blanket and Felt Insulation
ASTM C578	Preformed, Block Type Cellular Polystyrene Thermal Insulation
ASTM C591	Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C610	Expanded Perlite Block and Thermal Pipe Insulation
ASTM C612	Mineral Fiber Block and Board Thermal Insulation
ASTM C921	Properties of Jacketing Materials for Thermal Insulation
ASTM C1136	Flexible Low Permeance Vapor Retarders for Thermal Insulation
ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
ASTM D1000	Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
ASTM D1621	Standard Test Method for Compressive Properties Of Rigid Cellular Plastics
ASTM D1622	Standard Test Method for Apparent Density of Rigid Cellular Plastics
ASTM D1940	Method of Test for Porosity of Rigid Cellular Plastics
ASTM D2126	Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
ASTM D2240	Standard Test Method for Rubber Property—Durometer Hardness
ASTM E84	Surface Burning Characteristics of Building Materials
ASTM E814	Standard Test Method for Fire Tests of Penetration Firestop Systems
ASTM E2336	Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems
MICA	National Commercial & Industrial Insulation Standards
NFPA 225	Surface Burning Characteristics of Building Materials
UL 723	Surface Burning Characteristics of Building Materials

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.
- B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.
- C. Insulation systems shall be applied by experienced contractors. Within the past five (5) years, the contractor shall be able to document the successful completion of a minimum of five (5) projects of at least 50% of the size and similar scope of the work specified in this section.

1.7 DESCRIPTION

- A. Furnish and install all insulating materials and accessories as specified or as required for a complete installation. The following types of insulation are specified in this section:
 - Pipe Insulation
 - Duct Insulation
 - Equipment Insulation
- B. Install all insulation according to the latest edition of MICA (Midwest Insulation Contractors Association) Standard and manufacturer's installation instructions. Exceptions to these standards will only be accepted where specifically modified in these specifications.

1.8 DEFINITIONS

- A. Concealed: shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.

1.9 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, fitting materials along with material safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.10 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Do not store insulation materials on grade or where they are at risk of becoming wet. Do not install insulation products that have been exposed to water.
- B. Protect installed insulation work with plastic sheeting to prevent water damage.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers: Armacell, CertainTeed, Manson, Childers, Dow, Extol, Fibrex, Halstead, Foster, Imcoa, ITW, Johns Manville, Knauf Insulation, Owens-Corning, Pittsburgh Corning, VentureTape or approved equal.

- B. Materials or accessories containing asbestos will not be accepted.
- C. Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame spread rating of 25 or less and smoke developed rating of 50 or less, with the following exception:
 - 1. Pipe insulation which is not located in an air plenum may have a flame spread rating not over 25 and a smoke developed rating no higher than 450 when tested according to UL 723 and ASTM E84.

2.2 INSULATION TYPES

- A. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.
- B. Flexible Fiberglass Insulation: Minimum nominal density of 0.75 lbs. per cu. ft., and thermal conductivity of not more than 0.3 at 75 degrees F, rated for service to 250 degrees F.
- C. Rigid Fiberglass Insulation: Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75°F mean temperature, 0.25 at 125°F, 0.27 at 150°F, 0.29 at 200°F, 0.32 at 250°F, minimum compressive strength of 25 PSF at 10% deformation, rated for maximum service temperature of 450°F.
- D. Semi-Rigid Fiberglass Insulation: Minimum nominal density of 3 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 75°F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450°F. Insulation fibers perpendicular to jacket and scored for wrapping cylindrical surfaces.
- E. Elastomeric Insulation: Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.27 at 75°F, minimum compressive strength of 4.5 psi at 25% deformation, maximum water vapor permeability of 0.17 perm inch, maximum water absorption of 6% by weight, rated for service range of -20°F to 220°F on piping and 180°F where adhered to equipment.
- F. Polyolefin Insulation: Flexible closed cell, minimum nominal density of 1.5 lbs. per cu. ft., thermal conductivity of not more than 0.24 at 75°F, minimum compressive strength of 5 psi at 25% deformation, maximum water vapor permeability of 0.0 perm inch, maximum water absorption of 0% by weight and volume, rated for service range of -165°F to 210°F.
- G. Polyisocyanurate Insulation: Rigid closed cell polyisocyanurate, minimum nominal density of 2.0 lbs. per cu. ft., thermal conductivity of not more than 0.19 at 75°F aged 180 days, minimum compressive strength of 24 psi parallel and 13 psi perpendicular, maximum water vapor permeability of 4 perm inch, maximum water absorption of 2% by volume, rated for service range of -290°F to 300°F.

2.3 ADHESIVES, MASTICS, SEALANTS, AND REINFORCING MATERIALS

- A. Products shall be compatible with surfaces and materials on which they are applied and shall be suitable for use at operating temperatures of systems to which they are applied.
- B. Fiberglass Insulation Adhesive: Must comply with ASTM C916, Type II: Foster 85-60, Childers CP-127, Duro Dyne SSG.
- C. Vapor Retarding Mastic: For below ambient equipment/piping use a water-based mastic with a water vapor permeance of less than 0.04 perms at 40 mils dry film thickness per ASTM E 96: Childers CP-34, Foster 30-65 Vapor-Fas, Knauf Insulation, KI-900 or KI-905, Vamasco 749.
- D. Weather Barrier Breather Mastic: For above ambient equipment/piping use water based mastic with a permeance greater than 1.0 perms at 1/16" dry film thickness per ASTM E96. Foster 46-50 Weatherite, Childers Vi-Cryl CP-10/CP-11, Vamasco WC-5, Knauf Insulation KI-700 or KI-705.
- E. Lagging Adhesive/Coatings: For all indoors applications used in conjunction with canvas/glass cloth: Foster 30-36, Childers CP-50A MV1, Vamasco 713.
- F. For all indoor applications used in conjunction with canvas/glass cloth: the coating must be anti-fungal and shall meet ASTM D 5590 with 0 growth rating (AF): Foster 30-36 AF Seal Fas, Childers CP-137 AF Chil-Seal.

- G. Reinforcing Mesh: Use Foster 42-24 Mast A Fab, Childers Chil Glas #10 or Pittsburgh Corning PC 79.
- H. Insulation Joint Sealant: Joint sealants to be non-shrinking and permanently flexible.
 - Used on all below ambient piping to prevent moisture ingress.
 - For Polyisocyanurate use Foster 95-44 Elastolar, Childers CP-76 Chil-Byl, Pittsburgh Corning CW Sealant.
 - For Elastomeric use Armaflex 520 or equal.

2.4 JACKETS

- A. PVC Fitting Covers and Jackets (PFJ): White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be minimum 30 mil unless otherwise noted.
- B. All Service Jackets (ASJ Max): Heavy duty, poly-encapsulated, fire retardant material with white kraft reinforced foil vapor barrier, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.
- C. Foil Scrim All Service Jackets (FSJ): Glass fiber reinforced foil kraft laminate, factory applied to insulation. Maximum permeance of .02 perms and minimum beach puncture resistance of 25 units.
- D. Fabric Reinforced Mastic Jackets (FMJ): Glass fiber reinforcing fabric imbedded in weather barrier mastic as per manufacturer's recommended procedure for 2 coat application.
- E. Self-Adhering Jackets (SAJ).
 - 1. 5-ply, self-adhering multiple laminated waterproofing material with reflective aluminum foil, high density polymer films and cold weather acrylic adhesive providing zero (0.0) permeability. Minimum 6 mils material thickness, 35lb puncture resistance when tested according to ASTM D1000 and flame spread/smoke developed rating of 10/20 when tested according to UL 723.
 - 2. Vapor retarding tape shall be specifically designed and manufactured for use with the self-adhering jacket specified above. Tape shall be provided by the same manufacturer that provides jacketing. Vapor retarding tapes used with self-adhering jackets shall have a maximum permeance of 0.0 perms.
- F. Vapor Retarding Jackets (VRJ).
 - 1. Polyvinylidene chloride (PVDC) vapor retarding jacket material with minimum 6 mils material thickness and maximum permeance of 0.01 perms. Material shall not support the growth of mold or mildew. Dow Saran or equivalent.
 - 2. Vapor retarding tape shall be specifically designed and manufactured for use with the vapor retarding jacket specified above. Tape shall be provided by the same manufacturer that provides jacketing. Vapor retarding tapes used with vapor retarding jackets shall have a maximum permeance of 0.01 perms.

2.5 INSULATION INSERTS AND PIPE SHIELDS

- A. Manufacturers: B-Line, Pipe Shields, Value Engineered Products.
- B. Construct inserts with calcium silicate or polyisocyanurate (service temperatures below 300°F only), minimum 140 psi compressive strength. Piping 12" and larger, supplement with high density 600 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum 180 degree coverage on bottom supported piping and full 360 degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate.

- C. Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to preengineered/premanufactured product described above. On low temperature systems, high density rigid polyisocyanurate may be substituted for calcium silicate provided insert and shield length and shield gauge are increased to compensate for lower insulation compressive strength.
- D. Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of the same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1"x6" block for piping through 2-1/2" and three 1"x6" blocks for piping through 4". Submit shield schedule to demonstrate equivalency to preengineered/premanufactured product described above.
- E. Wood blocks will not be accepted.

2.6 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands to be 3/4" wide, constructed of aluminum or stainless steel. Minimum thickness to be .015" for aluminum and .010" for stainless steel.
- D. Tack fasteners to be stainless steel ring grooved shank tacks.
- E. Staples to be clinch style.
- F. Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.
- G. Finishing cement to be ASTM C449.
- H. Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz./sq. yd.
- I. Fungicidal water base duct liner coating (Foster 40-20 or equal) to be compatible with vapor retarding coating. This product must be EPA registered to be used inside HVAC ducts. Coating must comply with ASTM D 5590 with 0 growth rating.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that all piping, equipment, and ductwork are tested and approved prior to installing insulation. Do not insulate systems until testing and inspection procedures are completed.
- B. Verify that all surfaces are clean, dry and without foreign material before applying insulation materials.

3.2 INSTALLATION

- A. All materials shall be installed by skilled labor regularly engaged in this type of work. All materials shall be installed in strict accordance with manufacturer's recommendations, building codes, and industry standards. Do not install products when the ambient temperature or conditions are not consistent with the manufacturer's recommendations. Surfaces to be insulated must be clean and dry.
- B. Locate insulation and cover seams in the least visible location. All surface finishes shall be extended in such a manner as to protect all raw edges, ends and surfaces of insulation.
- C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.
- D. Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2".

- E. Use full length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.
- F. All pipe and duct insulation shall be continuous through walls, ceiling or floor openings and through sleeves except where firestop or firesafing materials are required. Vapor barriers shall be maintained continuous through all penetrations.
- G. Provide a continuous unbroken moisture vapor barrier on insulation applied to systems noted below. Attachments to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- H. Provide a complete vapor barrier for insulation on the following systems:
 - Cold Water Make-Up
 - Chilled Water
 - Refrigerant
 - Glycol
 - Insulated Duct
 - Equipment, ductwork or piping with a surface temperature below 65°F

3.3 PROTECTIVE JACKET INSTALLATION

- A. PVC Fitting Covers and Jackets (PFJ): Lap seams and joints a minimum of 2" and continuously seal PVC with welding solvent recommended by jacket manufacturer. Lap slip joint ends 4" without fasteners where required to absorb expansion and contraction. For sections where vapor barrier is not required and jacket requires routine removal, tack fasteners may be used. Secure PVC fitting covers with tack fasteners. For systems requiring a vapor barrier, apply a 1-1/2" band of mastic over ends, throat, seams and penetrations.
- B. All Service Jackets (ASJ) and Foil Scrim Kraft Jackets (FSK): Install according to manufacturer's recommendations using factory supplied lap seals and butt strip seals. In addition to factory adhesive, secure lap seals and tape with clinch type staples.
- C. Self-Adhering Jackets (SAJ):
 - 1. Install according to manufacturer's recommendations. Cut allowing minimum 4" overlap on ends and 6" on longitudinal joints. Align parallel to surface. Remove release paper and press flat to surface to avoid wrinkles. Rub entire surface for full adhesion and sealing at joint overlaps. On exterior applications, provide a bead of compatible caulk along exposed edges.
 - 2. Piping with self-adhering (SAJ) jackets shall have elbows, fittings, valves and butt joints wrapped with 2 layers of vapor retarding tape. Piping with a PVC jacket (PFJ) installed over the self-adhering (SAJ) jacket may be provided with a single, lapped layer of vapor retarding tape for elbows, fittings and valves under the PVC jacket. Vapor retarding tape shall be compatible with the jacket material used.
- D. Fabric Reinforced Mastic Jackets (FMJ): Glass fiber fabric shall be fitted without wrinkles. Glass fiber fabric shall be sized immediately upon application with lagging adhesive and shall be capable of drying within 6 hrs. Apply adhesive and coating according to manufacturer's recommendations. All seams shall overlap not less than 2".
- E. Vapor Retarding Jackets (VRJ): Piping with vapor retarding jackets (VRJ) shall have elbows, fittings, valves and butt joints wrapped with 2 layers of vapor retarding tape. For piping without a (PFJ) jacket, wrap jacket with 1" wide vapor retarding tape at 12" centers with a 25% overlap. Piping with a PVC jacket (PFJ) installed over the vapor retarding jackets (VRJ) may be provided with a single, lapped layer of vapor retarding tape for elbows, fittings and valves under the PVC jacket. Vapor retarding tape shall be compatible with the jacket material used.

3.4 PIPING, VALVE, AND FITTING INSULATION

A. General:

1. Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2" lap on jacket seams and 3" tape on butt joints, firmly cemented with lap adhesive unless otherwise noted. Additionally, secure with clinch style staples along seams and butt joints.
2. On systems requiring a vapor retarding jacket, seal off all raw ends of insulation and butt joints with vapor retarding mastic at intervals of not more than 20 feet on piping to create a vapor dam. Also provide a vapor dam on each side of valves, unions, and tees. Coat staples, longitudinal and transverse seams with vapor retarding mastic and on systems requiring vapor retarding jacket, coat insulated elbows, fittings, and valves with vapor retarding mastic.
3. Where insulated piping is installed on hangers and supports, the insulation shall be installed continuous through the hangers and supports. High density inserts shall be provided as required to prevent the weight of the piping from crushing the insulation. Pipe shields are required at all support locations. The insulation shall not be notched or cut to accommodate the supporting channels.
4. On low temperature systems, use premanufactured insulated pipe riser clamps such as Pipe Shields E1000 and E 2000 series.
5. Fully insulate all reheat coil piping, fittings and valves (except for unions) up to coil connection to prevent condensation when coil is inactive during cooling season. Provide a vapor proof seal between the pipe insulation and the insulated coil casing.

B. Insulation Inserts and Pipe Shields:

1. Provide pipe shields at all hanger and support locations. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Quantity and placement of inserts shall be according to the manufacturer's installation instructions, however the inserts shall be no less than 12" in length. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed as required for system.
2. Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.

C. Fittings and Valves: Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up insulation of the same thickness as adjoining insulation. Where the ambient temperature exceeds 150°F, cover insulation with fabric reinforcing and mastic. Where the ambient temperatures do not exceed 150°, furnish and install PVC fitting covers.

D. Elastomeric and Polyolefin: Where practical, slip insulation on piping during pipe installation when pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. For elastomeric insulation, apply full bed of adhesive to both surfaces. For polyolefin, seal factory preglued seams with roller and field seams and joints with full bed of hot melt polyolefin glue to both surfaces. Cover elastomeric insulation on systems operating below 40°F with vapor barrier mastic.

E. Polyisocyanurate: Fittings, valves, unions, flanges, couplings and specialties shall be insulated with factory molded insulation of the same thickness as adjoining insulation. Secure insulation sections with two wraps of nylon filament tape 9"-12" on center. On single insulation layer systems and on the outer layer of double insulation layer systems, apply a 1/16" thick bead of joint sealant rated for system operating temperatures to the outer edge of all longitudinal and butt insulation joints. For piping service below 20°F, use two layers of insulation with inner and outer butt and longitudinal joints staggered and offset 90 degrees. Where two layers of insulation are used, do not use sealant on the inner layer or adhere the inner layer to the outer layer. Apply vapor stop bead of joint sealant between pipe and insulation on both sides of valves, expansion/contraction joints, flanges, thermometers/gauges, attached vent and drain lines. Insulate attached non-

circulated lines, control lines, vents, etc. for a minimum distance of 6" from pipe. Cover insulation with a protective jacket as specified below. Do not penetrate protective covering or insulation with mechanical fasteners.

3.5 PIPING PROTECTIVE JACKETS

- A. In addition to the jackets specified in the pipe insulation schedule below the following protective jackets are required:
- B. Provide a protective PVC jacket (PFJ) for the following insulated piping:
 - Piping exposed in finished locations, including garages, and where indicated on plans.
- C. Provide a protective PVC (PFJ) or Fabric Reinforced Mastic (FMJ) jacket for the following insulated piping:
 - All piping within mechanical rooms.

3.6 PIPE INSULATION SCHEDULE

- A. Provide insulation on new and existing remodeled piping as detailed, as noted on plans, and as indicated in the following schedule:

Service	Insulation	Jacket	Insulation Thickness by Pipe Size				
			< 1"	1" < 2"	2" - <4"	4" < 8"	8" >
Heating Hot Water & Humidifier Steam & Condensate	Rigid Fiberglass	ASJ	1.5"	1.5"	2"		
<i>Note: On 1" or smaller hot water pipe runouts to terminal unit coils the insulation thickness may be reduced to ½" on both the supply and return pipes within 4ft of the coil but not on the distribution system side of the temperature control valve.</i>							
Chilled Water	Polyiso./Polysty.	VRJ or SAJ	1.5"	1.5"	1.5"		
Geothermal Piping	Rigid Fiberglass	ASJ	1"	1"	1"		
Refrig. Suction >40°F	Elastomeric	None	0.5"				
Cold Water Piping	Rigid Fiberglass	ASJ	0.5"				
Cooling Coil Condensate Drain	Rigid Fiberglass	ASJ	0.5"	0.5"	1"		

- B. The following piping and fittings are not to be insulated:
 - Hot water piping inside radiation, convector, or cabinet heater enclosures
 - Piping unions for systems not requiring a vapor barrier
- C. For systems with fluid temperatures 65°F or less, furnish and install removable elastomeric insulation covers, plugs or caps for all mechanical equipment and devices that require access by balancing contractors or service and maintenance personnel. Examples include but are not limited to: flow sensing devices, circuit setters, manual ball valve air vents, drain valves, blowdown valves, pressure/temperature test plugs, grease fittings, pump bearing caps, equipment labels, etc. Covers shall be tight fitting to ensure a complete vapor barrier.

3.7 DUCT INSULATION

- A. General:
 1. Secure flexible blanket duct insulation on sides and bottom of ductwork over 24" wide with weld pins. Space fasteners 18" on center or less as required to prevent sagging. Compress insulation no more than 25%.
 2. Secure rigid board insulation to ductwork with weld pins. Apply insulation with joints firmly butted as close as possible to the equipment surface. Pins shall be located a maximum of 3" from each edge and spaced no greater than 12" on center.

3. Install weld pins without damage to the interior galvanized surface of the duct. Clip pins back to washer and cover penetrations with tape of same material as jacket. Firmly butt seams and joints and cover with 4" tape of same material as jacket. Seal tape with plastic applicator and secure with staples. All joints, seams, edges and penetrations to be fully vapor sealed with vapor retarding mastic.
4. Stop and point insulation around access doors and damper operators to allow operation without disturbing insulation or jacket material.
5. External supply duct insulation is not required where ductwork contains continuous 1" acoustical liner, unless otherwise indicated. Provide 4" overlap of external insulation over ends of acoustically lined sections.
6. Where insulated ductwork is supported by trapeze hangers, the insulation shall be installed continuous through the hangers. Drop the supporting channels required to facilitate the installation of the insulation. Where rigid board or flexible insulation is specified, install high density inserts to prevent the weight of the ductwork from crushing the insulation.
7. Where insulated low temperature (below 45°F) ductwork is supported by steel metal straps or wire ropes that are secured directly to the duct, the straps or ropes shall be completely covered with insulation and sealed to provide a complete vapor barrier.
8. Where insulated duct risers are supported by steel channels secured directly to the duct, extend the insulation and vapor barrier jacketing to encapsulate the support channels.

3.8 DUCTWORK PROTECTIVE COVERINGS

- A. In addition to the jackets specified in the duct insulation schedule below the following protective coverings are required:
- B. Provide a protective covering of 2 coats of indoor/outdoor vapor retarding mastic with fibrous glass or canvas fabric covering (FMJ) or self-adhering jacket (SAJ) meeting 25/50 Flame Spread/Smoke Rating for the following ductwork:
 - Insulated ductwork located in mechanical rooms, mezzanines, catwalks, and as noted on plans.

3.9 DUCT INSULATION SCHEDULE

- A. Provide duct insulation on new and existing remodeled ductwork as detailed, as noted and scheduled on plans, and as indicated in the following schedule:

Service	Insulation Type	Jacket	Insulation Thickness
Outside air ducts	Rigid Fiberglass	FSK	2"
Mixed air ducts	Rigid Fiberglass	FSK	2"
Concealed supply ducts	Flexible Fiberglass	FSK	2" (R6 min. installed)
Exhaust and Relief ducts downstream of backdraft dampers	Rigid Fiberglass	FSK	2"
Exhaust ducts downstream of energy recovery units	Rigid Fiberglass	FSK	2"
Louver blank-off panels	Rigid Fiberglass	FSJ	2"

3.10 EQUIPMENT INSULATION

- A. General: Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.
- B. Semi-Rigid Fiberglass: Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place. Fill all joints, seams and depressions with insulating cement to a smooth, even surface. Cover with reinforcing fabric and 2 coats of mastic (FMJ). Use vapor barrier mastic on systems requiring a vapor barrier.

- C. Elastomeric/Polyolefin: Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints. Place insulation with edge joints firmly butted pressing to surface for full adhesion. Seal seams and joints vapor tight.

3.11 EQUIPMENT INSULATION SCHEDULE

- A. Provide equipment insulation as follows:

Equipment	Insulation Type	Jacket	Insulation Thickness
Reheat coil casing in concealed supply ducts	Flexible Fiberglass	FSK	2"
Reheat coil casing in exposed supply ducts	Rigid Fiberglass	FSK	2"
Hot water air separators and Hydraulic Separators	Semi-Rigid Fiberglass	ASJ	1.5"
Hot water storage/buffer tanks	Semi-Rigid Fiberglass	ASJ	2"
Geothermal & Chilled water air separators	Elastomeric/Polyolefin	None	1"
Geothermal & Chilled water pumps	Elastomeric/Polyolefin	None	1"

END OF SECTION 23 07 00

**SECTION 23 09 14 - PNEUMATIC AND ELECTRIC INSTRUMENTATION AND CONTROL DEVICES
FOR HVAC**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes control system specifications for all HVAC work as well as related control for systems found in other specification sections. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Point List
 - 3. Related Work
 - 4. Reference
 - 5. Work Not Included
 - 6. Federal Bidding Requirements
 - 7. Quality Assurance
 - 8. Reference Standards
 - 9. System Description
 - 10. Submittals
 - 11. Design Criteria
 - 12. Operation and Maintenance Data
 - 13. Material Delivery and Storage
- C. PART 2 - Products
 - 1. Air Piping
 - 2. Control Dampers
 - 3. Control Valves
 - 4. Control System Instrumentation
 - 5. Electric/Electronic Thermostats
 - 6. Duct Smoke Detector and Fire Alarm Interface Modules
 - 7. Air Flow Stations
 - 8. Gas Detection System
 - 9. Temperature Control Panels
 - 10. Temperature Sensors
 - 11. Humidity Sensors
 - 12. Pressure Transducers (Air)
 - 13. Pressure Transducers (Liquid)
 - 14. Current Status Switches
 - 15. Power Supplies
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Air Piping
 - 3. Wire and Air Piping Conduit and Tubing Installation Schedule
 - 4. Control Dampers

5. Control Valves
 6. Control System Instrumentation
 7. Room Thermostats and Temperature Sensors
 8. Low Limit Thermostats (Freezestats)
 9. Air Flow Stations
 10. Pressure Transducers and High Limit Pressure Switches
 11. Temperature Control Panels
 12. Current Status Switches
- 1.2 POINT LIST (Section 23 09 15)
- 1.3 RELATED WORK
- A. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC - Coordination
 - B. Section 23 09 15 - Direct Digital Control Input/Output Point Summary Tables
 - C. Section 23 09 24 - Direct Digital Control System for HVAC (Informational purposes only)
 - D. Section 23 09 93 - Sequence of Operation
 - E. Section 23 33 00 - Ductwork Accessories - for control damper installation
 - F. Division 22 – Plumbing – Equipment provided to be controlled or monitored
 - G. Division 23 - HVAC - Equipment provided to be controlled or monitored
 - H. Division 26 - Electrical - Installation Requirements & Equipment provided to be controlled or monitored
 - I. Division 28 - Electronic Safety and Security
- 1.4 REFERENCE
- A. Applicable provisions of Division 1 govern work under this section.
- 1.5 WORK NOT INCLUDED
- A. Direct digital controls and energy management interface, as specified in Section 23 09 24.
- 1.6 FEDERAL BIDDING REQUIREMENTS
- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
 - B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.
- 1.7 QUALITY ASSURANCE
- A. Installing contractor must be a manufacturer's branch office or an authorized representative of a Direct Digital Control (DDC) equipment manufacturer that provides engineering and commissioning of the DDC equipment. Submit written confirmation of such authorization from the manufacturer. Indicate in letter of authorization that installing contractor has successfully completed all necessary training required for engineering, installation, and commissioning of equipment and systems and that such authorization has been in effect for a period of not less than three years. DDC equipment may or may not be required to be installed by this contractor as part of the project, but the intent of this quality assurance specification is to ensure that the installing contractor has the capabilities to engineer, install, and commission the field devices supplied under this section for temperature control.

1.8 REFERENCE STANDARDS

- A. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
- B. ANSI/ASTM B32 Specification for Solder Metal
- C. ASTM B75 Seamless Copper Tube
- D. ASTM D1693 Environmental Stress-Cracking of Ethylene Plastics
- E. ASTM D 635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
- F. UL 94 Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
- G. AMCA 500-D Laboratory Method of Testing Dampers for Rating

1.9 SYSTEM DESCRIPTION

- A. System is to use direct digital control with electric actuation for air handling units; direct digital control with electric actuation for room temperature, room humidity, terminal airflow control, and for terminal units as indicated.
- B. All pneumatic tubing and electrical wiring are to be permanently tagged or labeled (within one inch of terminal strip) with a numbering system to correspond with the "Record Drawings". Tags or labels shall be printed not handwritten.

1.10 SUBMITTALS

Include the following information:

- A. Manufacturer's data sheets indicating model number, pressure/temperature ratings, capacity, methods and materials of construction, installation instructions, and recommended maintenance. General catalog sheets showing a series of the same device is not acceptable unless the specific model is clearly marked.
- B. Schematic flow diagrams of systems showing fans, pumps, coils, dampers, valves, and other control devices. Label each device with setting or adjustable range of control. Indicate all wiring, clearly, differentiating between factory and field installed wiring. Wiring should be shown in schematics that detail contact states, relay references, etc. Diagrammatic representations of devices alone are not acceptable.
- C. Details of construction, layout, and location of each temperature control panel within the building, including instruments location in panel and labeling. Also include on drawings location of mechanical equipment controlled (room number), horsepower and flow of motorized equipment (when this data is available on plans), locations of all remote sensors and control devices (either by room number or column lines).
- D. Schedule of control dampers indicating size, leakage rating, arrangement, pressure drop at design airflow, and number and size of operators required.
- E. Schedule of control valves indicating system in which the device is to be used, rated capacity, flow coefficient, flow required by device served, actual pressure drop at design flow, size of operator required, close-off pressure, and locations where valves are to be installed.
- F. A complete description of each control sequence for equipment that is not controlled by direct digital controls. Direct digital controlled equipment control sequences will be provided by the DDC control contractor.
- G. Prior to request for final payment, submit record documents which accurately record actual location of control components including panels, thermostats, wiring, and sensors. Incorporate changes required during installation and start-up.
- H. Provide a complete set of Submittal Drawings to the 23 09 24 DDC Contractor to enable them to coordinate the interfacing of the 23 09 14 controls with the 23 09 24 supplied controls. The 23 09 24 contractor is also required to provide any information regarding their supplied control equipment to the 23 09 14 contractor so that the 23 09 14 contractor can complete his engineered Submittal Drawings.

- I. Provide a complete set of control Record Drawings to the 23 09 24 DDC Contractor to enable them to provide a complete composite set of drawings incorporating DDC and electric controls as specified. Where communication and/or power wiring is specified to be provided under this Section, point to point routing of communication trunks and power wiring between DDC controllers, DDC communication devices, control panels, and Ethernet switches shall be documented in the control Record Drawings.

1.11 DESIGN CRITERIA

- A. Size all control apparatus to properly supply and/or operate and control the apparatus served.
- B. Provide control devices subject to corrosive environments with corrosion protection or construct them so they are suitable for use in such an environment.
- C. Provide devices exposed to outside ambient conditions with weather protection or construct them so they are suitable for outdoor installation.
- D. Use only UL labeled products that comply with NEMA Standards. Electrical components and installation to meet all requirements of the electrical sections (Division 26) of project specifications.

1.12 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.
- B. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:
 - 1. Lubrication instructions, including list/frequency of lubrication.
 - 2. List indicating types and grades of oil and/or grease, packing materials, normal and abnormal tolerances for devices, and method of equipment adjustment.
 - 3. Table noting full load power factor, service factor, NEMA design designation, insulation class and frame type for each motor provided.
 - 4. A complete set of record control drawings.

1.13 MATERIAL DELIVERY AND STORAGE

- A. Provide factory shipping cartons for each piece of equipment and control device. This contractor is responsible for storage of equipment and materials inside and protected from the weather.

PART 2 - PRODUCTS

2.1 AIR PIPING

- A. ASTM B75 seamless, hard drawn or annealed copper tubing with ANSI B16.22 wrought copper fittings, except final connections to apparatus may be made with brass compression-type fittings. Use ANSI/ASTM B32, 95/5 tin antimony solder.
- B. Virgin polyethylene plastic tubing classified as flame retardant under UL 94 and conforming to ASTM D1693 stress-crack test.

2.2 CONTROL DAMPERS

- A. Provide control dampers shown on the plans and as required to perform the specified functions. Dampers shall be rated for velocities that will be encountered at maximum system design and rated for pressure equal or greater than the ductwork pressure class as specified in Section 23 31 00 of the ductwork where the damper is installed.
- B. Use only factory fabricated dampers with mechanically captured replaceable resilient blade seals, stainless steel jamb seals and with entire assembly suitable for the maximum temperature and air velocities encountered in the system.
- C. All dampers in stainless steel, PCD coated steel, PVC, PTFE, or fiberglass ductwork shall be constructed of stainless steel.

- D. All dampers in aluminum ductwork shall be constructed of stainless steel or aluminum.
- E. Dampers in galvanized ductwork shall be constructed of galvanized steel and/or aluminum.
- F. All dampers, unless otherwise specified, to be rated at a minimum of 180° F working temperature. Leakage testing shall be certified to be based on latest edition of AMCA Standard 500-D and all dampers, unless otherwise specified, shall have leakage ratings as follows:

Damper Class	Differential Pressure	Leakage
Class IA	1" w.g.	≤3 CFM/ft ²
Class I	4" w.g.	≤8 CFM/ft ²
Class I	8" w.g.	≤11 CFM/ft ²
Class I	12" w.g.	≤14 CFM/ft ²

- G. Leakage rate dampers for differential pressures that they will encounter at maximum system design pressures.
- H. Steel framed dampers: Nailor models 2010 and 2020; Greenheck models VCD-33 and VCD-42; Johnson Controls model V-1330; Ruskin Models CD60 and CD40; other approved equal.
- I. Aluminum frame and blade dampers: Nailor models 2010EAF and 2020EAF; Greenheck model VCD-43; Ruskin model CD50; Arrow model AFD-20; other approved equal.
- J. Dampers used as shut-off dampers in open-ended ductwork, louvers without duct connections, in exhaust fan inlets with no outlet ductwork or where indicated shall be aluminum frame with insulated aluminum blades: Nailor models 2010IB and 2020IB; Greenheck model ICD-44; Ruskin model CDTI50; Arrow model AFDTI-25; other approved equal.
- K. Dampers used for directed mixing of airstreams, i.e. outside air and return air, to be parallel blade type and sized for an air velocity of 1800 to 2000 fpm with the damper blades shall be arranged so that the air streams are directed at one another to facilitate mixing. Dampers used for throttling or modulating applications other than air stream mixing to be opposed blade type. Two position dampers may be parallel or opposed blade type.
- L. Dampers used for isolation on the discharge of centrifugal fans shall have damper blades perpendicular to the fan shaft to minimize system effect. Dampers mounted with blades vertically shall be designed for vertical blade orientation.
- M. Dampers for applications other than fume exhaust to have frames of not less than 16 gauge galvanized steel or 12 gauge extruded aluminum. Blades to be two-ply steel airfoil of not less than 2 x 20 gauge galvanized steel (14 gauge equivalent) or extruded aluminum airfoil, with stainless steel, acetal, Celcon, bronze, or nylon bearings. Maximum allowable blade width is 8 inches. Use plated steel linkage hardware.
- N. Maximum damper width is 48 inches; where required width exceeds 48 inches, use multiple damper sections. Inside frame free area shall be a minimum of 90% of total inside duct area.
- O. Multiple width damper sections shall utilize jack shaft linkages unless noted below. Sections over 144 inches wide shall be actuated from two locations on the jack shaft. Double width damper sections for two-position operation may be actuated without jack shafts if each damper section is actuated separately. Dampers that have multiple width and multiple vertical sections shall have a jackshaft for each vertically stacked set of dampers and be provided with crossover linkages between jack shafts to transfer uneven loading.

- P. Jack shafts shall be extended outside of the ductwork for external actuator mounting. Provide bearings on the point of exit for support of damper shafts to prevent wear on the shaft and the ductwork. If locating actuators out of the air stream is impossible, obtain mounting location approval from the designer unless the contract documents indicate in air stream mounting is acceptable. In no cases shall damper actuators for fume exhaust systems be located in the air stream or require entering the air stream to service an actuator.
- Q. Provide weatherproof NEMA 4 enclosures (Belimo N4 option or equal, Belimo ZS-100 or ZS-150 are not acceptable) that have removable covers that have clasps or machine screws (no sheet metal screws) and that do not require removing fasteners from the ductwork to prevent actuator failure or freeze-up when mounting in locations exposed to harsh environments or outdoor locations.
- R. Size operators for smooth and positive operation of devices served, and with sufficient torque capacity to provide tight shutoff against system temperatures and pressure encountered. For electric modulating actuation, use fully proportional actuators with zero and span adjustments. For two-position electric actuation use 24 VAC for DDC controlled actuators, 120 VAC actuators may be used for hardwire interlocking. See 23 09 15 for specific type of input signal required. Actuator stroke times shall match the requirements of the DDC controllers provided under 23 09 24 and/or the specific system requirements for proper operation. All electric actuators will be provided with overload protection to prevent motor from damage when stall condition is encountered. Equip operators with spring return for applications involving fire, freeze protection, moisture protection or specified normally open/closed operation. If spring return actuators are not available for applications because of torque requirements or other application requirements, stored energy fail safe may be used if approved by the A/E.
- S. Where control sequences require damper position indication or interlock, provide damper end switches integral to the damper actuators with form "C" contacts. Damper end switches shall have adjustable positions that can be set for proving the damper open, closed, or both depending on the specified application. End switch contact ratings shall be suitable for application. Where multiple banks of dampers are provided and not physically interlocked, end switches shall be provided for each bank of dampers and wired together to prove all dampers are in the position to be indicated. End switches shall not contain mercury.
- T. All power required for electric actuation shall be provided by this contractor if it is not able to be directly provided from the DDC controller.
- U. Provide operators with linkages and brackets for mounting on device served.

2.3 CONTROL VALVES

- A. Provide all control valves as shown on the plans/details and as required to perform functions specified. Spring ranges must be selected to prevent overlap of operation and simultaneous heating and cooling.
- B. Size operators to allow smooth and positive operation of devices served and to provide sufficient torque capacity for tight shutoff against system temperatures and pressure encountered. For electric modulating actuation, use fully proportional actuators with 0-10VDC inputs and zero and span adjustments unless specified otherwise in the chart below. If TriState with feedback is specified, valve position shall be fed back to the controller and controller shall position valve based on this feedback. For two-position electric actuation use 24 VAC for DDC controlled actuators, 120 VAC actuators may be used for hardwire interlocking. Electric actuators, for applications other than terminal units, shall be provided with a manual override capability. All electric actuators shall be provided with a visible position indicator.
- C. All power required for electric actuation shall be provided by this contractor if it is not able to be directly provided from the DDC controller.
- D. Provide operators that are full proportioning or two-position, as required for specified sequence of operation. Provide spring-return for applications involving fire, freeze protection, moisture protection or specified normally open/closed operation. Valves shall move to their fail positions on loss of electrical power to the actuator.

- E. Provide end switches integral to the valve actuator to prove the valve open, closed, or both to meet the application where specified in the plans or specifications. End switch contact ratings shall be suitable for application.
- F. Two-position shut-off valves shall be sized for a maximum pressure drop of 2 PSI at design flow and shall be a minimum of line size.
- G. Provide operators with linkages and brackets for mounting on device served.
- H. All valves unless specifically noted on the plans or indicated below shall be globe style valves.

VALVE SERVING	TYPE Globe Butterfly (BF) Ball Press. Independ. Ball (PI Ball)	Signal 0-10 VDC TriState (24VAC) 2-Position Elect.	Spring Return Required Yes/No	Fail Position Open (through coil) Closed (bypass coil) Last Position
Reheat Coil	Ball	0-10 VDC	No	Last Position
Radiation w/Reheat	Ball	0-10 VDC	No	Last Position
Standalone Radiation	Ball	0-10 VDC	No	Last Position
CUH and UH	Ball	0-10 VDC	No	Last Position
AHU Hot Water Coil	Ball	0-10 VDC	Yes	Open
AHU Cooling Coil	Ball	0-10 VDC	Yes	Closed

See plan details, notes, and schedules for where 2-way and 3-way valves should be used.

- I. Water Systems:
 1. Use equal percentage valves for two-way control valves; size for a pressure drop not less than 4 psi or more than 6 psi. Where valve sizes are less than line size, Corrected Cv should be used to correct for piping reducers/increasers. Modulating valve size should never be less than half of line size. Consult with A/E for acceptable pressure drop if available valve selections do not fall within the desired pressure range. Note: For low flows, the required minimum Cv size will result in lower pressure drop than 4 psi.
 2. Use three-way valves sized for a maximum pressure drop of 5 psi and that have linear characteristics so that the valve pressure drop remains constant regardless of the valve position.
 3. Butterfly valves: Iron body, stainless steel shaft, bronze bearings, and resilient seat. Disc to be aluminum-bronze, nickel-plated ductile iron, cast iron with welded nickel edge, or stainless steel. Valve assembly to be bubble tight, suitable for use on water systems at 150 psig and 240°F. When butterfly valves are used in modulating applications, entering and leaving pipe sizes and required transition distances shall be detailed on the control valve submittals. The control contractor shall be responsible for coordinating the proper pipe sizes and transitions with the mechanical contractor to provide the correct Cv at 70° open position.
 4. Characterized Ball Valves 2" and smaller: The following manufacturers are acceptable: Honeywell, Belimo, Johnson Controls, KMC Controls, Yamatake, Bray, Siemens. Forged brass or bronze body, stainless steel shaft and ball, reinforced Teflon or PTFE ball seals, double O-ring stem seals, characterized disk, maximum of ANSI Class IV (0.01%) leakage, suitable for use on water systems at 150 psig and 212°F. Minimum size for ball valves shall be 0.4 Cv.
 5. Characterized Ball Valves 2-1/2" and larger: Brass or cast iron body, stainless steel shaft and ball, reinforced PTFE Ball seats, EPDM double O-ring stem seals or reinforced PTFE stem packing, characterized disk, iron flanged ends, maximum of ANSI Class IV (0.01%) leakage, suitable for use on water systems at 218 psig and 280°F.

6. Pressure Independent Characterized Ball Valves: The following manufacturers and models are acceptable: Belimo model PIQCV and ePIV and Griswold Controls PIC-V. Forged brass or bronze body, reinforced Teflon or PTFE ball seals, double O-ring stem seals, characterized disk, maximum of ANSI Class IV (0.01%) leakage, suitable for use on water systems at 150 psig and 212°F. Flow shall be varied by actuator position and at any given position, flow through the valve shall not vary more than $\pm 5\%$ due to system pressure fluctuations across the valve in the selected operating range. Valves shall be pressure independent between a system differential pressure of 8 and 50 PSID. Minimum size for ball valves shall be 0.4 Cv.

2.4 CONTROL SYSTEM INSTRUMENTATION

- A. Manufacturers: Averaging Type - Johnson Controls, or equal; Bulb Type - Johnson Controls, Ashcroft, Marshall, Weksler.
- B. PIPE THERMOMETERS: 9" stem type with an adjustable swivel mount. Scale graduations of 2°F and mid-range accuracy of $\pm 1^\circ\text{F}$. Install thermometers in separable brass wells filled with conductive fluid. Thermometer temperature range shall not be more than twice the expected temperature range at installed location.
- C. REMOTE BULB THERMOMETERS: 3" or larger dial type with recalibration screw on face. Accuracy within 1% of scale range. Thermometers with sensing elements in air ducts with an area of above 6 square feet to have averaging liquid or gas filled capillary sensing elements. Provide separable wells for all pipeline applications. Thermometer temperature range shall not be more than twice the expected temperature range at installed location.

2.5 ELECTRIC/ELECTRONIC THERMOSTATS

- A. LOW LIMIT THERMOSTATS (freezestats): Electric two-position type with temperature sensing element and manual reset. Unit to be capable of opening control circuit if any one-foot length of sensing element is subject to a temperature below the setpoint. Length of sensing element to be not less than one linear foot per square foot of coil surface areas. Unless otherwise indicated, set low limit controls at 36°F.
- B. AQUASTATS: Line voltage type with single pole, double throw switch of adequate rating for the applied load.
- C. REMOTE BULB THERMOSTATS: Line voltage type with single pole, double throw switch of adequate rating for the applied load. Thermostat to have adjustable setpoint suitable for controlled load.
- D. IMMERSION TYPE THERMOSTAT SENSORS: Rod and tube type with linear output. Provide separable wells with heat conductive fluid for installation in pipeline. Units shall be factory calibrated.

2.6 DUCT SMOKE DETECTOR AND FIRE ALARM INTERFACE MODULES

- A. Detectors with auxiliary contacts or fire alarm control modules will be provided by others. Provide wiring, conduit, and necessary interface with fire alarm system to perform specified sequence of operation.

2.7 AIR FLOW STATIONS

- A. Provide duct mounted airflow station type based on the following minimum design velocities. Pitot or thermal dispersion flow stations can be used for fan inlet flow stations. Outside air flow stations shall be thermal dispersion or fixed orifice type only. Turndown of variable volume fan systems must be considered. Provide an airflow station schedule detailing the airflow range to be measured, corresponding velocity pressure, differential pressure transducer range, and the airflow station size.

Air Velocity	Duct Mounted Air Flow Station Type
100-3000 FPM	Fixed Orifice
0-5000 FPM	Thermal Dispersion
>700 FPM	Thermal Dispersion or Multi-probe Velocity Pressure Pitot Style

- B. Duct mounted multi-probe velocity pressure pitot air flow stations: Multi-probe duct velocity pressure sensing station constructed of minimum 16 gauge galvanized steel casing, and multiple metallic velocity pressure sensors with automatic averaging manifold. For duct installations, provide an aluminum honeycomb cell air straightener with maximum openings of ½" and minimum of 3" depth. Each airflow measuring element shall contain multiple Total and Static pressure sensors, placed at equal distances (for rectangular Ducts) and at concentric area centers (for circular ducts) along the element length. The number of sensors on each element and the quantity of elements utilized at each installation shall comply with the ASHRAE standards for duct traversing. The airflow measuring elements shall be capable of producing steady, non-pulsating Total and Static pressure signals, with accuracy within $\pm 2\%$ of actual flow. Airflow resistance to be less than or equal to 0.23" of water at 4000 feet per minute air velocity.
- C. Fan inlet probe air flow stations: For fan inlet probes provide two probes for each fan inlet (for DWDI fans provide four probes). Pressure drop caused by the airflow elements shall not exceed 0.03" w.c. at 2000 FPM. Airflow elements shall be provided with all necessary pivot mounting hardware and signal connection fittings for connection to tubing provided by the installing contractor. For pitot type air flow stations, the static and total pressure manifold piping by the installing contractor shall be piped symmetrically so take-off will be located where line lengths between all probes are equal in length. Thermal dispersion type shall not to be used for inlet probe air flow stations.
- D. Fan inlet piezometers: Where fan inlet piezometers are provided, these shall be used by the control contractor for air flow measurement. The air velocity transducers shall be provided under this Section and sized as described below.
- E. For duct mounted and fan inlet pitot flow stations or factory mounted piezometers, air velocity transducers range shall be sized less than two times the design velocity pressure at maximum flow and will meet the requirements under the PRESSURE TRANSDUCERS (AIR) specification later in this specification section unless noted below.
- F. Thermal dispersion air flow stations:

1. Manufacturers: Ebtron, Air Monitor, Kurz Instruments, or equal.
2. Probe Sensor Density:

Area (sq. ft.)	Sensors
≤ 1.5	2
>1.5 to <4	4
4 to <8	6
8 to <12	8
12 to <16	12
≥ 16	*

* Minimum 4 sensors per 4 square feet of area where area is rounded up or down to the nearest 4 square foot area, i.e. ≤ 18 sq. ft. = 16 sensors, >18 sq. ft. = 20 sensors

3. Airflow Sensor Accuracy: $\pm 2\%$ of reading.
 4. Calibrated Range: 0-2500 FPM for duct applications and 5000 FPM for fan inlet applications.
 5. Temperature Sensor Accuracy: $\pm 0.15^\circ\text{F}$.
 6. Temperature: -20°F to $+140^\circ\text{F}$.
 7. Relative Humidity: 0 to 95% (non-condensing).
- G. Fixed orifice air flow stations:
1. Where indicated, provide a complete, dedicated outdoor airflow measurement system capable of directly measuring the airflow through an outside air inlet/opening and providing the measured airflow values.

2. The outdoor airflow measurement system shall consist of a dedicated monitor/transmitter and flow sensing element combined to create a complete system. The system shall be factory calibrated and configured based on the application and installation configuration.
3. The flow sensing element(s) shall be constructed of 316 SS and only materials that are designed to resist corrosion due to the presence of salt or chemicals in the airstream. The flow sensing elements shall not be affected by the presence of moisture, dirt or debris in the airstream and shall not be affected by gusting wind.
 - a. Airflow Sensor Accuracy: $\pm 5\%$ of reading.
 - b. Calibrated Range: 150-2400 FPM for free inlet and duct applications.
 - c. Temperature Sensor Accuracy: $\pm 0.1\%$ at 32°F.
 - d. Temperature: -40°F to +120°F.
 - e. Relative Humidity: 0 to 99% (non-condensing).
- H. Provide transmitter that will average up to sixteen sensors and provide two field selectable linear analog output signals (4-20mA and 0-10 VDC) proportional to airflow and temperature. Sensor electronic circuitry other than the temperature sensors shall not be exposed to the air stream and shall be protected from moisture to prevent failure.

2.8 TEMPERATURE CONTROL PANELS

- A. Constructed of steel or extruded aluminum, with hinged door, keyed lock, and baked enamel finish. Install controls, relays, transducers, and automatic switches inside panels. Label devices with permanent printed labels and provide asbuilt wiring/piping diagram within enclosure. Provide raceways for wiring and poly within panel for neat appearance. Provide termination blocks for all wiring terminations. Label outside of panel with panel number corresponding to plan tags and asbuilt control drawings as well as building system(s) served.
- B. Control panels that have devices or terminations that are fed or switch 50V or higher shall enclose the devices, terminations, and wiring so that Personal Protective Equipment (PPE) is not required to service the under 50V devices and terminations within the control panel. As an alternative, a separate panel for only the 50V and higher devices may be provided and mounted adjacent to the under 50V control panel.
- C. For panels that have 120VAC power feeds provide a resettable circuit breaker. Provide label within the panel indicating circuit number of 120VAC serving panel.
- D. Provide a service shutdown toggle switch for each air handling unit system and associated exhaust fan systems (not general exhaust fans) and energy recovery systems located inside the temperature control panel that will initiate a logical shutdown of the air handling unit system as specified under Section 23 09 15. Label the switch "Service Shutdown" and so it is clear which position is shut down and which is auto.

2.9 GAS DETECTION SYSTEM

- A. Manufacturers: Honeywell, Toxalert, Opera, Armstrong Monitoring Crop, Brasch or equal.
- B. Provide a controller to monitor integral or remote electrochemical carbon monoxide (CO) and nitrogen dioxide (NO₂) sensors and with integral relay(s) to start the exhaust fan(s) per the drawings. When a sensor indicates a gas concentration of 35 ppm (CO), 1 ppm (NO₂) or higher, the associated ventilation system shall start and an LED on the face of the controller shall indicate "Warning level" (ventilation system on) operation. If the gas concentration reaches 50 ppm (CO), 2 ppm (NO₂) or higher a red alarm LED on the face of the controller shall light and the audible alarm shall sound and an alarm set of contacts shall close. The audible alarm shall have a momentary push button silence switch.
- C. Provide "Sensor Failure" indication for each sensor. The sensor shall be designed such that the controller can detect when a sensor has failed. Provide an alarm or LED on the face of the controller panel for each sensor input to indicate sensor failure. The detection of a failed sensor shall sound the audible alarm.

2.10 TEMPERATURE SENSORS

- A. Thermistor temperature sensor manufacturers: PreCon, BAPI, and ACI.
- B. Use thermistor or RTD type temperature sensing elements constructed so accuracy and life expectancy is not affected by moisture, physical vibration, or other conditions that exist in each application.
- C. RTD's shall be of nickel or platinum construction and have a base resistance of 1000 Ω at 70°F and 77°F respectively. 100 Ω platinum RTD's are acceptable if used with temperature transmitters.
- D. The temperature sensing device used must be compatible with the DDC controllers used on the project.

RTD	
Accuracy (Room Sensor Only)	minimum $\pm 1.0^{\circ}\text{F}$
Accuracy (Averaging)	minimum $\pm 1.2^{\circ}\text{F}$
Accuracy (Other than Room Sensor or Averaging)	minimum $\pm 0.65^{\circ}\text{F}$
Range	minimum -40 - 220°F

Thermistor	
Accuracy (All)	minimum $\pm 0.36^{\circ}\text{F}$
Range	minimum -30 - 230°F
Heat Dissipation Constant	minimum 2.7 mW/°C

Temperature Transmitter	
Accuracy	minimum $\pm 0.1^{\circ}\text{F}$ or $\pm 0.2\%$ of span
Output	4-20 mA

- E. Provide limited range or extended range sensors if required to sense the range expected for a respective point. Use RTD type sensors for extended ranges beyond -30 to 230°F. If RTD's are incompatible with DDC controller direct temperature input use temperature transmitters in conjunction with RTD's.
- F. Use wire size appropriate to limit temperature offset due to wire resistance to 1.0°F. If offset is greater than 1.0°F due to wire resistance, use temperature transmitter. If feature is available in DDC controller, compensate for wire resistance in software input definition.
- G. Terminal unit discharge temperature sensors shall be provided under this Section.
- H. Terminal unit sensors shall be provided with blank covers and no adjustments and shall be provided under this Section. Provide information to the AE on sensor colors offered by the manufacturer and obtain approval on what color should be provided on the project.
- I. Use averaging elements on duct sensors when the ductwork is ten square feet or larger. All mixed air and heating coil discharge sensors shall have averaging elements regardless of duct size.
- J. In piping systems use temperature sensors with separable wells designed to be used with temperature element.

2.11 HUMIDITY SENSORS

- A. Use capacitive thin-film polymer sensor types with a range of 0-100% RH. Accuracy to be no less than $\pm 2\%$ in the range of 20% RH to 80% RH with a response time of 120 seconds or less. Provide covers for room humidity sensors as specified for temperature sensors.
- B. For outside air applications, use sensor designed for outside air use along with weather enclosure. Provide sensor equal to Vaisala Model HMD60UO w/ DTR503B enclosure and weather resistant mounting hardware.

2.12 PRESSURE TRANSDUCERS (AIR)

A. Provide pressure transducers specified below for the following applications:

- Duct static pressure applications where setpoints are specified to control at greater than 0.1" w.g.
- Pitot type fan inlet air flow stations.
- Air filtration in fan powered equipment.

B. Manufacturers: Mamac Systems, Setra, and Veris Industries.

1. Provide a transmitter that operates on the capacitance principle and is capable of sensing low positive, negative or differential pressures. Transmitter shall have a minimum of three pressure ranges adjustable by an onboard switch or jumper. Size the transmitter where the middle or high range is suitable for the application. Use a bi-directional transmitter for applications that may have both positive and negative pressure excursions. Transmitter shall be provided with an integral four-digit display of the pressure sensed.

Accuracy (including no-linearity and hysteresis)	± 1% FS
Compensated Temperature Range	32°-140°F
Temperature Effect	0-1" wc Range .09% FS/°F; >1" wc Range .02% FS/°F
Output	4-20 MA
Load Impedance (smallest maximum acceptable)	800 Ω maximum
Operating Temperature	32°-140°F

C. For air filtration monitoring, size differential pressure transducers to provide for the following ranges:

Filter Type	Scale Range (inch w.g.)
Panel Filters	0.0 to 0.5
MERV 8	0.0 to 1.0
MERV 13	0.0 to 2.0
MERV 14	0.0 to 2.0

D. Provide pressure transducers specified below for the following applications:

- Duct static pressure applications where setpoints are specified to control at 0.1" w.g. or lower.
- All duct mounted pitot type air flow stations.

E. Manufacturers: Paragon Controls MicroTrans, Air Monitor Veltron DPT2500 Plus, or approved equal.

1. The airflow transducer shall provide noise filtration and automatic auto-zeroing. The automatic zeroing circuit shall be capable of maintaining the transducer output to within □0.25% of operating span. The transducer output shall be locked and maintained at the last given output value during the automatic zeroing period so as not to interrupt the automatic control process. Use a bi-directional transmitter for applications that may have both positive and negative pressure excursions. Transmitter shall be provided with an integral four-digit display of the pressure sensed.

Transducer Span	<2 times the design velocity pressure at maximum flow, single range.
Accuracy	±0.25% of full scale, including non-linearity, hysteresis, deadband, and non-repeatability.
Temperature Effect	±0.15% of full scale/°F.
Response	0.5 sec. for 98% of full span change.
Overpressure	5 PSIG Proof.
Power	24VAC/VDC.
Analog Output	0-5VDC, 0-10VDC, or 4-20mA field adjustable.
Auto Zero Frequency	every 1 to 24 hours on 1-hour intervals.

- F. For fan housing or duct static or differential pressure sensing, use gasketed metal static pressure sensors, Mamac A-520 or equal. Mount in location shown on plans or approved by A/E.

2.13 PRESSURE TRANSDUCERS (LIQUID)

- A. Provide a transmitter that utilizes capacitive or thin film strain gauge sensing. Provide for an analog gauge piped in parallel with the transducer. Gauge shall meet specifications as specified in Section 23 05 15. Coordinate with mechanical contractor to provide and install this gauge. For differential pressure applications provide with bypass valve manifold assembly with valved venting capability.

Accuracy (including no-linearity and hysteresis)	± 0.5% FS
Compensated Temperature Range	32°-150°F
Temperature Effect (over compensated range)	0.03%/°F
Output	4-20 MA
Load Impedance (smallest maximum acceptable)	600 Ω Minimum
Operating Temperature	0°-175°F
Hysteresis	0.75% of span

2.14 CURRENT STATUS SWITCHES

- A. Provide a current sensor with adjustable threshold and digital output with LED display, equal to a Veris model H-708/H-904. Threshold adjustment must be by a multi-turn potentiometer or set by multiprocessor that will automatically compensate for frequency and amperage changes associated with variable frequency drives. When used on variable speed motor applications, use a current sensor that will not change state due to varying speeds. Current switches with integral relays shall not be used for start/stop and status motor applications.

2.15 POWER SUPPLIES

- A. Provide all required power supplies for transducers, sensors, transmitters, and relays. All low voltage transformers shall have a resettable secondary circuit breaker and be listed as class 2 power supplies. All transformer assemblies in enclosures shall have isolated high and low voltage compartments with separate removeable covers for connections.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install system with trained mechanics and electricians employed by the control equipment manufacturer or an authorized representative of the manufacturer. Where installing contractor is an authorized representative of the control manufacturer, such authorization shall have been in effect for a period of no less than three years.

- B. Install all control equipment, accessories, wiring, and piping in a neat and workmanlike manner. All control devices must be installed in accessible locations. This contractor shall verify that all control devices furnished under this Section are functional and operating the mechanical equipment as specified in Section 23 09 93.
- C. All cables to the electronic input/output devices, sensors, relays, and interlocking wiring (all of which shall be supplied and installed under this section of specification) interfaced with the Direct Digital Control System shall be extended into the 23 09 24 DDC panel with a minimum of 5 ft. of cable to allow for termination by the 23 09 24 DDC Contractor. This contractor shall provide a technician to inspect and validate all tubing, wiring, and field devices associated with the DDC interface in coordination with and under direction of the 23 09 24 DDC Contractor to ensure that each device is operating per the control sequences as specified in Section 23 09 93.
- D. Label all control devices except for terminal unit devices with permanent printed labels that correspond to control drawings. Labeling for each device shall be unique within each mechanical system. Temperature control junction and pull boxes shall be identified utilizing spray painted green covers. Other electrical system identification shall follow the 26 05 53 specification. For control devices mounted above accessible ceilings, label the ceiling tile grid at the ceiling tile that is to be removed for access to the control device. The label shall be pre-printed using clear polyester tape with black bold 28 size font for ceilings under 12 feet. For ceilings over 12 feet high, use bold 40 size font. For accessible ceilings, use an arrow to point at ceiling tile to be removed for access.
- E. All control devices and electrical boxes mounted on insulated ductwork shall be mounted over the insulation. Provide mounting stand-offs where necessary for adequate support. Cutting and removal of insulation to mount devices directly on ductwork is not acceptable. This contractor shall coordinate with the insulation contractor to provide for continuous insulation of ductwork.
- F. Mounting of electrical or electronic devices shall be protected from weather if the building is not completely enclosed. This contractor shall be solely responsible for replacing any equipment that is damaged by water that infiltrates the building if equipment is installed prior to the building being enclosed.
- G. Provide all electrical relays and wiring, line, and low voltage, for control systems, devices, and components. Install all high voltage and low voltage wiring (includes low voltage cable) in metal conduit, Electrical Non-metallic Tubing (ENT), or Electrical Metallic Tubing (EMT), as scheduled below and hereafter referred to generically as conduit except above accessible ceilings as noted below. See Wire and Air Piping Conduit Installation Schedule below for specific conduit or tubing to be used. All raceways, enclosures, fittings, and associated supports shall be provided and installed according to the requirements set forth in Division 26, NFPA 90 (NEC) and Chapter SPS 316 of the Wisconsin Administrative Code. All conduits shall be routed parallel and/or perpendicular to walls and adjacent piping. Raceways shall be located to maintain headroom and working clearance around equipment and devices that require inspection and service.
- H. In general, support all raceways from the building structure. No component of a raceway system shall be secured to corrugated metal roof deck. Do not impose on the installations of other trades. Securing conduit, rods, straps, hangers, etc. to suspended ceiling components, electrical raceways, plumbing piping, fire protection sprinkler piping, HVAC piping or ductwork, or their associated support systems, will not be accepted.
- I. Conduit shall be a minimum of 1/2" for low voltage control provided the pipe fill does not exceed 40%.
- J. Minimum low voltage wiring gauge to be 18 AWG for outputs and 20 AWG for inputs. All low voltage wiring to be stranded.
- K. Low voltage wiring can be run without conduit above accessible lay-in tile ceilings. All wiring in mechanical rooms, above inaccessible hard ceilings, exterior locations, and in any exposed areas, and in all other locations shall be installed in conduit. Wire for wall sensors shall be installed in conduit concealed in the wall. Wiring for radiation valves shall be installed in conduit concealed in the wall. For retrofit installations, all wiring for sensors and valves shall be installed in conduit concealed in new walls. Sensor wiring for existing walls shall be installed without conduit and concealed in the wall (fished) where

possible. If running wire concealed in the existing wall is not possible, install in surface raceway as specified or if not specified, consult with the A/E for raceway type and color to be provided.

- L. Where wiring is installed free-air, installation shall consider the following:
- Wiring shall utilize the cable tray wherever possible.
 - Wiring shall run at right angles and be kept clear of other trades work.
 - Wiring shall be supported utilizing "J" or "Bridal-type" steel mounting rings anchored to ceiling concrete, piping supports, walls above ceiling or structural steel beams. Mounting rings shall be of open design (not a closed loop) to allow additional wire to be strung without being threaded through the ring. For mounting rings that do not completely surround the wire, attach the wire to the mounting ring with a strap.
 - At HVAC terminal units only, where the wiring serves a specific device; e.g., controller, actuator, transmitter, etc. associated with the unit, the j-hooks or Bridal rings required to support the wiring, may be secured to the rods or straps that support the ductwork or piping that serves the unit. Wall penetrations shall be sleeved.
 - Supports shall be spaced at a maximum 4-foot interval unless limited by building construction. If wiring "sag" at mid-span exceeds 6-inches; another support shall be used.
 - Wall penetrations shall be sleeved, and fire stopped as specified.
 - Wiring shall not be supported from existing cabling, existing tubing, plumbing or steam piping, ductwork, any component of a suspended ceiling, or electrical or communications conduit.
- M. Control panels serving equipment fed by emergency power shall also be served by emergency power. This contractor shall be responsible for all 120VAC power, not provided in the Division 26 specifications, required for equipment provided under this section. Power shown for temperature control panels on plans may be utilized by the 23 09 24 and 23 09 14 contractor.
- N. Provide communication trunk wiring to integrated devices (i.e. VFD's, Flow Meters, Chillers, Lighting Panels, Electrical Meters, etc.) that are specified to be connected to the building automation system. Communication trunk wiring shall be as required by the equipment specified under the 23 09 24 Sections and shall be routed to the DDC panel designated for that equipment as shown on the plans or the closest DDC panel if not designated. If communication trunks required daisy chained style wiring, provide two communication cables to the DDC panel so that the communication trunk is not dead ended.
- O. Install all terminal unit DDC controls and associated sensors furnished under Section 23 09 14 and 23 09 24 that are field mounted at the terminals units (not terminal unit controls that are mounted in centralized temperature control panels). For terminal units, i.e., fin tube radiation, convectors, cabinet unit heaters, fan coils, where the DDC controller is to be installed in the terminal unit enclosure, the DDC controller shall be installed in a location within the terminal unit enclosure designed to house controls. In no cases shall DDC controllers be installed in the convective or forced air flow stream of the terminal unit.
- P. Above accessible lay-in tile ceilings where VAV box DDC controllers are designed to be directly mounted on air terminals, the DDC controller shall be installed without an enclosure. Above accessible lay-in tile ceilings where additional controllers are required, they shall not be mounted directly to the ductwork but be mounted on din rail or back panel in an accessible location as close as possible to the terminal unit(s) being controlled. In exposed ceilings or in mechanical rooms, an equipment enclosure that completely encloses the DDC controller and allows for conduit terminations shall be provided as described below.

- Q. In mechanical rooms or other locations where the VAV terminal is not above an accessible lay-in ceiling, the enclosure will be provided under Section 23 36 00. If other terminals are associated and controlled from the same VAV terminal DDC controller and additional controllers are required for control, the Section 23 09 24 contractor shall provide the enclosure for mounting under this Section.
- R. Any devices other than DDC controllers, i.e., relays, pressure switches or sensors, etc. associated with VAV terminal unit control shall be installed in an enclosure furnished under this Section.
- S. Where occupancy sensors are to be interlocked with terminal units that serve more than one room, all occupancy sensors for the rooms served shall be wired in parallel and wired to the terminal unit DDC controller.
- T. Provide all 24VAC power transformers and wiring for DDC terminal unit controls. Provide all communication wiring to the DDC supervisory controller for the terminal units provided under 23 09 24. Provide all power and communication wiring type and installation as required by the DDC controller manufacturer for the terminal units. Tag all terminal units with printed labels to match the terminal unit room schedules. Terminate wiring for all terminal unit controllers and perform end to end point checkout of all inputs and outputs to the terminal unit controllers. Verify the communication trunk and controller addressing.
- U. Start/stop and safety relays for motor loads shall be mounted remotely at the VFD or starter being controlled. Label these relays per above tagging requirements and locate in position on the VFD or starter where the label and power indication light for the relay is visible.
- V. If terminal unit controllers are furnished under Section 23 09 24, the 23 09 24 contractor shall provide a laptop or other tools and training to the 23 09 14 contractor on how to perform the communication trunk testing and end to end point checkout as described above. Terminal unit room schedules are to be provided under this Section and supplied to the 23 09 24 contractor. The 23 09 24 contractor shall provide engineered control drawings for installation of the terminal unit controllers and deliver these to the 23 09 14 contractor in time to meet the project schedule for the installation of these terminals. Communication trunk wiring for the DDC control panels provided under Section 23 09 24 shall be provided by the 23 09 24 contractor unless otherwise specified.
- W. Install "hand/off/auto" selector switches on systems where automatic interlock controls are specified and "hand/off/auto" selector switches are not supplied with the equipment controlled. Control panel power will not be required for "hand" switch to operate. When switch is in "hand" position, allow manual operation of the selected device without operating the interlocked motors but allowing all unit safety devices to stay in the circuit.
- X. For service shutdown switches provided in temperature control panels for service shutdown of HVAC systems, label the associated VFD's or motor starters that there is a service shutdown switch and the temperature control panel designation where the switch is located.
- Y. All wiring in control panels shall be terminated on a terminal strip. Wire nuts are not acceptable. A maximum of two wires shall be terminated under any one terminal.
- Z. Utilizing a control panel as a raceway for wiring to another control panel is prohibited.
- AA. All pneumatic tubing, cabling and electrical wiring terminated at controllers, devices and terminal strips are to be permanently tagged or labeled with permanent adhesive labels within one inch of terminal strip with a numbering system to correspond exactly with the "Record Drawings". Jumpers where both ends of the wire are visible and terminations are within 6" of each other do not need to be labeled. Spare wires are to be labeled as "Spare" with unique number designations.
- BB. After completion of installation, test and adjust control equipment. Submit data showing set points and final adjustments of controls.

3.2 AIR PIPING

- A. Conceal piping whenever possible. Exposed piping may be run only in mechanical rooms, storage rooms, or other areas where mechanical systems piping is exposed.

- B. Mechanically attach tubing to supporting surfaces. Sleeve through concrete surfaces in minimum one-inch sleeves, extended 6 inches above floors and one inch below bottom surface of slabs. Fire stop any open space in the sleeve after the air piping is installed if the sleeve is in a fire rated surface.
- C. Purge tubing with dry, oil free compressed air before connecting control instruments.
- D. Install all polyethylene tubing in conduit as scheduled below unless specified otherwise hereafter. Exposed polyethylene tubing not exceeding 18 inches may be used for connection to an instrument or operator without being installed in conduit. All Conduit to be independently supported, all boxes must be supported, all conduit ends to have bushings for protection of tubing.
- E. Conduit shall be a minimum of 1/2" for poly tubing provided the pipe fill does not exceed 40%.
- F. Minimum poly tubing size allowed is 1/4" OD. If an instrument has a barbed fitting that will only accept 5/32" tubing, connection to the device can be made with 5/32" tubing that is as short as is practical. Couplings are acceptable in this instance.
- G. Install all exposed piping and conduit parallel to or at right angles to the building structure and support adequately at uniform intervals. Use only tool made bends in copper air pipe.
- H. Tubing must be installed and supported in a manner as specified for exposed locations and acceptable to A/E and Owner.
- I. Where polyethylene tubing is installed free-air, installation shall consider the following:
- Tubing shall run at right angles and be kept clear of other trades work.
 - Tubing shall be supported utilizing "J-" or "Bridal-type" mounting rings anchored to ceiling concrete, piping supports or structural steel beams. Rings shall be designed to maintain tubing bend to larger than the minimum bend radius (typically 4 x tubing diameter).
 - Supports shall be spaced at a maximum 4-foot interval unless limited by building construction. If tubing "sag" at mid-span exceeds 6-inches, another support shall be used.
 - Tubing shall never be laid directly on the ceiling grid or attached in any manner to the ceiling grid wires.
- J. Tubing shall not be attached to existing cabling, existing tubing, plumbing or steam piping, ductwork, ceiling supports or electrical or communications conduit.
- K. Tubing connected to air terminal unit devices shall be attached to the terminal unit device to prevent tubing from becoming kinked or becoming disconnected. Tubing serving air terminals may be routed on top of ductwork serving that terminal unit for a maximum distance of eight feet.
- L. Number code all polyethylene tubing and install neatly with no concealed splices.
- M. Piping material used shall be as follows.
1. All exposed copper to be hard drawn.
 2. Use only polyethylene tubing inside panels.
 3. In concealed locations (other than noted below) hard copper, soft copper, or polyethylene tubing in conduit shall be used.
 4. Polyethylene tubing in block, stud. or concrete walls must be in conduit and associated boxes to be of steel.
 5. Where air piping is within concrete slab or under grade use only polyethylene tubing in conduit.
 6. For exposed outdoor locations, use hard copper or polyethylene tubing in conduit.
 7. Polyethylene tubing may be used in exposed areas if run in a fully enclosed rigid metal raceway or metal conduit and ambient temperature is less than 150°F.

8. Use copper tubing, where subject to temperatures in excess of 150°F or where adjacent to heating pipes passing through a common sleeve.
9. When polyethylene tubing is used above accessible lay-in acoustical panel ceilings it must be fire resistance "FR" rated pass the UL 94 vertical flame test with a rating of V2, be rated as self extinguishing under ASTM D 635, and may be run without conduit.

3.3 WIRE AND AIR PIPING CONDUIT AND TUBING INSTALLATION SCHEDULE

- A. The following conduit schedule shall apply to both polyethylene tubing and wire in conduit where conduit is specified for air tubing or wiring. Conduit and tubing referenced below shall meet specifications in Section 26 05 33 and as defined below.
 1. Air piping shall be run in independent conduit without wiring. In no cases shall wiring and air piping share a conduit, raceway or cable tray.
 2. Where air piping and wiring share a trough or wire management system above a control panel, code required separation shall be provided.
 3. Conduit other than that specified below for specific applications shall not be used.
 4. Underground Installations within Five Feet (1.5 m) of Foundation Wall: Rigid steel conduit.
 5. Underground Installations More than Five Feet (1.5 m) From Foundation Wall: Rigid steel conduit. Plastic-coated rigid steel conduit. Schedule 40 PVC conduit.
 6. Under Slab on Grade Installations: Schedule 40 PVC conduit.
 7. Exposed Outdoor Locations: Rigid steel conduit.
 8. Concealed in Concrete and Block Walls: Rigid steel conduit. Schedule 40 PVC conduit.
 9. Within Concrete Slab: Rigid steel conduit. Schedule 40 PVC conduit.
 10. Concealed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
 11. Exposed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.
 12. Exposed Dry Interior Locations for Control Devices with Conduit Connections: EMT or Flexible Metal Conduit (FMC). Minimum length shall be one foot (300 mm); maximum length shall be three feet (900 mm). Minimum size FMC of 3/8".
 13. Exposed Dry Interior Locations for Control Devices without Conduit Connections: Where HVAC equipment control panels or devices do not provide for the direct connection of conduits, exposed wiring may be extended to complete the final connections in dry locations, providing it does not exceed 18 inches in length.

3.4 CONTROL DAMPERS

- A. All control dampers furnished by the control manufacturer are to be installed by the Mechanical Contractor under the coordinating control and supervision of the Control Contractor in locations shown on plans or where required to provide specified sequence of control.
- B. Damper end switches, where required, shall be integral to the actuator that is mounted to the damper drive shaft or auxiliary shaft attached to a damper drive blade. End switches shall be adjusted to prove the damper the position opposite the fail position of the damper actuator unless the control sequence requires a different position to be proven to accomplish the specified control sequence.
- C. Coordinate installation with the sheetmetal installer to obtain smooth duct transitions where damper size is different than duct size. Blank off plates will not be accepted.
- D. Each operator shall serve a maximum damper area of 36 square feet. Where larger dampers are used, provide multiple operators.

3.5 CONTROL VALVES

- A. All temperature control valves furnished by the control manufacturer are to be installed by the Mechanical Contractor under the coordinating control and supervision of the Control Contractor in locations shown on plans or where required to provide specified sequence of control.

3.6 CONTROL SYSTEM INSTRUMENTATION

- A. Install thermometers at each point of temperature transmission (sensors) and control, except reheat coils, unless the drawings indicate a thermometer is to be installed by the piping or sheetmetal installer. Install thermometers to permit easy reading from the floor or operating platform. Provide remote mounting or swiveled mounting as required for easy reading. Flush mounting where not easily read is not acceptable.

3.7 ROOM THERMOSTATS AND TEMPERATURE SENSORS

- A. Check and verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate room thermostats and sensors 48 inches above floor. Align with light switches and humidistats. For drywall installations, thermostat mounting shall use a back-box attached to a wall stud, drywall anchors are not acceptable.
- B. Any room thermostats or sensors mounted on an exterior wall shall be mounted on a thermally insulated sub-base. Subbase to provide a minimum of one-half inch of insulation.
- C. Where thermostats or sensors are mounted on exterior walls or in any location where air transfer will affect the measured temperature or humidity seal the conduit and any other opening that will affect the measurement.
- D. For reheat coil discharge temperature sensors, mount in the duct a minimum of three feet downstream of the reheat coil.

3.8 LOW LIMIT THERMOSTATS (Freezestats)

- A. Install low limit controls where indicated on the drawings or as specified. Unless otherwise indicated, install sensing element on the downstream side of heating coils. When air handling units have chilled water coils downstream of the heating coil, the element shall be located at the entering side of the chilled water coil. For single row heating coils in air handling units without chilled water coils, the element shall be run in the shadow of the heating coil tubing as much as possible or be located a minimum of 2 feet downstream of the heating coil.
- B. Distribute (serpentine) sensing element horizontally across the coil to cover every square foot of coil; on larger coils this may require more than one instrument.
- C. Mount the unit head in an accessible location as to allow for resetting after low limit trips while still meeting manufacturer's installation requirements for proper function. Mount units using flanges and element holders. Provide duct collars or bushings where sensing capillary passes through sheetmetal housings or ductwork; seal this penetration to eliminate air leakage. Elements shall be supported across coils or openings adequately to prevent movement from air current. Support methods shall be those suitable for use in air plenums with temperatures of up to 180 deg F. Metal fastening clips are the preferred method. Securing elements by use of plastic or nylon cable ties will not be accepted. Special attention should be paid to ensure elements will not rub on fasteners or other edges that will eventually cause damage.

3.9 AIR FLOW STATIONS

- A. Install airflow stations according to manufacturer's recommendations. Install straightening vanes upstream of unit where required per manufacturers recommendations. For electronic flow stations with displays, the display shall be mounted at approximately 5' above finished floor on the ductwork or other suitable location. In locations where the display cannot be mounted at this height, consult with the AE for a suitable mounting location. Displays shall be mounted above the insulation on standoffs to allow insulation behind the display and not attached directly to the ductwork if it is insulated.

3.10 PRESSURE TRANSDUCERS AND HIGH LIMIT PRESSURE SWITCHES

- A. Install capped tees in air piping at air pressure transducers for connection of calibration equipment. Capped tee shall consist of two inch poly tubing capped with a brass plug. Rubber caps are not acceptable. Install Petes Plugs fittings at each take-off from main piping for liquid pressure transducers for connection of calibration equipment. Install differential pressure transducers for filter monitoring at the filter section of the air handling unless otherwise specified. All other differential or static pressure transducers and differential or static pressure high limit switches for air applications should be mounted in the temperature control panel serving the equipment being controlled or monitored. All devices mounted on equipment shall be mounted in a location that is at a maximum of five feet above the floor. For all air static and differential pressure applications, use metal static pressure tips for insertion into the fan housing or ductwork. For steam and liquid applications, provide shutoff valves at piping takeoff points.
- B. High and low static safety switches shall be labeled with the static pressure trip setpoint and shall match the record control drawing sequence of operation.

3.11 TEMPERATURE CONTROL PANELS

- A. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. All control panel openings shall be plugged. Conduits and other penetrations on the top of the cabinets shall be sealed on the exterior of the cabinet with silicone caulk to resist water penetration. One cabinet may accommodate more than one system in same equipment room. Provide permanent printed labeling for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
- B. Provide as-built control drawings of all systems served by each local panel in a location adjacent to or inside of panel cover. Provide a protective cover or envelope for drawings.

3.12 CURRENT STATUS SWITCHES

- A. Provide for each fan or pump specified or shown on point list. Set threshold adjustment to indicate belt or coupling loss. Readjust threshold for proper operation after final balancing is completed. Use the variable frequency drive (VFD) integrated relay output for motor status, if provided on the VFD, in lieu of a discrete current switch. A separate current switch provided under this Section shall be wired in parallel with the VFD motor status relay when a bypass starter is provided on the VFD to prove motor status in the bypass mode. When a VFD serves more than one fan, provide a separate current switch for each fan served.

END OF SECTION 23 09 14

DDC INPUT / OUTPUT SUMMARY TABLE

PROJECT NO: 21107		DDC CONTROLLERS PROVIDED UNDER SPECIFICATION SECTION 23 09 24																																	
PROJECT: WRIGHTSTOWN SWEF & STATE PATROL POST		HARDWARE										SOFTWARE																							
FACILITY		INPUT										ALARMS			ENERGY MANAGEMENT SYSTEM FUNCTIONS														Comments						
LOCATION:		OUTPUT		DIGITAL		ANALOG		DIGITAL		ANALOG		DIGITAL	ANALOG		Day/Night Setback	Demand Limiting	Dial-up I/O	Duty Cycling	Optimum Start/Stop	Scheduled Occ/Unoc	Totalization	Trend	Redundancy Control	Lighting Integration	Fire Alarm Integration	Security/Access Integration	Elect P/QM Integration	Chiller Integration		CFM Offset	OA Lockout	CHW Reset	Smoke Control	Fire Alarm Override	
OUTAGAMIE COUNTY		DIGITAL	ANALOG	0-10 VDC	4-20 mA	Tri-State Actuator	Duration Adjust Actuator	Switch Closure	Control Relay Contact	Current Sensing Switch	Flow Switch	Temperature	Resistive	Differential Pressure	Actuator Feedback	Static Pressure	Flow	Equipment Status	Maintenance	Pressure	High Limit	Low Limit													
SYSTEM: Supply VAV Terminals (See plans for Qty)												X									X	X													
POINT DESCRIPTION																																			
Zone Temperature																																			
Occupancy Sensor																																			
Supply Air Damper ^{1 & 2}																																			
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Temperature Setpoint Adjust Range ⁵																																			

Notes:

1. Analog outputs must utilize a calculated proportional command from software. Actual output can be any type but floating outputs shall have feedback from the actuator so actual actuator position is maintained.
2. Damper actuators can utilize stepper type motors.
3. Can be tri-state or proportional actuation.
4. The minimum software points listed, if necessary to the application, shall be mapped. Any additional software points that are available and requested by the owner shall be mapped by the DDC controller.
5. Separate heating and cooling setpoints are preferred. If temperature setpoint is a single input that will offset the heating and cooling supervisory setpoints up or down together by an adjustable range.

DDC CONTROLLERS PROVIDED UNDER SPECIFICATION SECTION 23 09 24

1. Analog outputs must utilize a calculated proportional command from software. Actual output can be any type but floating outputs shall have feedback from the actuator so actual actuator position is known.
2. Can be tri-state or proportional actuation.

DDC CONTROLLERS PROVIDED UNDER SPECIFICATION SECTION 23 09 24

Note: The minimum software points listed, if necessary to the application, shall be mapped by the owner shall be mapped by the DDC contractor

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DDC CONTROLLERS PROVIDED UNDER SPECIFICATION SECTION 23 09 24

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DDC CONTROLLERS PROVIDED UNDER SPECIFICATION SECTION 23 09 24

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PROJECT NO: 21107 DDC CONTROLLERS PROVIDED UNDER SPECIFICATION SECTION 23 09 24

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Note: The minimum integrated points listed shall be mapped. Any additional software points that are available and requested by the owner shall be mapped by the DDC contractor.

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Note: Input/output points are wired to W-HP-1 supervisory controller. Coordinate with submitted equipment

Note: The minimum integrated points listed shall be mapped. Any additional software points that are available and requested by the owner shall be mapped by the DDC contractor.

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Note: Coordinate inputs/outputs with submitted equipment.

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DDC CONTROLLERS PROVIDED UNDER SPECIFICATION SECTION 23 09 24

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DDC CONTROLLERS PROVIDED UNDER SPECIFICATION SECTION 23 09 24

END OF SECTION 23 09 15

SECTION 23 09 24 - DIRECT DIGITAL CONTROL SYSTEM FOR HVAC (INFORMATIONAL PURPOSES ONLY)

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. The work associated with this section WILL NOT be bid as part of the Division 23 scope of work. Work in this section includes Direct Digital Control (DDC) panels, main communication trunk, software programming, and other equipment and accessories necessary to constitute a completely coordinated extension of the existing building Direct Digital Control (DDC) system. This system interfaced with pneumatic/electric controls (Section 23 09 14) utilizing Direct Digital Control signals to operate actuated control devices will meet, in every respect, all operational and quality standards specified herein, a fully coordinated modification and extension via DDC of the existing Central Building Automation System.
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Work Not Included
 - 6. Federal Bidding Requirements
 - 7. Quality Assurance
 - 8. Submittals
 - 9. Operation and Maintenance Data
 - 10. Material Delivery and Storage
- C. PART 2 - Products
 - 1. General
 - 2. Local Control Panels
 - 3. Direct Digital Controls (DDC)
 - 4. Networking/Communications
 - 5. BACnet Requirements
 - 6. Supervisory Controllers
 - 7. System Software Features
 - 8. Programmable Controllers
 - 9. Application Specific Controllers - HVAC
 - 10. Operator Interface Requirements
 - 11. Web Based HTML Browser Interface
- D. PART 3 - EXECUTION
 - 1. General
 - 2. Installation
 - 3. Owner Training

1.2 RELATED WORK

- A. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC - Coordination
- B. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC
- C. Section 23 09 15 - Direct Digital Control Input/Output Point Summary Tables

- D. Section 23 09 93 - Sequence of Operation for HVAC Controls
 - E. Division 22 – Plumbing – Equipment provided to be controlled or monitored
 - F. Division 23 - HVAC - Equipment provided to be controlled or monitored
 - G. Division 26 - Electrical - Equipment provided to be controlled or monitored
- 1.3 REFERENCE
- A. Applicable provisions of Division 1 govern work under this section.
- 1.4 REFERENCE STANDARDS
- A. FCC Part 15, Subpart J, Class A - Digital Electronic Equipment to Radio Communication Interference.
- 1.5 WORK NOT INCLUDED
- A. Section 23 09 14 work includes furnishing and installing all field devices, including electronic sensors for the DDC of this section, equipment, and all related field wiring, interlocking control wiring between equipment, pneumatic tubing, sensor mounting, etc., that is covered in that section.
 - B. Motorized control dampers and actuators, thermowells (temperature sensing wells), automatic control valves and their actuators are also covered in Section 23 09 14.
- 1.6 FEDERAL BIDDING REQUIREMENTS
- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
 - B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.
- 1.7 QUALITY ASSURANCE
- A. MANUFACTURER: Automated Logic.
 - B. INSTALLER: A firm specializing and experienced in DDC control system installation for no less than 5 years. All engineering and commissioning work shall be done by qualified employees of this manufacturer, or qualified employees of an Authorized Representative of that manufacturer that provides engineering and commissioning of the manufacturer's control equipment. Where installing contractor is an authorized representative of the control equipment manufacturer, submit written confirmation of such authorization. Indicate in letter of authorization that the installing contractor has successfully completed all necessary training required for the engineering, installation, and commissioning of equipment and systems to be provided for the project and that such authorization has been in effect for a period of not less than three years. The letter of authorization should also indicate that the installing contractor is authorized to install the manufacturer's DDC equipment at the project location at the time the project is bid. Installation of the equipment shall be done by qualified mechanics and/or electricians in the direct employ or be directly subcontracted and under the supervision of the manufacturer or Authorized Representative. The contractor providing and installing the equipment under this specification section shall be the same contractor providing and installing equipment under the 23 09 14 specification section.
 - C. RESPONSE TIME: During warranty period, four (4) hours or less, 24-hours/day, 7 days/week.
 - D. ELECTRICAL STANDARDS: Provide electrical products, which have been tested, listed and labeled by Underwriters' Laboratories (UL) and comply with NEMA standards.
 - E. DDC Standards: DDC manufacturer shall provide written proof with shop drawings that the equipment being provided is in compliance with F.C.C. rules governing the control of interference caused by Digital Electronic Equipment to Radio Communications (Part 15, Subpart J, Class A).

1.8 SUBMITTALS

- A. Include the following information: Details of construction, layout, and location of each temperature control panel within the building, including instrument's location in panel and labelling. Indicate which piece of mechanical equipment is associated with each controller and what area within the building is being served by that equipment. For terminal unit control, provide a room schedule that would list mechanical equipment tag, room number of space served, address of DDC controller, and any other pertinent information required for service.
- B. **PRODUCT DATA:** Submit manufacturer's specifications for each control device furnished, including installation instructions and startup instructions. General catalog sheets showing a series of the same device is not acceptable unless the specific model is clearly marked. Annotated software program documentation shall be submitted for system sequences, along with descriptive narratives of the sequence of operation of the entire system involved. Submit wiring diagram for each electrical control device along with other details required to demonstrate that the system has been coordinated and will function as a system.
- C. **MAINTENANCE DATA:** Submit maintenance data and spare parts lists for each control device. Include this data in maintenance manual.
- D. **RECORD DRAWINGS:** Prior to request for final payment provide complete composite record drawings to incorporate the DDC and Pneumatic/Electric fieldwork. Accurate Section 23 09 14 record drawings to be supplied by the Section 23 09 14 contractor with the accuracy of these drawings being the responsibility of the 23 09 14 contractor. In the event that changes are required to the 23 09 14 supplied record drawings after they have been compiled by the 23 09 24 contractor, it shall be the 23 09 14 contractors responsibility to provide updated composite record drawings incorporating the 23 09 24 record drawings. All software addressing for device communication shall be noted for all devices provided under this section and the communication addressing required for devices provided by others that are integrated into the direct digital control system provided under this section. Coordinate with the supplier of the equipment specified to be interfaced through digital communications for communication addressing. Provide circuit number of 120VAC panel power circuit(s) feeding each control panel on record drawings. Label circuit number(s) inside the panel served.

1.9 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.10 MATERIAL DELIVERY AND STORAGE

- A. Provide factory shipping cartons for each piece of equipment and control device. This contractor is responsible for storage of equipment and materials inside and protected from the weather.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide DDC control products in sizes and of capacities as required, conforming to manufacturer's standard materials and components as published in their product information, designed and constructed as recommended by the manufacturer and as required for application indicated.
- B. System shall be capable of operating with 120 VAC power supply, fully protected with a shutdown-restart circuit, and associated hardware and software.
- C. All DDC controllers shall use screw terminals for termination of individual wires. Spade lugs are not acceptable.

2.2 LOCAL CONTROL PANELS

- A. Use control panels with suitable mounting brackets for each supply fan system. Locate panel adjacent to system served.

- B. Fabricate panels of 14 gauge furniture grade steel or 6063-T5 extruded aluminum alloy, totally enclosed on six sides, hinged door and keyed lock, with manufacturer's standard shop painted finish and color.
- C. Provide UL listed cabinets for use with line voltage devices.
- D. Control panels that have devices or terminations that are fed or switch 50V or higher shall enclose the devices, terminations, and wiring so that Personal Protective Equipment (PPE) is not required to service the under 50V devices and terminations within the control panel. As an alternative, a separate panel for only the 50V and higher devices may be provided and mounted adjacent to the under 50V control panel. For DDC controllers that are directly fed by 120VAC, provide an externally mounted 120VAC, 5A fast blow fuse to feed these controllers.
- E. Plastic control enclosures will be approved provided all conduits are bonded and grounded.
- F. Provide control panels for all DDC Controllers, ASC's and associated function modules. All controls to be in control panels provided under this Section except for the following:
 - 1. Terminal unit controllers mounted within the terminal unit equipment enclosure as specified under Section 23 09 14.
 - 2. Above accessible lay-in tile ceilings where VAV box controllers designed to be directly mounted on air terminals.
 - 3. Above accessible lay-in tile ceilings where additional controllers are required for air terminal unit control. Where additional controllers are required, they shall not be mounted directly to the ductwork but be mounted on din rail or back panel in an accessible location as close as possible to the terminal unit(s) being controlled.
 - 4. Any devices other than DDC controllers, i.e. relays, pressure switches, etc. shall be installed in an enclosure.
- G. All wiring for controllers shall be managed in a neat and workmanlike manner.
- H. Permanently label all controls; tag all control wiring and document both on control drawings.

2.3 DIRECT DIGITAL CONTROLS (DDC)

- A. System to be capable of integrating multiple building functions, including equipment supervision and control, alarm management, energy management, and trend data collection.
- B. DDC to consist of Supervisory Controllers, Programmable Controllers, stand-alone Application Specific Controllers (ASC's), operator interface devices.
- C. The vendor of the system provided under this Section shall provide all software and communication interface hardware necessary to program and upload/download programmable and application specific controllers from a laptop computer and make additional copies and future software revisions available for sale directly to the Owner.
- D. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, ASC's, and operator devices.
- E. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

2.4 NETWORKING/COMMUNICATIONS

- A. The design of the DDC shall be networked. The highest level networking shall use Ethernet and the sub-level networking shall use serial communications. Inherent in the system's design shall be the ability to expand or modify the highest network either via a local area network (LAN), wide area network (WAN), or a combination of the two schemes.
- B. The highest-level DDC communications network shall be capable of direct connection to and communication with a high-speed LAN or WAN utilizing an Ethernet connection. Communication protocol used shall be BACnet/IP.

- C. The supervisory controller shall directly oversee a local network such that communications may be executed directly to and between programmable controllers and ASC's. All operator devices, either network resident or connected via dial-up modems, shall have the ability to access all points and application reports on the network.
- D. Provide serial communication ports on all ASC's for operator's terminal communications with the DDC Controller.
- E. Access to system data shall not be restricted by the hardware configuration of the DDC system.
- F. Global data sharing or global point broadcasting shall allow point data to be shared between programmable controllers and ASC's when it would be impractical to locate multiple sensors.
- G. Network design shall include the following provisions:
 - Data transfer rates for alarm reporting and quick point status from multiple programmable controllers and ASC's. The minimum baud rate shall be 9600 baud.
 - Support of any combination of programmable controllers and ASC's. A minimum of 32 programmable controllers and ASC's shall be supported on a single local network. The buss shall be addressable for up to 32 ASC's.
 - Detection of single or multiple failures of ASC's or the network media.
 - Error detection, correction, and re-transmission to guarantee data integrity.
 - Use commonly available, multiple-sourced, networking components.
 - Use of an industry standard communication transport, such as, ARCNET, Ethernet, and IEEE RS-485 communications interface.
- H. Provide a temporary Ethernet network for communications between supervisory controllers and operator workstation until the building IT network is available for use by the DDC system. The temporary Ethernet network and all other communications required for the DDC system shall be installed as required for specified operation of mechanical equipment so check out and commissioning of the equipment can occur in a timely manner.

2.5 BACNET REQUIREMENTS

- A. BACnet of highest level network communications will utilize BACnet/IP over Ethernet and field level communications shall utilize BACnet MSTP. No other communication protocol is acceptable.
- B. All controllers shall provide a Protocol Implementation Conformance Statement (PICS) and BACnet Interoperability Building Blocks (BIBB'S) as required by the American National Standards Institute/American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ANSI/ASHRAE) Standard 135-2001, BACnet protocol.
- C. In general, all devices shall support the following:
 1. Segmentation Capability
 2. Segmentation requests supported
 3. Segmentation responses supported
 4. Standard Object Types Supported
 - Analog input
 - Analog output
 - Analog value
 - Binary input
 - Binary output
 - Binary value

- Calendar
 - Device
 - Event enrolment
 - Group
 - Multistate input
 - Multistate output
 - Multistate value
 - Notification class
 - Schedule
5. Character Sets supported
- ANSI X3.4
 - ISO 10646 Universal Character Set-2
6. All highest level networked supervisory devices shall support the following:
- a. Data Link Layer Option
 - BACnet Internet Protocol (IP) (Annex J)
 - b. Networking Options
7. BACnet/IP Broadcast Management Device (BBDM)
- D. BACnet object name and description shall match the existing naming conventions used by the Owner for their existing Building Automation System, where applicable. Coordinate with Owner control personnel to establish the naming conventions prior to programming of any controllers provided under this specification section. All controllers shall have object names, descriptions, and engineering units that are writable at the controller level and shall be programmed so that the object names, descriptions, and engineering units match the desired naming standards as specified above. Ensure that the BACnet object attributes for object name, object description, engineering units and other required attributes will be transferred through to the Supervisory Controller when the auto-discovery function is executed.
- E. Coordinate BACnet device instance numbering with the facility personnel for controllers provided under this Section that are being connected to an existing building automation system. This contractor shall be responsible for correcting any conflicts with existing devices that may occur or changing the device instance numbers to comply to follow the agency BACnet device instance numbering scheme.

2.6 SUPERVISORY CONTROLLERS

- A. Supervisory controllers shall be microprocessor-based, multi-tasking, multi-user and digital control processors.
- B. Supervisory controllers shall be BTL Listed and shall be provided with open connectivity to any manufacturers BACnet programmable or application specific direct digital controllers.
- C. The contractor shall provide all labor to build the supervisory controller database in conjunction with and under the supervision of the Owner's control personnel. Naming conventions, database structure, and global application strategies shall be reviewed and approved by the Owner's control personnel before implementation
- D. Each supervisory controller shall have sufficient memory to support its own operating system and databases including:
 - Control processes
 - Energy management application
 - Alarm management
 - Trend data

- Maintenance support applications
 - Operator I/O
 - Dial-up communications
 - Manual override monitoring
- E. The system shall be modular in nature, and shall permit easy expansion through the addition of field controllers, sensors, and actuators.
- F. Supervisory controllers shall provide at least two RS-232C or USB serial communication ports or Ethernet ports for simultaneous operation of multiple operator I/O devices, such as laptop computers, personal computers, and video display terminals.
- G. Supervisory controllers shall monitor the status of all overrides and include this information in the logs and summaries to inform the operator that automatic control has been inhibited.
- H. Each supervisory controller shall continuously perform self-diagnostics, communications diagnostics, and diagnostics of all subsidiary equipment. Supervisory controllers shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each supervisory controller.
- I. Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard 587-1980. Isolation levels shall be sufficiently high to allow all signal wiring to be run in the same conduit as high voltage wiring acceptable by electrical code.
- J. In the event of the loss of normal power, there shall be an orderly shutdown of the supervisory controller to prevent the loss of data base or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
- K. Upon restoration of normal power, the supervisory controller shall automatically resume full operation without manual intervention.
- L. Should supervisory controller memory be lost for any reason, the supervisory controller shall have the capability of reloading its programming via high speed local area network from the control system archive workstation or server, the local RS-232C port, or telephone line dial-in.

2.7 SYSTEM SOFTWARE FEATURES

- A. All necessary software to form a complete operating system, as described in this specification, shall be provided as an integral part of the supervisory controller, and shall not be dependent upon higher level computer for execution
- B. Control software shall include a provision for limiting the number of times that each piece of equipment may be cycled within any one-hour period.
- C. The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
- D. Supervisory controllers shall have the ability to perform any or all of the following energy management routines:
- Time of day scheduling
 - Calendar based scheduling
 - Holiday scheduling
 - Optimal start
 - Optimal stop

- Demand limiting
 - Load rolling
 - Heating/cooling interlock
- E. All programs to be executed automatically without the need for operator intervention, and be flexible enough to allow user customization. Programs shall be applied to building equipment described in Section 23 09 93 of this specification.
- F. Supervisory controllers shall be able to execute configured processes defined by the user to automatically perform calculations and control routines.
- G. It shall be possible to use any of the following in a configured process:
- Any system-measured point data or status
 - Any calculated data
 - Any results from other processes
 - Boolean logic operators (and, or)
- H. Configured processes may be triggered based on any combination of the following:
- Time of day
 - Calendar date
 - Other processes
 - Events (e.g., point alarms)
- I. A single process shall be able to incorporate measured or calculated data from any and all other ASC's.
- J. A single process shall be able to issue commands to points in any and all other programmable controllers and ASC's on the local network.
- K. Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each supervisory controller shall perform distributed; independent alarm analysis and filtering to minimize network traffic and prevent alarms from being lost. At no time shall the ability of supervisory controllers to report alarms be affected by either operator activity at the local I/O device or communications with other ASC's on the network.
- L. All alarm or point change reports shall include the English language description of each point and the time and date of the occurrence.
- M. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided. Users shall have the ability to manually inhibit alarm reporting for each point.
- N. The user shall also be able to define conditions under which point changes need to be acknowledged by an operator and/or logged for analysis at a later date.
- O. Alarms reports and messages shall be directed to an operator device.
- P. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 60-character alarm message to more fully describe the alarm condition or direct operator response.
- Q. Each supervisory controller shall be capable of storing a library of at least 100 messages. Each message may be assignable to any number of points in the panel.
- R. A data collection utility shall be provided to automatically sample, store, and display system data.

- S. Measured and calculated analog and binary data shall be assignable to user definable trends for the purpose of collecting operator specified performance data over extended periods of time. Sample intervals of 1 minute to 24 hours, in one minute or one hour intervals, shall be provided. Each supervisory controller shall have a dedicated buffer for trend data and shall be capable of storing 16 trend logs. Each trend log shall have up to four points trended at 48 data samples each. Data shall be stored at the supervisory controller and up-loaded to the DDC system server when archiving is desired.
- T. Supervisory controllers shall automatically accumulate and store runtime hours for binary input and output points specified in Section 23 09 14 of this specification.
- U. Supervisory controllers shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis, user defined, for user-selected analog and binary pulse input type points.
- V. Totalization shall provide calculation and storage accumulations of up to 9,999,999 units (e.g., KWH, gallons KBTU, tons, etc.).
- W. The totalization routine shall have a sampling resolution of one minute.
- X. The user shall have the ability to define a warning limit. Unique, user specified messages shall be generated when the limit is reached.
- Y. The information available from pulse totalization shall include, but not be limited to, the following:
 - Peak demand, with date and time stamp
 - 24-hour demand log
 - Accumulated KWH for day
 - Sunday through Saturday KWH usage
 - Demand KW annual history for past 12 periods
 - KWH annual history for past periods
- Z. Supervisory controllers shall have the ability to count events, such as the number of times a pump or fan system is cycled on and off.
- AA. The event totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.

2.8 PROGRAMMABLE CONTROLLERS

- A. Programmable controllers shall be provided with a software program that shall allow the user to design flexible software algorithms for the control sequences as described in Sections 23 09 14 and 23 09 93 portions of this specification.
- B. Programmable controllers shall support all necessary point inputs and outputs to perform the specified control sequence in a totally stand-alone fashion.
- C. Each programmable controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.
- D. Each programmable controller shall support the use of a locally mounted status and adjust panel interface to allow for the local adjustment of all setpoints, temporary override of any input or output points and status of all points directly at the controller. The capabilities of the locally mounted status and adjust panel shall include, but not be limited to, the following information for the programmable controllers to which:
 - Display temperatures
 - Display status
 - Display setpoints
 - Display control parameters
 - Override binary output control

- Override analog output control
 - Override analog setpoints
 - Modification of gain and offset constants
- E. All system set points, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the programmable controller.
- F. Programmable controllers shall support, but not be limited to, the following configurations of systems to address current requirements as described in Sections 23 09 14 and 23 09 93 portions of this specification, and for future expansion of air handling units:
- Mixed air handling units
 - 100 percent outside air handling units
 - Boiler or chiller plants with pump logic
 - Generic system interlocking through hardware

2.9 APPLICATION SPECIFIC CONTROLLERS - HVAC

- A. Each supervisory controller shall be able to extend its monitoring and control through the use of stand-alone application specific controllers (ASC's).
- B. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor based, multi-tasking, real-time digital control processor.
- C. Each ASC shall have sufficient memory to support its own operating system and databases including:
- Control Processes
 - Energy Management Applications
 - Operator I/O (Portable Service Terminal)
- D. The operator interface to any ASC point or program shall be through the supervisory controller connection to any ASC on the network.
- E. ASC's shall directly support the temporary use of a portable service terminal that can be connected to the ASC via zone temperature or directly at the controller. The capabilities of the portable service terminal shall include, but not be limited to, the following information for the:
- Display temperatures
 - Display status
 - Display setpoints
 - Display control parameters
 - Override binary output control
 - Override analog output control
 - Override analog setpoints
 - Modification of gain and offset constants
- F. All system set points, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the ASC.
- G. ASC's shall support, but not be limited to, the following configurations of systems to address current requirements as described in Sections 23 09 14 and 23 09 93 portions of this specification, and for future expansion of air handling units:
- Variable Air Volume Terminals
 - Reheat Terminals

- H. Provide a method to view and print a summary of current K-factors for flow correction for each VAV terminal through the DDC system. The summary shall have a minimum of 50 K-factors per group of VAV terminals.
- I. All system setpoints, proportional bands, control algorithms, calibration constants, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the ASC.
- J. All application specific controllers shall be fully programmable. Question and answer or template programming are not acceptable unless this is used to generate the initial application program and the result is able to be freely modified without restriction. Control sequences for terminal unit control that utilize devices wired directly to the terminal unit application controller shall be programmed in the application specific controller and shall be stand-alone in function, i.e., occupancy sensing, temperature setpoint setback, etc. Supervisory controllers shall not be involved in the control sequence logic unless it involves sharing data between or from individual terminal unit controllers to be utilized in a global sequence, i.e., trim and respond strategies, terminal unit grouping, etc.

2.10 OPERATOR INTERFACE REQUIRMENTS

- A. **COMMAND ENTRY/MENU SELECTION PROCESS:** Operator interface software shall minimize operator training through the use of English language prompting and English language point identification.
- B. **TEXT-BASED DISPLAYS:** The operator interface shall provide consistent text-based displays of all system point and application data described in this specification. Point identification, engineering units, status indication, and application naming conventions shall be the same at all operator devices.
- C. **GRAPHIC-BASED DISPLAYS:** The operator interface shall provide graphic based displays of each system. The point data associated with each system shall dynamically update at a minimum of every 30 seconds. Graphic displays shall be linked to each other to provide a "drill down" capability from main graphic displays to more specific system-based displays. Provide a building level graphic display that links to system graphics. For systems that have ASC controlled terminal unit controls, provide a building floor plan with dynamic temperatures shown on the graphic that can be drilled into for more specific terminal information. Points provided in the graphic shall have the override and adjust capability specified under operator commands. The contractor providing the DDC system under this Section shall provide all graphic displays for the project. Submit all graphic displays to the Owner's control personnel for review and approval. Graphics shall be completed to provide enough time for approval and time for binding to be in place before control system commissioning is scheduled to occur.
- D. **PASSWORD PROTECTION:**
 - 1. Multiple-level password access protection shall be provided to allow the user/manager to limit control, display, and data base manipulation capabilities as he deems appropriate for each user, based upon an assigned password.
 - 2. Passwords shall be exactly the same for all operator devices.
 - 3. A minimum of three levels of access shall be supported:
 - Level 1: Data access and display
 - Level 2 = Level 1 + operator overrides and commands
 - Level 3 = Level 2 + database generation and modification
 - 4. A minimum of 4 passwords shall be supported at each supervisory controller.
 - 5. Operators will be able to perform only those commands available for their respective passwords. Menu selections displayed at any operator device shall be limited to only those items defined for the access level of the password used to log-on.
 - 6. Provide user definable, automatic log-off timers of from 1 to 60 minutes to prevent operators from inadvertently leaving devices on-line.

- E. OPERATOR COMMANDS: The operator interface shall allow the operator to perform commands including, but not limited to, the following:
- Start-up or shutdown selected equipment
 - Adjust setpoints
 - Override analog and binary outputs
 - Add/modify/delete time programming
 - Enable/disable process execution
 - Lock/unlock alarm reporting for each point
 - Enable/disable totalization for each point
 - Enable/disable trending
 - Enter temporary override schedules
 - Define holiday schedules
 - Change time/date
 - Enter/modify analog alarm limits
 - Enable/disable analog alarm limits
 - Enable/disable demand limiting
 - Enable/disable duty cycle
- F. LOGS AND SUMMARIES:
1. Reports shall be generated manually, and directed to the displays. As a minimum, the system shall allow the user to easily obtain the following general listing of all points in the system that shall include, but not be limited to:
 - Points currently in alarm
 - Off-line points
 - Points currently in override status
 - Points in weekly schedules
 - Holiday programming
 2. Summaries shall be provided for specific points, for a logical point group, for a user-selected group of groups, or for the entire facility without restriction due to the hardware configuration on the facility management system. Under no conditions shall the operator need to specify the address of hardware controller to obtain system information.
- G. SYSTEM CONFIGURATION AND DEFINITION:
1. All temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.
 2. The system shall be provided complete with all equipment, software, and documentation necessary to allow an operator to independently perform the following functions:
 - Add/delete/modify application specific controllers
 - Add/delete/modify points of any type, and all associated point parameters, and tuning constants
 - Add/delete/modify alarm reporting definition for each point
 - Add/delete/modify energy management applications
 - Add/delete/modify time and calendar-based programming
 - Add/delete/modify totalization for every point

- Add/delete/modify historical data trending for every point
 - Add/delete/modify configured control processes
 - Add/delete/modify dial-up telecommunication definition
 - Add/delete/modify all operator passwords
 - Add/delete/modify alarm messages
- H. PROGRAMMING DESCRIPTION: Definition of operator device characteristics, ASC's, individual points, and shall be performed through fill-in-the-blank templates.
- I. NETWORK-WIDE STRATEGY DEVELOPMENT: Inputs and outputs for any process shall not be restricted to a single ASC, but shall be able to include data from any and all other ASC's to allow the development of network-wide control strategies.
- J. SYSTEM DEFINITION/CONTROL SEQUENCE DOCUMENTATION: All portions of system definition shall be self-documenting and be capable of providing hardcopy printouts of all configuration and application data.
- K. DATA BASE SAVE/RESTORE/BACK-UP: Backup copies of all programmable controller, ASC and supervisory controller databases shall be stored in at least one personal computer or laptop. Users shall also have the ability to manually execute downloading of a programmable controller, ASC or supervisory controller database.
- 2.11 WEB BASED HTML BROWSER INTERFACE
- A. Provide a HTML based browser interface (Web Server) for accessing the DDC system. This shall include all hardware and software to provide an Ethernet twisted pair connection to the owners local or wide area network (LAN or WAN) that can be used to access the DDC system through a standard internet browser.
- B. All information shall be provided to the owner's IT staff to facilitate connection through the owner's LAN/WAN.
- C. At a minimum, this interface shall be capable of all functions described under the Operator Interface section, Password Protection, Operator Commands, and Logs and Summary subsections of this specification.

PART 3 - EXECUTION

3.1 GENERAL

- A. All electronic work required as an integral part of the central building automation system work is the responsibility of this section unless specifically indicated otherwise in this section, Section 23 09 14, or in Division 26.
- B. This contractor shall provide all labor, materials, engineering, software permits, tools, check-out and certificates required to install a complete DDC expansion to the existing central building automation system as herein specified. This system expansion shall be compatible with and interfaced to the existing computer driven automation center, and shall operate through all the existing I/O devices, central processing unit (CPU), and digital communication trunks. This connection to the digital communications trunk shall be true bi-directional analog and digital communications with the existing central building automation system.
- C. Any and all points added with this project shall be properly interfaced into the existing central building automation system format and grouped for display purposes into the system such that all points associated with a new or existing DDC system can appear together on the CRT display or printed log. Assignment of points to a group shall not be restricted by hardware configuration of the points of direct digital control. It shall be possible to assign a point to appear in more than one system. An English descriptor and an alpha/numeric identifier shall identify each system.

- D. This central building automation system expansion as herein specified shall be fully integrated and completely installed by this section. It shall include all required computer CPU software and hardware. Include the engineering, installation, supervision, calibration, software programming, and checkout necessary for a fully operational system.

3.2 INSTALLATION

- A. All work and materials are to conform in every detail to the rules and requirements of the National Electrical Code and present manufacturing standards. All wiring and cable installation shall conform to the wiring installation as specified in the installation section of Section 23 09 14. All material shall be UL approved.
- B. The addition of this specified system expansion shall in no way impair the future capabilities of any existing functions of the computer driven central building automation system. A system expansion with lesser capabilities will not be accepted. Further, this contractor will not put in jeopardy the normal, uninterruptable operation of the entire building automation system the time it is interfaced through the completion of this project.
- C. 23 09 24 Contractor to provide all VAV terminal unit zone and discharge temperature sensors. 23 09 24 Contractor to provide all required transformers to serve terminal units.
- D. Install system and materials according to manufacturer's instructions, rough-in drawings and details on drawings.
- E. Line voltage wiring to power the DDC Controllers, not provided by the Division 26 contractor, to be by this contractor.
- F. Control panels serving equipment fed by emergency power shall also be served by emergency power.
- G. Provide uninterruptable power supplies where necessary to provide proper startup of equipment or to accomplish power restart control sequences specified.
- H. Mount control panels adjacent to associated equipment on vibration-free walls or free-standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.
- I. Provide as-built control drawings of all systems served by each local panel in a location adjacent to or inside of panel cover. Provide a protective cover or envelope for drawings.
- J. Cable tray routing of the communication trunks is acceptable.
- K. Where a new system is required to be extended to an existing Building Automation Network (BAN) (typically connected via the Owner Local Area Network (LAN) or Wide Area Network (WAN)), extension of the data-net between DDC Controllers and to the BAN to be by this contractor. All wiring and cable installation shall conform to the wiring installation as specified in the installation section of Section 23 09 14.
- L. Provide all necessary routers and or repeaters to accomplish connection to the BAN via the panel-mounted port provided.
- M. Provide two data jacks in control panels housing supervisory controllers and allocate 6"x6" for each data jack in the panel. The first jack will be used for connecting the supervisory controller to the BAN. The second jack will be used as a spare for connecting to the BAN by service personnel.
- N. Provide an input for a service shutdown toggle switch for each air handling unit system provided inside the temperature control panel that will initiate a logical shutdown of the air handling unit system.
- O. All tubing, cable and individual wiring is to be permanently tagged, with numbers corresponding with "Record Drawings", spares are to be labelled as "Spare".
- P. Provide technician to work with air balancing contractor and/or provide balancing contractor with necessary hardware to over-ride DDC controllers for air balancing.
- Q. Provide documentation to demonstrate that all points, input and output, have been checked out and verified operational, note any points not operating properly with notation of reason.

3.3 OWNER TRAINING

- A. All training provided for the Owner shall comply with the format, general content requirements and submission guidelines specified.
- B. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 4 hours.
- C. Provide two follow-up visits for troubleshooting and instruction, one six months after substantial completion and the other at the end of the warranty period. Length of each visit to be not less than 2 hours or the time necessary to provide required information and complete troubleshooting and inspection activity for all controls installed under this section. Coordinate the visit with the Owner and provide an inspection report to the Owner of any deficiencies found.

END OF SECTION 23 09 24

SECTION 23 09 93 - SEQUENCE OF OPERATION FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes control sequences for HVAC equipment as well as equipment furnished by others that may need monitoring or control. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Description of Work
 - 4. Submittals
 - 5. Operation and Maintenance Data
 - 6. Design Criteria
- C. PART 2 - Products
 - 1. Not Applicable
- D. PART 3 - EXECUTION
 - 1. General Control
 - 2. Water-Source Heat Pump Control (WHP-1/CP-11)
 - 3. Geothermal Pump Control (CP-1 and CP-2)
 - 4. Boiler Control (B-1/CP-12)
 - 5. Heating Water Circulating Pump Control (CP-5 and CP-6)
 - 6. Infloor Heating Control (FWS-1 through FWS-3/CP-7 through CP-10)
 - 7. Chilled Water Circulating Pump Control (CP-3 and CP-4)
 - 8. Terminal Unit Control – DDC and Electric
 - 9. Primary Humidifier Control (H-1 and H-4)
 - 10. Standalone Humidifier Control (H-2 H-3)
 - 11. Variable Volume Mixed Air Handling Unit Control (AHU-1/RF-1, EF-5 and EF-7)
 - 12. Packaged Energy Recovery Ventilator Control (ERV-1)
 - 13. Ductless Split System AC & Humidifier Control (DAC-1 through DAC-2, H-2 and H-3)
 - 14. Makeup Air Unit Control (MAU-1/EF-10, 11, 12, and 13)
 - 15. Garage 112 Ventilation (EF-8/L-1)
 - 16. Garage 113 Ventilation (EF-9/L-2)
 - 17. Gas Fired Unit Heater Control (GUH-1)
 - 18. Gas Fired Unit Heater Control (GUH-2)
 - 19. Gas Fired Unit Heater Control (GUH-3 and GUH-4)
 - 20. Sprinkler Room 115A Temperature Control (EFH-1/EF-14)
 - 21. Destratification Fan Control (DF-1 through DF-3)
 - 22. Domestic Water Heater Integration
 - 23. Domestic Recirc Water Pump Control
 - 24. Lighting Control Integration
 - 25. Miscellaneous

1.2 RELATED WORK

- A. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC – Coordination
- B. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC
- C. Section 23 09 24 - Direct Digital Control System for HVAC (Informational purposes only)
- D. Division 22 - Plumbing – Equipment provided to be controlled or monitored
- E. Division 23 - HVAC - Equipment provided to be controlled or monitored
- F. Division 26 - Electrical - Equipment provided to be controlled or monitored
- G. Division 28 - Electronic Safety and Security

1.3 REFERENCE

- A. Section 23 09 14 work includes furnishing and installing all field devices, including electronic sensors for the DDC of this section, equipment, and all related field wiring, interlocking control wiring between equipment, pneumatic tubing, sensor mounting, etc., that is covered in that section.
- B. Motorized control dampers and actuators, thermowells (temperature sensing wells), automatic control valves and their actuators are also covered in Section 23 09 14.

1.4 DESCRIPTION OF WORK

- A. Control sequences are hereby defined as the manner and method by which automatic controls function. Requirements for each type of operation are specified in this section.
- B. Operation equipment, devices and system components required for automatic control systems are specified in other Division 23 control sections of these specifications.
- C. All temperature, humidity, and pressure sensing, and all other control signal transportation for the control sequences shall be furnished under Section 23 09 14. All electronic and electric input/output signals shall be extended under Section 23 09 14, with adequate lead length for termination within the appropriate control panel being provided under Section 23 09 24.
- D. Sequences for equipment controlled by Direct Digital Controls (DDC) as specified are accomplished by hardware and software provided under Section 23 09 24. Sequences for equipment controlled by electric self-contained controls are accomplished by hardware provided under Section 23 09 14.

1.5 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals, Section 23 05 00 and Sections 23 09 24, and 23 09 14 for descriptions of what should be included in the submittals.
- B. Shop drawings shall be provided by contractor(s) providing equipment under Sections 23 09 24 and 23 09 14. The contractor providing the DDC equipment shall provide a complete narrative of the sequence of operations for equipment that is controlled through the DDC system. The contractor providing the 23 09 14 equipment shall provide a complete narrative of the sequence of operation for equipment that is controlled directly from that equipment (without control logic through the DDC system). The narrative of the sequence of operation shall not be a verbatim copy of the sequences contained herein but shall reflect the actual operation as applied by the contractor.

1.6 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.
- B. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:
 - 1. All final setpoints and terminal unit air flow correction factors ("K" factors) shall be documented on the as-built control drawings as determined by working in conjunction with the balancing contractor.

1.7 DESIGN CRITERIA

- A. Reference Section 23 09 14.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE

- A. Reference Sections 23 09 24 and 23 09 14 for product descriptions.

PART 3 - EXECUTION

3.1 GENERAL CONTROL

- A. **BACNET OBJECTS:** All hardwired points listed in 23 09 15 and any setpoints, timers, or other control elements that are specified to be adjustable (adj.) in the following control sequences shall be mapped as BACnet objects and be available on the user interface to be adjusted. Consult with the owner's HVAC and/or DDC personnel prior to programming to determine if there are any items that they do not want to have mapped as BACnet objects. This is especially important for DDC controlled items that are duplicative, i.e., air terminal units.
- B. **BACNET ADDRESSING:** BACnet instance IDs shall be coordinated with the owner's established BACnet instance ID addressing scheme. If there is not such a scheme in place, the contractor(s) providing BACnet DDC controllers shall work with the agency to establish such a scheme and document this in the asbuilt control drawings. BACnet/IP addressing shall be coordinated with the agency prior to installation. BACnet MSTP addressing shall be addressed to provide for consecutive addressing to provide for the best speed of response. Max Master address shall be set appropriately for speed of response.
- C. **USER INTERFACE/FEATURE SOFTWARE:** Consult with the owner's HVAC and/or DDC personnel prior to programming to determine BACnet object naming conventions, user views, graphic layout, security matrix, alarming, trending, and scheduling preferences desired by the agency. Failure to consult and come to agreement prior to programming shall require the DDC contractor to make changes in the above listed items as desired by the owner to the system at no cost. Section 23 09 15 feature software checkmarks are guides only and are not specific to what is required by the owner.
- D. **SETPOINTS:** All setpoints indicated in the control specification are to be adjustable. The setpoints shall be readily available to be modified in the mechanical system software system summary (either textual or graphic based) and under the same software level as hardware points. Some less used setpoints may be provided on a lower software level, if requested by the owner for clarity. The setpoints indicated herein are only specified as a calculated starting point (or initial system operation). It is expected that setpoint adjustments and control loop tuning shall be required to provide optimum system operation based on requirements of the building. The control contractor shall work with the balancing contractor and the owner to provide the final system setpoint adjustments and control loop tuning after the system is in operation and building is in use. Document all final setpoints on the as-built control drawings. Any questions regarding the intended operation of the HVAC equipment and control systems shall be referred to the HVAC design engineer through the appropriate construction communication process. The following setpoints should be used as initial setpoints unless otherwise specified in the individual control sequences:
- Occupied Space Terminal Unit Heating: 70°F
 - Occupied Space Terminal Unit Cooling: 75°F
 - Unoccupied Space Terminal Unit Heating: 62°F
 - Unoccupied Space Terminal Unit Cooling: 82°F
 - Entry Way Heating: 60° F
 - Mechanical or Unoccupied Space Ventilation: 82°F
 - Mechanical or Unoccupied Space Heating: 60°F

- E. **ANTI-CYCLING:** When HVAC equipment or a sequence is specified to be started and stopped by a temperature, humidity, pressure setpoint or any other controlled variable, there shall be an adjustable differential setpoint that shall be set to prevent short cycling of the systems and equipment due to minor changes in the controlled variable. Temperature differential setpoints shall be set at 2°F and non-temperature setpoints shall be set at 10% of the controlled range unless otherwise specified. Setpoints shall indicate at when the process should be turned on. Heating and cooling differentials shall be set for above setpoint and will be used to turn the process off. For example, an economizer sequence called to switch at 68°F, would turn on at 68°F and off at 70°F since it is a cooling function. A heating lockout setpoint of 50°F would turn on heating control at 50°F and off at 52°F. Non-temperature differentials shall be set above setpoint if the setpoint is indicating a minimum value or below setpoint if the setpoint is indicating a maximum value. Provide minimum runtime timers for loads that are cycled to prevent over-cycling. Timers shall be set as specified or as needed to prevent damage or excessive wear to the equipment. Unless otherwise specified in the individual control sequences, fans and pumps shall have a minimum runtime on timers of 15 minutes (adj.) and off timers of 5 minutes (adj.). Safeties shall override runtime timers.
- F. **DEADBANDS:** Provide deadbands for all DDC control loops to prevent constant hunting of output signals to controlled devices. Deadbands shall be set to provide adequate control around setpoint as follows unless otherwise specified in the individual control sequences:
- Temperature Control: $\pm 0.5^{\circ}\text{F}$
 - Humidity Control: $\pm 1\%$ RH
 - Airflow Control: $\pm 2\%$ of total flow
 - AHU Static Pressure Control: ± 0.01 in. w.c.
- G. **ALARMS:**
1. Provide all alarmed points with adjustable time delays to prevent nuisance tripping under normal operation and on equipment start-up. For all commanded outputs that have status feedback, provide an alarm that will indicate the commanded output is not in its commanded state. Provide alarms on all points as indicated on point charts. For existing building automations systems, add/delete what is called on the point charts for after consultation with owner to provide consistent alarming throughout the automation system.
 2. For devices that have form "C" contacts available for alarm monitoring, use closed contacts for the Normal condition and open contacts on Alarm condition. This shall provide a level of supervision by detecting a break in the wiring.
- H. **TREND DATA:**
1. Trends shall be provided for all hardware I/O points and integrated points listed as having trending in Section 23 09 15 point charts and for analog and binary data points mapped to the user interface as specified below. Interval trending with sample intervals of 10 minutes shall be provided on analog process variables (this includes both analog inputs and calculated process variables) and process outputs. In addition, provide Change of Value (CoV) trending for all binary input and output points, binary data points mapped to the user interface, and for all analog inputs and process variables. Analog inputs and process variables and setpoints shall be set at 5% CoV of setpoint. Analog process outputs shall have CoV set at 5% of the output range. Other analog data points mapped to the user interface shall have CoV trends of 5% of their range. Consult with the user agency specific standard values for interval and CoV trends for different points and control types. Data shall be stored at the supervisory controller or in the field controller and up-loaded to the DDC system server when archiving is desired. Consult with the user agency to determine which trends should be archived.
- I. **EQUIPMENT START/STOP FAILURE STATES:** All start/stop points for equipment shall utilize normally open contacts unless called out specifically in the individual control sequences.

- J. RESTART DELAYS:
1. Provide restart delays for all large loads (15 HP or greater) to be invoked on emergency power and after normal power is restored. Manifolded air and water system loads shall be started simultaneously, if required. Timers shall be embedded in individual controllers and staggered by five seconds (adj.). Systems shall be restarted in a logical manner so systems serving other systems are started first, i.e., hot water systems started before AHU's served. Adjust timers as needed to have systems fully operational if serving other systems. If specific start-up sequences are specified below, these shall take precedence over this sequence.
- K. LEAD/LAG SEQUENCING: For sequences that call for lead/lag of equipment connected to building automation systems, the lead device shall be able to be chosen through a selectable day of the week and time of day through the building automation system. Coordinate with the owner for scheduling switchover and frequency. Unless otherwise directed, switchover shall occur at 10AM Tuesday and shall rotate the lead device on a weekly cycle rotating through all devices sequentially. For standalone lead/lag sequence controllers (non-DDC), the lead device shall be selected by a switch on the panel face.
- L. VARIABLE FREQUENCY DRIVE (VFD) MOTOR RUN STATUS: Use the VFD programmable relay dry contact output specified to be provided with the VFD under Section 23 05 14 to prove motor run status and detect belt loss or coupling break. If a bypass contactor is provided with the VFD, provide an adjustable current switch and wire it in parallel with the VFD output for proving motor status.
- M. VFD BYPASS & SAFETY INTERLOCKS: VFD's equipped with bypass starters shall be interlocked so that the start/stop and safety circuits that are called out for VFD operation shall be functional when the VFD is indexed to the bypass starter mode. Unless otherwise specified in the sequence below, the switch from inverter to bypass starter modes shall be through a manual switch provided on the VFD/bypass starter package.
- N. VFD MINIMUM SPEED & RAMP TIMERS: The VFD start-up technician shall work with the DDC Temperature Control Contractor determine the minimum speed required for the motor controlled by the VFD to provide cooling of the motor as installed to prevent heat related problems. This minimum speed shall be set in the VFD controller. Unless otherwise noted in the following control sequences or needed for lower turndown for volume matching, minimum speeds for fans shall be set at 15 Hz. If a lower minimum speed is required for volume matching of fans, the minimum speed shall never be set below 6 Hz to prevent overheating of the motor. Pump minimum speeds shall be 20 Hz for 1750 RPM motors and 25 Hz for 1150 RPM motors to ensure seals stay lubricated. The controlled motor shall ramp linearly in speed between the minimum Hz and the maximum Hz required for the application (may not be 60 Hz) as the control speed signal increases from 0% to 100% speed. The VFD start-up technician shall work with the DDC Temperature Control Contractor to set the acceleration and deceleration timers in the VFD controller at 30 seconds for motors less than 40 HP and 60 seconds for motors 40 HP and greater.
- O. CURRENT SWITCH SETUP: When current switches are used for proving fan or pump status, they shall be set up so that they will detect belt or coupling loss by the reduction in current draw on loss of coupled load. The current switch calibration shall be repeated by the 23 09 14 contractor after the balancer is complete. Current switches shall be provided for each motor on multiple fan air handling units and status provided individually to the DDC system for each motor.
- P. DAMPER INTERLOCKS FOR FANS WITH STARTERS: For fan systems with magnetic starters and shutoff dampers specified with end switches, the damper interlock shall be hardwired in such a way that the damper shall open if the fan starter hand / off / auto switch is in the hand or in the auto position and being called to start. After the damper end switch has proven the damper open, a hardwire interlock from the end switch to the starter holding coil for the fan shall cause the fan to start. For fan systems that are ducted in parallel, see specific sequence for fan system on interlock requirements.

- Q. DAMPER INTERLOCKS FOR FANS WITH VFD'S: For fan systems with VFD's and shutoff dampers specified with end switches, hardwire interlock the shutoff damper with the fan VFD. When the fan is remotely or locally commanded to start, VFD contacts shall energize outside air damper actuator to open damper. The damper position end switch shall be wired to run permissive input on the VFD and enable the VFD to start when the damper position end switch provides the damper is open. This operation shall be provided for VFD and bypass operation if the VFD is provided with a bypass. The damper end switch shall also be monitored by the DDC system. For fan systems that are ducted in parallel, see specific sequence for fan system on additional interlock requirements.
- R. DAMPER INTERLOCKS FOR FANS WITH EC MOTORS: Actuator(s) shall be wired directly to fan power.
- S. FAN SYSTEM ISOLATION DAMPER CONTROL: For fans that have isolation dampers that are controlled by the DDC system, the dampers shall be powered open and closed and not utilize the actuator fail position spring (if specified) to operate. Dampers that are wired to fan power shall use the fail position spring in the actuator to actuate the damper.
- T. FAN INTERLOCKING: Provide interlocks between supply and return or exhaust fan systems as scheduled on the plans or called out in individual control sequences. If DDC controlled, interlocks shall be done through DDC start/stop points unless otherwise specified in individual control sequences. If not DDC controlled, interlocks shall be accomplished via hardwire interlocks between fan starters or VFD's.
- U. SERVICE SHUTDOWN SWITCHES: Provide a switch for servicing each AHU and a software switch in the DDC system that will provide the same function. If either the hardware or software switch is in the off position, the associated AHU shall be shut down in an orderly fashion following the specific sequences below. When the both the hardware and software switches are on, the AHU shall be restarted in an orderly fashion following the specific sequences below. Multiple AHU's shall be allowed to be turned off from the DDC workstation through software overrides on the DDC system. If a switch is turned off, an alarm will be annunciated through the DDC system for all switches in the off position. The switches shall be located inside the associated control panel.
- V. AUTO-TUNING CONTROL LOOPS: For systems that have auto-tuning for PID control loops, contact the user agency for preferences on how the auto-tuning shall be implemented prior to programming. If the agency is not contacted on preferences, the control contractor responsible for programming shall adjust the loops as desired by the user agency at no additional cost. Typically, autotuning for control loops on major mechanical equipment that have services that can be lost, i.e., chilled water, steam, hot water, should be turned off so if there is a loss in service, the control loops do not adjust gain and integral to values that will cause the control loops to not function properly.
- W. THERMOSTATS AND SENSORS: All devices and equipment including terminal units, specified to be controlled in a control sequence by a thermostat or sensor, shall be provided with a thermostat or sensor, whether or not the device is indicated on the plans. Consult the HVAC design engineer for the thermostat or sensor location.
- X. ORIGINAL EQUIPMENT MANUFACTURER (OEM) CONTROLLER DDC INTEGRATION: Provide DDC programming to define all equipment integral input/output points, setpoints, data points, calculations, etc. that are available through the manufacturer's communication interface. Consult with the owner's DDC operations personnel to determine if some of the points should be omitted (for clarity or lack of value). The following equipment shall be integrated into the DDC system:
- Boiler
 - Water Source Heat Pump
 - Circulating Pumps
 - Humidifiers
 - Energy Recovery Unit
 - Makeup Air Unit
 - Variable Frequency Drives

- Domestic Water Heater (furnished by Div 22)
 - Lighting Control (furnished by Div 26)
- Y. WATCH DOG TIMER: Where the integrated system consists of programmable DDC controllers with BACnet objects mapped to an enterprise level Building Automation System (BAS) and it is shown that the BACnet objects do not indicate when they are offline on the enterprise level BAS when communication is lost between the two systems, software algorithms shall be provided to alarm when communication is lost. The integrated system shall program a binary data object that is toggled on and off at an adjustable rate (initially one minute) that shall be monitored by the enterprise level BAS which shall alarm if the toggling ceases.
- Z. WEEKLY SCHEDULING: Provide scheduling of DDC terminal units in groups based on occupancy. Work with the owner to determine how many groups are required and which zones should be included. Individual terminal units shall be able to receive temporary schedules that will override the group schedules. Temporary override buttons at the zone sensor (where specified on point charts) shall override the scheduling to occupied. When groups that consist of more than 20% of terminal units are indexed to occupied, the associated air handling unit shall start if not already running.
- AA. PARALLEL FAN BUMPLESS TRANSFER: For fan systems that have multiple fans ducted in parallel, sequencing of the fans shall be programmed so that when a planned start or stop of a fan is initiated either manually or automatically, the isolation dampers and fan speeds shall be sequenced to limit the static pressure variance in the system to $\pm 10\%$ of the static setpoint.
- BB. DDC CONTROLLER COMMUNICATION BUS CONFIGURATION: The actively controlled primary mechanical equipment (AHU's, hot water, chilled water, boilers, etc.) DDC controllers shall be configured to be located on the same supervisory controller BACnet MSTP communication trunk unless the supervisory controller capacity prevents it. If this is the case, the primary mechanical equipment DDC controllers shall be separated onto supervisory controllers in such a way that the systems that need to share information for operation and interlocking shall reside on the same supervisory controllers. When AHU systems have associated exhaust fan systems that are interlocked and designed to operate together as a combined air system within a building, these must be on the same BACnet MSTP trunk. Peer-to-peer communication shall be used for interlocks and data sharing between the AHU and exhaust fans systems, when possible, to limit air system disruptions in the event of a supervisory controller failure. Other critical building systems that require communication between DDC controllers to operate shall be on the same BACnet MSTP communication trunk. Terminal unit controllers shall be located on a separate BACnet MSTP trunks if necessary to allow for primary equipment to reside on the same BACnet MSTP trunk. If the DDC controllers used for control of primary mechanical equipment and interlocks or point information is required for proper operation as described above do not use BACnet MSTP communication but use Ethernet communication, the DDC controllers shall be connected to the same Ethernet switch. If the controllers cannot be connected to the same switch, hardwired points between controllers shall be used to share information.
- CC. CONTROLLED VARIABLE REQUIREMENTS: All controlled variables, i.e., static pressure, differential pressure, temperature, humidity, etc., shall be wired directly to the DDC controller in which the software PID loop or other similar software loop resides unless the control sequence specifically allows the controlled variable to be routed over the network. Where a controlled variable is used for reset of a PID loop, the controlled variable shall be allowed to be shared over the network unless specified to be directly wired to the DDC controller.
- DD. CALCULATED DATA POINTS
1. Provide calculated data points for actual dirty pressure drop for all variable volume air handling units with supply flow measurement based on the following equation:
 - Actual Dirty Filter $\Delta P = (\text{Meas. Supply CFM} / \text{Design CFM})^2 \times \text{Design Dirty Filter } \Delta P$

2. Provide a calculated data point for outside airflow for all fans that have return and outside air mixing dampers and the points required to allow for the following equation:
 - $\text{Outside Airflow} = \text{Supply CFM} \times (\text{MAT}-\text{RAT})/(\text{OAT}-\text{RAT})$
3. Where Supply CFM is measured either on variable volume fans or as balanced on constant volume units, MAT is Mixed Air Temperature, RAT is Return Air Temperature, and OAT is Outside Air Temperature. This point is designed as a check for outside air flow stations accuracy and outside air ventilation minimum damper positions. It should be noted that the accuracy of the calculated outside airflow will diminish as outside air temperature approaches return air temperature. It should be used as a check only when the RAT and OAT are greater than 20°F and the accuracy of the RAT and OAT temperature sensors are assured.

3.2 WATER-SOURCE HEAT PUMP CONTROL (WHP-1/CP-11)

- A. The water-source heat pump shall be controlled by its supervisory controller and shall be enabled by the DDC system through BACnet integration. The changeover between heating and cooling shall be determined by the DDC system. Provide integrated points for monitoring and alarms.
- B. The supervisory controller is to provide control of the water temperature by staging on or off the compressors in the array of chillers based upon the commanded temperature set point communicated over the BAS by the DDC system. The compressor staging PID algorithm compares the chiller plant leaving water temperature*, trending over an adjustable time period, to the commanded water temperature set point in order to determine system demand. The sequencing logic will respond to changes in the system demand by initiating or terminating compressor “enable” or “disable” commands to the unit module(s). If the demand is increasing and crosses the threshold for starting another compressor, the sequencing logic will select and enable the unit module with the least amount of accumulated compressor run time and then issue an “enable” command to the compressor with the lowest run time. In the event that a unit module is already operating a lead compressor, the controller will issue an “enable” command to the lag compressor of that unit module. As the system demand decreases and crosses the threshold for halting compressor operation, the sequencing logic will issue a “disable” command to the compressor with the highest run time.
- C. Cooling operation is based upon a chilled water temperature set point with the chillers load heat exchanger fully opened to the chilled water piping and its source (condenser) heat exchanger fully open to the Net Energy Water Loop piping to reject the heat of compression. Upon sensing that the leaving chilled water temperature has risen above the set point plus dead band value, the first unit module is placed into operational mode. The first stage compressor enable command is provided after a 90 second delay allowing the internal motorized water valve to fully open. The compressor Proportional Integral & Differential (PID) control begins to stage “up” or “down” based upon the leaving chilled water temperature in the header rack. The chilled water system setpoint shall be 44°F (adj.). Chilled Water Reset Function: The DCC system shall provide an external signal commanded over the BAS that shifts the chilled water temperature set point higher from 0 - 10°F to maximize plant efficiency. An optional field provided and installed chilled water storage tank is used in this application that requires additional water volume due to the system piping. In this case, a field installed chilled water temperature sensor is installed in the storage tank to control the modular chiller’s compressor staging. The temperature sensor located in the chilled water temperature header rack will be ignored for control, but will be monitored.
- D. Heating operation is based upon a hot water temperature set point with the chillers load heat exchanger fully opened to the hot water piping and its source (evaporator) heat exchanger fully open to the Net Energy Water Loop piping to extract heat. Upon sensing that the leaving hot water temperature has dropped below the set point plus dead band value, the refrigerant reversing valves of the first unit module are energized to place the unit into the heating operational mode. The first stage compressor enable command is provided after a 90 second delay allowing the internal motorized water valve to fully open. The compressor Proportional Integral & Differential (PID) control begins to stage “up” or

“down” based upon the leaving hot water temperature in the header rack. The hot water system design setpoint is 135°F. Hot Water Reset Function: The DDC system shall provide an external signal commanded over the BAS that shifts the hot water temperature set point lower from 0 - 10°F to maximize plant efficiency.

- E. Bypass Control: The bypass control is to prevent dead heading of the system water circulating pumps in a variable volume system when all of the unit modules water control valves are closed and is recommended for use with all piping header racks. When the system is enabled, the 2-way water bypass valve will be commanded open so that the water can circulate through the bypass. When the staging algorithm starts the first unit module in the sequence, then the bypass valve that was opened for circulation will be allowed to close again and will remain closed until all other unit module isolation valves have closed.

3.3 GEOTHERMAL PUMP CONTROL (CP-1 and CP-2)

- A. Start/Stop: The DDC system shall enable the lead pump and pump shall run continuous. The lag pump shall normally remain off. The geothermal water pump start/stop relays shall utilize normally closed contacts so upon failure of the relay or DDC controller the pump will fail on.
- B. Lead / Lag Control: Current status switches, either integral to the VFD and/or discreet devices, shall prove lead and lag pump operation. If the lead pump is called to run and the current status switch indicates that the lead pump is not operating for 30 seconds (adj.), an alarm shall be sent to the operator interface and the DDC system shall start the lag pump. Upon sensing the lead pump is operating, the lag pump shall be stopped. The DDC system shall index the lag pump to become the lead pump through weekly scheduling feature of the building automation system or through integral pump controls, if applicable.
- C. WHP-1 supervisory controller shall control pump speed to maintain minimum required flow and for full WHP-1 operation.

3.4 BOILER CONTROL (B-1/CP-12)

- A. The boiler is a high efficiency boiler with modulating burner control and circulating pump. The boiler shall be integrated into the building DDC system.
- B. The hot water system shall reset hot water temperature based on outdoor temperature. Water temperature shall be 80°F at 60°F outside temperature, reset linearly to 135°F at 0°F outside temperature (adjustable). Contractor shall work with WHP-1 representative to maximize hot water reset schedule.
- C. The boiler and circulating pump shall operate as backup to WHP-1 to maintain hot water setpoint. On a drop in setpoint of 5°F (adj.), the boiler and circulating pump shall be enabled. The boiler and circulating pump shall modulate up to maintain setpoint. The boiler will continue to increase as required. The boiler/pump will modulate down in response to the control system in a reverse manner. The boiler/pump will come offline at the transfer setpoint.

3.5 HEATING WATER CIRCULATING PUMP CONTROL (CP-5 and CP-6)

- A. Start/Stop: The DDC system shall start the lead pump on a call for heat in the building. The lag pump shall normally remain off. The hot water pump start/stop relays shall utilize normally closed contacts so upon failure of the relay or DDC controller the pump will fail on. Hot water pumps shall be commanded off if all building heating setpoints are satisfied and the outside air temperature is above 50°F (adj.).
- B. Lead / Lag Control: Current status switches, either integral to the VFD and/or discreet devices, shall prove lead and lag pump operation. If the lead pump is called to run and the current status switch indicates that the lead pump is not operating for 30 seconds (adj.), an alarm shall be sent to the operator interface and the DDC system shall start the lag pump. Upon sensing the lead pump is operating, the lag pump shall be stopped. The DDC system shall index the lag pump to become the lead pump through weekly scheduling feature of the building automation system or through integral pump controls, if applicable.

- C. Speed Control: The pump integral controls shall control the operating pump VFD to maintain proper flow based on embedded pump performance and characteristic curves.
- 3.6 INFLOOR HEATING CONTROL (FWS-1 THROUGH FWS-3/CP-7 THROUGH CP-10)
- A. Provide a DDC space temperature sensor to control the hot water circulator (pump) to maintain space temperature. When the space temperature is below setpoint, the DDC controller shall enable the pump to maintain setpoint. The reverse shall occur when space temperature is above setpoint. Provide DDC start/stop for pump control. The pump shall start on a call for heating. When space is satisfied pump shall be off. Provide a floor slab temperature sensor for monitoring purposes.
- 3.7 CHILLED WATER CIRCULATING PUMP CONTROL (CP-3 and CP-4)
- A. Start/Stop: The DDC system shall start the lead pump on a call for cooling in the building. The lag pump shall normally remain off. The chilled water pump start/stop relays shall utilize normally closed contacts so upon failure of the relay or DDC controller the pump will fail on.
 - B. Lead / Lag Control: Current status switches, either integral to the VFD and/or discreet devices, shall prove lead and lag pump operation. If the lead pump is called to run and the current status switch indicates that the lead pump is not operating for 30 seconds (adj.), an alarm shall be sent to the operator interface and the DDC system shall start the lag pump. Upon sensing the lead pump is operating, the lag pump shall be stopped. The DDC system shall index the lag pump to become the lead pump through weekly scheduling feature of the building automation system or through integral pump controls, if applicable.
 - C. Speed Control: WHP-1 speed reference from the supervisory controller and the pump integral controls shall control the operating pump VFD to maintain proper flow based on embedded pump performance and characteristic curves
- 3.8 TERMINAL UNIT CONTROL - DDC AND ELECTRIC
- A. GENERAL: See the valve chart in Section 23 09 14 for requirements for type of valve, signal required, spring return requirements, and fail positions. The valve requirements specified in the Section 23 09 14 valve chart shall supersede what is called out in the terminal unit sequences.
 - B. DDC CONTROLLED TERMINAL UNIT MASTER COMMAND POINTS: Provide individual master software points for each of the following functions that can be executed from a single command through the DDC system:
 - Command all terminal unit heating valves open by floor (i.e., reheat, radiation, etc.).
 - Command all terminal unit heating valves closed by floor.
 - Command all terminal unit cooling valves open by floor.
 - Command all terminal unit cooling valves closed by floor.
 - Command all VAV terminals to scheduled minimum flow by scheduled groups as described below. If groups are not specified, provide a master software point for all VAV terminals by associated AHU by floor.
 - Command all VAV terminals to scheduled maximum flow by scheduled groups as described below. If groups are not specified, provide a master software point for all VAV terminals by associated AHU by floor.
 - C. REHEAT OR BOOSTER COIL CONTROL: Provide a DDC space temperature sensor to control a modulating electronic control heating coil valve to maintain space temperature. When space temperature is below setpoint modulate the heating coil valve open. The reverse shall occur when space temperature is above setpoint. Provide a discharge air temperature sensor for monitoring purposes. The heating coil valve shall be commanded closed whenever the associated AHU is off.

- D. CABINET UNIT HEATER AND UNIT HEATER CONTROL: Provide a DDC space temperature sensor to control the electronic control heating valve to maintain space temperature. When space temperature is below setpoint modulate the heating coil valve open. The reverse shall occur when space temperature is above setpoint. Provide a strap on aquastat mounted on the hot water return line set at 100°F to control the unit fan when hot water temperature is above setpoint. A current switch shall provide status of the unit fan through the DDC system.
- E. VAV TERMINAL UNIT WITH REHEAT DDC CONTROL:
1. Refer to the VAV schedules on the plans for occupancy sensor interlock requirements, minimum and maximum flow rates, and outside air control.
 2. Provide a DDC space temperature sensor to control, in sequence, a modulating electronic control valve for the hot water reheat coil and actuator for terminal air flow.
 3. Cooling. The air terminal air valve will modulate between the maximum and minimum listed CFM to maintain the cooling setpoint with the reheat valve closed.
 4. Heating. When space temperature is below space sensor setpoint and the air terminal damper has modulated to the cooling minimum flow position, the air terminal damper shall move to the heating CFM setting and the HW valve will modulate to maintain space sensor heating setpoint. If the space sensor continues to call for heat and the hot water valve is fully open, the air valve shall modulate further open to satisfy room setpoint. The reverse shall occur when space temperature is above setpoint. The heating coil valve shall be commanded closed whenever the associated AHU is off. Heating shall be enabled whenever the AHU runs. Provide a discharge air temperature sensor for monitoring purposes.
 5. Provide separate adjustable minimum and maximum flow setpoints for both heating and cooling modes in the occupied mode. Flow setpoints shall be set as scheduled on the plans or in the specifications.
 6. Provide separate adjustable cooling and heating space temperature setpoints for both the occupied and unoccupied modes. When the space temperature is between the heating and cooling setpoints, the heating valve shall be closed and the airflow at cooling minimum flow.
 7. Radiation Control (WF/CONV):
 - a) Modulate electronic control hot water valve in sequence (simultaneously) with reheat coil to maintain space temperature when associated AHU is running. When space temperature is below setpoint modulate the hot water valve open. The reverse shall occur when space temperature is above setpoint. When the associated AHU is off, the radiation valve shall be modulated to maintain heating setpoint and the associated reheat valve shall be closed. Lock hot water radiation valve closed whenever outside air is above 50° F (adj.).
 - b) For circumstances where heat from a perimeter terminal is required prior to reheat coming on i.e., a large expanse of glass, etc., modify the sequence above and use for these areas only. Variations could be to have the radiation valve open 50% or 100% prior to modulating the reheat valve open.
 8. Time of Day Scheduling:
 - a) Weekly schedule the occupied mode for each zone and/or group by function to reduce the number of schedules required per the owner's needs or as specified in the air terminal unit schedules.

9. Grouping of Terminals:
- a) Provide a dynamically adjustable group assignment point for each terminal unit zone and a point that can be weekly scheduled for each group. Provide a minimum of one group per ten terminal unit zones (all groups do not need to be used). For large groups of terminals that are desired to be scheduled together (>10 terminals or 20% of the system flow, whichever is less), provide an adjustable delay timer set initially at one-minute intervals, to stage on or off subsets of terminals within the groups to prevent nuisance static or freezestat safety trips. An alternative would be to provide separate groups that are smaller that would be scheduled slightly apart to avoid nuisance trips. Feature software provided in the DDC system that accomplishes the above stated intent of grouping terminals for scheduling is acceptable. Grouping of the time-of-day schedules for the rooms shall be verified and documented with the owner and shall be provided prior to occupancy of the facility.
10. Occupancy Modes:
- a) For zones that have space occupancy sensors specified, occupancy sensors shall be used for determining the mode of the terminals. The occupancy sensor auxiliary contact, provided by Division 26, shall be wired to a DDC controller for indexing the zone to occupied, standby, or unoccupied. The occupancy sensor has an internal adjustable time delay before switching to unoccupied, specified in Division 26 to be set at 10 minutes (but is typically adjustable from 15 seconds to 30 minutes). When the room is time of day scheduled through the DDC system to be occupied or unoccupied and the occupancy sensor indicates the zone is occupied, the zone shall be indexed to the occupied mode. When the zone is scheduled to be occupied and the occupancy sensor indicates the zone has been unoccupied (auxiliary occupancy sensor contact opens) the DDC system shall delay for 20 minutes (adj.) before indexing the zone to the standby mode. When the zone is scheduled to be unoccupied and the occupancy sensor indicates the zone is unoccupied the DDC system shall delay for 20 minutes (adj.) before indexing the zone to the unoccupied mode.
 - b) For zones that do not have occupancy sensors specified, there shall only be occupied and unoccupied modes that are time of day scheduled.
11. Airflow Mode Control:
- a) In the occupied mode, the zone air terminals shall modulate between the minimum and maximum occupied flow rates as specified in the VAV schedules. In the standby and unoccupied mode, the zone air terminals shall modulate between the minimum unoccupied flow rate and the maximum occupied flow rate as specified in the VAV schedules except as required for unoccupied/standby heating control. All airflow setpoints shall be adjustable.
12. Unoccupied/Standby Heating Control with Radiation:
- a) If the AHU associated with the VAV terminal is running and the VAV terminal is indexed to unoccupied and has an unoccupied minimum airflow setpoint of zero, the associated radiation terminal shall be used for heating to maintain the unoccupied space temperature heating setpoint and the VAV terminal shall remain closed.
13. Unoccupied/Standby Heating Control without Radiation:
- a) If the space temperature falls below the unoccupied zone heating setpoint and the VAV terminal unoccupied airflow setpoint is zero CFM, the VAV terminal shall be indexed to the occupied minimum airflow and the heating valve controlled to maintain the VAV terminal discharge at the discharge air temperature limit control setpoint. When the space temperature rises 2°F (adj.) above the unoccupied space temperature setpoint, the VAV terminal damper and heating valve shall close.

14. Temperature Mode Control:

- a) In the occupied mode, the occupied zone temperature heating and cooling setpoints shall be maintained. In the standby mode, the standby zone temperature heating and cooling setpoints shall be maintained. In the unoccupied mode, the unoccupied zone temperature heating and cooling setpoints shall be maintained.

15. Temperature Setpoints:

- a) Temperature setpoints listed under the GENERAL CONTROL section shall be the default setpoints, but all setpoints shall be verified and documented with the owner prior to programming the air terminal DDC controllers. For the standby mode, the heating and cooling setpoints shall be 2°F greater and less than the cooling and heating setpoints respectively. For the unoccupied mode, the heating and cooling setpoints shall be 6°F greater and less than the cooling and heating setpoints respectively. All heating and cooling setpoints for each mode shall be adjustable.

F. WALL FIN/CONVECTOR TERMINAL STANDALONE DDC CONTROL:

- 1. Provide a DDC space temperature sensor to control a modulating electronic control hot water valve to maintain space temperature. When space temperature is below setpoint, modulate the hot water valve open. The reverse shall occur when space temperature is above setpoint. Lock hot water valve closed off whenever outside air is above 50°F (adj.).
- 2. Provide separate adjustable heating setpoints for both the occupied and unoccupied modes.

3.9 PRIMARY HUMIDIFIER CONTROL (H-1 and H-4)

- A. Humidifiers shall be integrated into the building DDC system. Control primary humidifiers located in the air handling units or ductwork by discharge air humidity sensors to maintain a humidity setpoint that is reset from return/exhaust humidity sensors as shown on the plans or specified under Section 23 09 15. The discharge air humidity setpoint shall be reset between 20% RH (adj.) and 85% RH (adj.) to maintain the PI loop calculated reset return/exhaust humidity setpoint. Provide two electronic discharge air humidity sensors for discharge humidity control. The highest humidity reading of the two discharge humidity sensors shall maintain the calculated discharge humidity setpoint. If the humidity readings of the two sensors vary by more than 8% RH (adj.), an alarm shall be sent through the DDC system. The return/exhaust humidity setpoint shall be reset between 35% RH (adj.) at an outside air dry bulb temperature of 50°F (adj.) and 25% RH (adj.) at an outside air dry bulb temperature of 0° F (adj.). Mount the humidity sensors at the same location a minimum of 6 feet or greater if required by humidifier manufacturer and a maximum distance of 15 feet. Whenever possible, humidity sensors should be located on the same side of the ductwork that the steam feed to humidifier is located. The humidifier control loop shall not be active until the supply fan speed signal exceeds 20% (adj.) command.

3.10 STANDALONE HUMIDIFIER CONTROL (H-2 and H-3)

- A. Humidifiers shall be integrated into the building DDC system. Control humidifiers by space humidistat to maintain a constant humidity setpoint. The setpoint shall be 30% RH (adj.). Provide a DDC space humidity sensor for monitoring.

3.11 VARIABLE VOLUME MIXED AIR HANDLING UNIT CONTROL (AHU-1/RF-1, EF-5 and EF-7)

- A. GENERAL:
 - 1. The air handling unit is variable air volume, indoor air unit.
 - 2. The air handling unit is controlled by direct digital controller (DDC).

3. The air handling unit is equipped with the following:
 - Supply fans with VFDs and isolation dampers.
 - Return fans with VFDs and isolation dampers.
 - Supply, return, and outside air airflow measuring stations furnished by TCC. (Refer to specification 23 09 14)
 - Outside air damper furnished by TCC. (Refer to specification 23 09 14)
 - Return air damper furnished by TCC. (Refer to specification 23 09 14)
 - Relief air damper furnished by TCC. (Refer to specification 23 09 14)
 - Chilled water coil for cooling.
 - Hot water coil for heating.
 - Humidifier.
 - 30% and 60% filter bank.
 - Actuators furnished by TCC. (Refer to specification 23 09 14)

B. FAN CONTROL:

1. Start/Stop: The DDC system shall start the supply and return fans via their respective VFDs. Provide scheduling of the AHU if desired by the owner. Upon a supply or return fan failure or when fan systems with fan arrays have half or more of the fans fail, command both supply and return fans to minimum speed and maintain start commands to each fan. On any fan failure, controlled elements within the AHUs shall be controlled as described under Shutdown Control. When failed fan status proves on, fan system shall automatically restart per sequences below. On a failure of either the supply or return fan, an alarm shall be sent through the DDC system.
2. For fan systems with two supply fans, sequence fans on based on supply fan speed. When fan speed is at 95% or more for 15 minutes (adj.), start the next supply fan. All supply fans shall be controlled at the same speed. When commanded fan speeds fall to 40% for 15 minutes (adj.), shut off the lag supply fan. When starting a fan, command the fan to start and run at minimum speed. When fan status is proven on, command the isolation damper open and release the fan to control. If a fan status does not prove on or the isolation damper end switch does not prove open within 2 minutes (adj.) of the fan start or damper open commands, command the supply fan off and the isolation damper closed, latch out this supply fan, and send a supply fan failure alarm through the DDC system. Provide a manual push-button switch located in the control panel and a software point to reset the shutdown latch out of the fan. When stopping a lag fan, command the damper to close and ramp the fan down to minimum speed at the same rate as the damper actuator stroke time (typically 90 seconds). After the fan is at minimum speed and the damper end switch indicates the damper is closed, command the fan off. When switching lead fans and stopping a lag fan, prove operation of the new lead fan and allow 2 minutes (adj.) for the fan to come up to speed before initiating the stop fan sequence. Provide a software point and hardware switch located inside the control panel for each fan to be taken out of service that shall initiate the shutdown sequence for the fan. If there is a lag fan that is available, it's start sequence shall be initiated and come into control before the shutdown sequence for the fan being taken out of service is stopped.
3. The above sequence may need to be modified to prevent static pressure variances as specified General, Parallel Fan Bumpless Transfer sequence. This may entail adjusting minimum speeds and/or ramping dampers or fans at different rates than specified above

C. CURRENT STATUS SWITCH:

1. Provide as described under GENERAL, VFD Motor Run Status, in this Section for both the supply and return fans.

E. SUPPLY FAN SPEED CONTROL:

1. The purpose of the supply fan control is to maintain a minimum static pressure in the supply ductwork to ensure proper terminal air box operation. Install a static pressure sensing probe in the main supply duct located at approximately $\frac{3}{4}$ of the way down the main supply duct as shown on the plans and pipe to the differential pressure transmitter that shall be located in the unit temperature control panel. The inputs to the differential pressure transmitter shall be the static pressure inside of the duct and the reference input shall sense the actual space served by the air system located in the ceiling below the duct probe. The DDC system shall modulate the supply fan VFD to maintain the static pressure setpoint as sensed by the static pressure sensor. If multiple supply fans are used, the same speed signal shall be sent to all operating fans unless the fan is in start or stop mode as described above. If multiple sensing locations are shown, the DDC system shall maintain the static pressure setpoint at the lowest reading sensor. If the static sensors deviate by more than 0.5 in. w.c. (adj.), an alarm shall be sent through the DDC system. Static pressure setpoint shall be as described in the Static Pressure Reset Control below.

F. FAN STATIC PRESSURE SETPOINT RESET CONTROL:

1. Static pressure setpoint shall be reset using true Trim & Respond logic within the range 0.3 in w.c. (adj.) to 1.2 in w.c. (adj.). When the fan is off, the setpoint shall be reset to 1 in. w.c. (adj.) and this setpoint shall be used on system start up. While the fan is proven on, every three minutes, (adj.) trim the setpoint by 0.04 in. w.c. downward if there are zero zone pressure requests. If there are more than one zone pressure requests, respond by increasing the setpoint upward by 0.06 in. w.c. If there is exactly one zone pressure request, the static pressure setpoint shall not be adjusted.
2. Each zone VAV shall produce a zone pressure request analog value of 0, 1 or 2. When the VAV damper is less than 90% (adj.) open the pressure request analog value shall be zero. If the VAV damper is greater than 90% (adj.) and less than the pressure request two setpoint, then the pressure request analog value shall be one. If the VAV Damper is greater than 99% open for 60 seconds (adj.) then the zone pressure request analog value shall be two. Zone pressure requests for each VAV zone associated with the AHU shall be summed in the supervisory controller.
3. Provide a binary data enable point for each zone to enable/disable the VAV damper in the trim and respond algorithm. All setpoints, timers, and zone pressure request threshold for the static pressure reset shall be adjustable. Tune the reset to prevent cyclic instability after the space is occupied. Provide a trend graph to show the relative stability of the static pressure setpoint. Final maximum setpoint shall be determined by the Balancing Contractor to satisfy the worst-case zone at maximum design condition.
4. When indexing more than 10% of the air terminals to occupied to occupied and the static pressure setpoint is below the fan start static setpoint, reset the static pressure to the fan start setpoint and release to trim and respond control. This is to prevent slow system recovery on scheduled start-up.

G. RETURN FAN SPEED CONTROL:

1. The purpose of the return fan control is to maintain a slightly positive building pressure. The return fan VFD shall modulate to maintain a constant CFM offset of 900 (adj.) from the supply fan to account for total exhaust from the area in which it serves while maintaining a slightly positive pressure. TCC shall coordinate with the balancing contractor to optimize this setting.
2. For fan systems with two return fans, sequence fans on based on return fan speed. When fan speed is at 95% or more for 15 minutes (adj.), start the next return fan. All return fans shall be controlled at the same speed. When commanded fan speeds fall to 40% for 15 minutes (adj.), shut off the lag return fan. If multiple return fans are used, the same speed signal shall be sent to all operating fans unless the fan is in start or stop mode as described below. When

starting a fan, command the fan to start and run at minimum speed. When fan status is proven on, command the isolation damper open and release the fan to control. If a fan status does not prove on or the isolation damper end switch does not prove open within 2 minutes (adj.) of the fan start or damper open commands, command the return fan off and the isolation damper closed, latch out this return fan, and send a return fan failure alarm through the DDC system. Provide a manual push-button switch located in the control panel and a software point to reset the shutdown latch out of the fan. When stopping a lag fan, command the damper to close and ramp the fan down to minimum speed at the same rate as the damper actuator stroke time (typically 90 seconds). After the fan is at minimum speed and the damper end switch indicates the damper is closed, command the fan off. When switching lead fans and stopping a lag fan, prove operation of the new lead fan and allow 2 minutes (adj.) for the fan to come up to speed before initiating the stop fan sequence. Provide a software point and hardware switch located inside the control panel for each fan to be taken out of service that shall initiate the shutdown sequence for the fan. If there is a lag fan that is available, its start sequence shall be initiated and come into control before the shutdown sequence for the fan being taken out of service is stopped.

3. The above sequence may need to be modified to prevent static pressure variances as specified General, Parallel Fan Bumpless Transfer sequence. This may entail adjusting minimum speeds and/or ramping dampers or fans at different rates than specified above

H. VENTILATION AIR CONTROL:

1. Reset Ventilation Air Flow Setpoint by Summing Zone Ventilation Rates: The outside air ventilation rate required at the AHU shall be determined the greater of the base ventilation rate setpoint of 900 CFM or the sum of the ventilation airflow required by each zone associated with the AHU. The zone ventilation values to be summed shall be based on the OCC OA Vent CFM as scheduled on the plans. Sum the value of the zones without occupancy sensors and the zones that have occupancy sensors only when they are occupied.
2. Minimum Ventilation Air Flow Control Using a Full Flow Outside Air Flow Station: When the economizer sequence is not enabled, the outside air damper shall modulate open to maintain the outside air flow minimum ventilation rate setpoint. When the outside air damper is 100% open, the return damper shall modulate towards closed to maintain the outside air flow minimum ventilation rate setpoint. When the economizer sequence is enabled, the outside air and return air dampers shall be limited from controlling below the outside air ventilation flow rate.
3. Minimum Ventilation Air Flow Control Using a Minimum Outside Air Flow Station: The minimum outside air damper shall modulate to maintain the minimum outside airflow ventilation setpoint. When the minimum outside air damper is fully open and the ventilation airflow rate is below setpoint, the return damper shall be overridden to modulate closed to maintain the minimum ventilation airflow rate. The return damper shall be limited to being overridden to 50% closed (adj.) in this mode. The Temperature Control Contractor shall work with the Balancing Contractor to determine the return damper limit setpoint required to provide the maximum ventilation airflow rate when the air handling unit is at full turndown. When the economizer outside air damper is modulated open to maintain the discharge air temperature, the return shall modulate as described in the discharge air temperature control sequence and shall not be overridden to maintain minimum ventilation. Final setpoints shall be included in the as-built sequence of operation by the Temperature Control Contractor.

I. FILTERS:

1. Install a differential static pressure sensor across each filter bank. Ensure that the static probes do not impede filter removal.
2. For pre-filter bank, provide an alarm to the operator interface when the differential static pressure exceeds 0.8" w.g. (adj.).

3. For final filter bank, provide an alarm to the operator interface when the differential static pressure exceeds 1.0" w.g. (adj.).
- J. DISCHARGE AIR TEMPERATURE CONTROL:
1. Install a temperature sensor in the supply duct downstream of the supply fan, all water coils and humidifiers.
 2. Discharge Air Temperature Setpoint: Discharge air temperature setpoint shall be 55°F (adj.).
 3. The heating coil, mixed air dampers, and the cooling coil shall be controlled in sequence to maintain the discharge air setpoint temperature. At no time shall the heating coil be operating when the mixed air dampers are economizing, or the chilled water valve is open. Whenever the discharge air temperature is above the setpoint, the following shall occur in sequence: The heating coil control shall modulate closed as sequenced below. When heating is completely off and the economizer sequence is enabled, the outside air damper and return air damper shall be modulated sequentially (outside air damper modulates open fully before return air damper modulates towards closed) to maintain the discharge air temperature setpoint. Provide an adjustable offset setpoint for adjusting the outside and return air damper sequential control as described above. When the offset setpoint is set at 100%, the outside air damper shall be fully open before the return air damper can modulate closed. When the offset setpoint is set at 50%, the outside air damper shall be 50% open before the return air damper can modulate closed. When the offset setpoint is set at 0%, the outside air damper shall be modulated together in a complimentary fashion. Any percentage of offset is allowable. Normal offset setpoint shall be 100%. When the outside air economizer damper is completely open and the return air damper is completely closed, or the economizer sequence is not enabled, the chilled water valve shall modulate open to maintain the discharge air temperature setpoint. When the discharge air setpoint is below setpoint the reverse shall occur. Cooling coil control shall be locked out below 50° F (adj.) outside air temperature.
- K. HOT WATER HEATING COIL CONTROL:
1. Modulate the heating coil control valve as sequenced under discharge air control.
- L. RELIEF DAMPER CONTROL:
1. The relief damper shall be modulated to maintain a relief plenum pressure setpoint of 0.10" w.c. (adj.). When the relief plenum pressure is above setpoint, the relief damper shall modulate open. When the relief plenum pressure is above setpoint the reverse shall occur. When economizer is switched to enabled by the economizer switchover as described below, the relief damper shall be commanded fully open and released to relief plenum pressure control. This is to ensure when economizer is switched back on when outside air temperature falls below the economizer switchover setpoint and the outside air damper goes from minimum airflow position to full economizer, the relief damper will be fully open to provide an air path for relief.
- M. ECONOMIZER CONTROL:
1. When the economizer sequence is enabled by the switchover sequence below, the outside air economizer damper and return damper shall modulate to provide outside air to be used for free cooling as described in the Discharge Air Control sequence.
 2. Floating Dry Bulb Economizer Switchover: The economizer sequence shall be enabled whenever the outside air temperature is more than 4°F (adj.) cooler than the return air temperature.
 3. If a globally shared data point is used for economizer switchover, provide a dry bulb economizer backup control sequence that shall enable the economizer whenever the building outside air temperature sensor is sensing below 68°F (adj.) outside air temperature and communication is lost to the globally shared data point.

N. SAFETIES:

1. General: All safeties shall be hard wired to the supply and return fan starters or VFD safety circuits. Starters shall not function in the "Hand" or "Auto" and VFD's shall be disabled if they are indexed to the "Auto" or "Hand" position in either the VFD or bypass modes.
2. Freezestat: Install an electric freezestat (refer to specification Section 23 09 14 for location) to shut down the unit (see Unit Shutdown for additional information) if the temperature downstream of the heating coil drops below 35°F (adj.). The electric freezestat shall act independently of the DDC system via hardwire interlock and shall override the DDC system control signal to open the heating coil control valve(s). A freezestat trip shall notify the DDC system that shall send an alarm to the operator interface.
3. Supply Fan High Pressure Limit: Install a static pressure probe located in the air handling unit main discharge duct at least six feet or as far as physically possible downstream of the fan and upstream of any dampers and pipe to a differential pressure switch located in the temperature control panel. Wire in series with the safety circuit of the supply and return fan. Differential pressure switch shall be a manual reset type and the DDC system shall monitor the status of the differential pressure switch. Initial setpoint shall be +3.5" w.c. (adj.).
4. Supply Fan Low Pressure Limit: Install a static pressure probe located in the air handling unit immediately upstream of the prefilter and pipe to a differential pressure switch located in the temperature control panel. Wire in series with the safety circuit of the supply and return fans. Differential pressure switch shall be a manual reset type and the DDC system shall monitor the status of the differential pressure switch. Initial setpoint shall be -1.5" w.c. (adj.).
5. Return Fan High Pressure Limit: Install a static pressure probe located in the discharge duct at least six feet or as far as physically possible downstream of the fan and upstream of any dampers and pipe to a differential pressure switch located in the temperature control panel. Wire in series with the safety circuit of the supply and return fan. Differential pressure switch shall be a manual reset type and the DDC system shall monitor the status of the differential pressure switch. Initial setpoint shall be +1.5" w.c.

O. FIRE ALARM SHUTDOWN:

1. Upon a Fire Alarm System alarm, the fire alarm control module provided by the electrical contractor at the temperature control panel shall change state of its contacts. This shall cause the unit to be shut down (see Unit Shutdown for additional information). An auxiliary contact shall be provided to notify the DDC system of a fire alarm shutdown. Upon reset of the fire alarm system, the unit shall restart automatically without user intervention subject to any restart delays. See Section 28 31 00 for fire alarm system programming requirements for AHUs.

P. UNIT SHUTDOWN:

1. Whenever the air handling unit is indexed off, the supply and return fans shall stop. Whenever both supply and return fans are off for any reason or the air handling unit is in fan failure mode as described under the Fan Control sequence the following shall occur:
2. The outside air damper and relief air damper shall close, and the return damper shall open.
3. The chilled water control valve(s) shall close.
4. The heating coil control valve(s) shall remain under control from the mixed air sensor to maintain 55 °F (adj.). Freezestat shall override heating control valve(s) open.

Q. UNOCCUPIED CONTROL:

1. General: This system is currently not intended to operate in unoccupied mode but shall be made capable. Occupied/unoccupied schedule shall be set at the DDC operator interface. When indexed to unoccupied the unit shall shutdown. Where provided, index DDC controlled heating and cooling terminal units associated with this air handling unit to maintain setback and setup temperature setpoints.
2. Unit Cycling to Maintain Setback/Setup Temperatures: Cycle the air handling unit on to maintain the setback and setup temperature zone setpoints to maintain 64°F and 80°F respectively. Reset supply return fan volume offset for return air fan control to zero. Supply fan shall be limited to the maximum return fan airflow. In the heating mode, the outside air and relief air dampers shall close, and the return air damper shall open, and heating discharge temperature control shall function as specified. In the cooling mode, the economizer and chilled water discharge temperature control shall be allowed to function as specified. Minimum on runtime timer shall be set for 15 minutes (adj.) and the off timer for 30 minutes (adj.).

R. HEATING OPTIMUM STARTUP:

1. This cycle shall override the unoccupied cycle. If the system was operating as a result of the unoccupied cycle, the system shall continue to operate. The DDC system shall measure the zone air temperature designated on the plans and the outside air dry bulb temperature to determine the minimum run time to warm the zone(s) to its setpoint. When the computed start time is reached, the DDC system shall start the air handling system and operate with the outside air and relief air dampers closed and the return air damper open. The air handling unit discharge air temperature shall be controlled as specified under Discharge Air Control. When the occupied time is reached, the unit shall be switched to occupied control and ventilation air shall be provided.

S. COOLING OPTIMUM STARTUP:

1. This cycle shall override the unoccupied cycle. If the system was operating as a result of the unoccupied cycle, the system shall continue to operate. The DDC system shall measure the zone air temperature designated on the plans and the outside air dry bulb temperature to determine the minimum run time to cool the zone(s) to its setpoint. When the computed start time is reached, the DDC system shall start the air handling system. The air handling unit discharge air temperature shall be controlled as specified under Discharge Air Control with the economizer and chilled water control active. When the occupied time is reached, the unit shall be switched to occupied control and ventilation air shall be provided.

3.12 PACKAGED ENERGY RECOVERY VENTILATOR CONTROL (ERV-1)

- A. This unit is a packaged air-to-air energy recovery unit for providing space heating and cooling, along with continuous ventilation air. Control and monitoring shall be integrated via BACnet.
- B. In unoccupied mode, ERV shall run continuously at first stage airflow. The unit packaged controls shall operate the fans, dampers, energy recovery wheel, hot water heating control valve, and chilled water control valve to maintain unoccupied space temperature setpoint.
- C. When indexed by the DDC system to the occupied mode, or on a signal from the space occupancy sensors (the occupancy sensor auxiliary contact, provided by Division 26, shall be wired to a DDC controller), ERV shall run continuously at second stage airflow. The unit packaged controls shall operate the fans, dampers, energy recovery wheel, hot water heating control valve, and chilled water control valve to maintain occupied space temperature setpoint. ERV shall run continuously at second stage airflow until indexed to unoccupied mode or a change in occupancy status to unoccupied.
- D. Install a temperature sensor in the supply air duct downstream of the supply fan and coils, and connect to unit controls.

3.13 DUCTLESS SPLIT SYSTEM AC CONTROL (DAC-1 THROUGH DAC-2)

- A. Units provided with remote wall mounted thermostat. Space temperature setpoint shall be 75°F (adj.). DAC-1A and DAC-1B shall be set up as primary/backup by having a 2°F (adj.) setpoint differential.
- B. Provide a DDC space temperature to monitor space temperature. Provide an alarm to the operator interface when the space temperature is outside the range of 65-80°F (adj.).

3.14 MAKEUP AIR UNIT CONTROL (MAU-1/EF-10, 11, 12, and 13)

A. GENERAL:

- 1. The makeup air unit is variable air volume (2-stage operation), 100% outdoor air, indoor unit.
- 2. DDC control and monitoring provided through BACnet integration.
- 3. The makeup unit is equipped with the following:
 - Supply fan with VFD.
 - Outside air inlet damper and actuator furnished with unit.
 - Direct-fired gas heat exchanger heating with inlet air sensor.
 - 30% filter bank with dirty filter sensor.

B. UNIT CONTROL:

- 1. Unit and interlocked exhaust fans (EF-12 and 13) shall start when indexed to occupied mode by the DDC system and shall run continuously at first stage airflow until indexed to unoccupied mode or until gas detection signal is satisfied. With MAU second stage timer active, or on gas detection system alarm, MAU-1 and interlocked exhaust fans shall operate at second stage airflow for 30 minutes (adj.) or until gas detection alarm signal is satisfied. MAU timer shall also allow floor warming system and gas fired unit heaters to maintain occupied space temperature setpoint. EF-10 and EF-11 shall run continuous.

C. FILTERS:

- 1. Install a differential static pressure sensor across the filter bank. Ensure that the static probes do not impede filter removal. Optional: Provide alarm from unit mounted dirty filter sensor.
- 2. For the filter bank, provide an alarm to the operator interface when the differential static pressure exceeds 0.5" w.g. (adj.).

D. DISCHARGE AIR TEMPERATURE CONTROL:

- 1. Install a temperature sensor in the supply duct downstream of the supply fan and heat exchanger.
- 2. Discharge Air Temperature Setpoint: The makeup air unit controls shall modulate the heating to maintain a discharge air temperature setpoint of 75°F (adj.).
- 3. Heating Inlet Air Sensor: The heating shall be locked out when the outside air temperature is above the 65°F (adj.).

E. UNIT SHUTDOWN:

- 1. Whenever the makeup air unit is indexed off, the supply fan shall stop. Whenever the supply fan is off for any reason or the makeup air unit is in fan failure mode, the following shall occur:
- 2. The outside air damper shall close, and heating shall be off.

H. UNOCCUPIED CONTROL:

- 1. General: Occupied/unoccupied schedule shall be set at the DDC operator interface. When indexed to unoccupied the unit shall shutdown.

- 3.15 GARAGE 112 VENTILATION (EF-8/L-1)
- A. Intake and exhaust dampers shall open and exhaust fan shall start when indexed to occupied mode by the DDC system or activated by gas detection signal and shall run continuously until indexed to unoccupied mode or until gas detection signal is satisfied.
- 3.16 GARAGE 113 VENTILATION (EF-9/L-2)
- A. Intake and exhaust dampers shall open and exhaust fan shall start when indexed to occupied mode by the DDC system or activated by gas detection signal and shall run continuously until indexed to unoccupied mode or until gas detection signal is satisfied.
- 3.17 GAS FIRED UNIT HEATER CONTROL (GUH-1)
- A. Install a space temperature sensor for 2-stage heating control and as indicated for each heater. Space temperature setpoint shall be set 2°F (adj.) below floor warming system space temperature setpoint.
- 3.18 GAS FIRED UNIT HEATER CONTROL (GUH-2)
- A. Install a space temperature sensor for 2-stage heating control and as indicated for each heater. Space temperature setpoint shall be set 2°F (adj.) below floor warming system space temperature setpoint.
- 3.19 GAS FIRED UNIT HEATER CONTROL (GUH-3 and GUH-4)
- A. Install a space temperature sensor for 2-stage heating control and as indicated for each heater. Space temperature setpoint shall be set 2°F (adj.) below floor warming system space temperature setpoint.
- 3.20 SPRINKLER ROOM 115A TEMPERATURE CONTROL (EFH-1/EF-14)
- A. Install a space temperature sensor for heating and cooling control. Space temperature heating setpoint shall be 60°F (adj.). Cycle electric fan-forced heater to maintain space heating setpoint. Space temperature cooling setpoint shall be 85°F (adj.). Cycle exhaust fan to maintain space cooling setpoint.
- 3.21 DESTRATIFICATION FAN CONTROL (DF-1 THROUGH DF-3)
- A. DDC control and monitoring provided through BACnet integration. Fans shall operate continuously at minimum speed during the heating season. Minimum speed shall be set where air movement at the floor level is first noticed. Adjust minimum speed as required to provide a more uniform space temperature throughout the full height of each space. Fans shall be controlled manually at the controller to provide maximum air movement during the cooling season, or as desired by the user.
- 3.22 DOMESTIC GAS-FIRED WATER HEATER INTEGRATION
- A. DDC control and monitoring provided through BACnet integration at water heater controller. Coordinate with Division 22 contractor.
- 3.23 DOMESTIC RECIRC WATER PUMP CONTROL (DWCP-1)
- A. Pump shall start when indexed by the DDC system to the occupied mode and run continuously until indexed to unoccupied mode. The domestic water pump start/stop relays shall utilize normally closed contacts so upon failure of the relay or DDC controller the pump will fail on.
- B. If the domestic water pump is called to run and the current status switch indicates that the pump is not operating for 30 seconds (adj.), an alarm shall be sent to the operator interface.
- 3.24 LIGHTING CONTROL INTEGRATION
- A. DDC control provided through BACnet integration at lighting controller. Coordinate with Division 26 contractor.
- 3.25 MISCELLANEOUS
- A. See miscellaneous points table in section 23 09 15 for additional items to be controlled or monitored not listed in this section.

END OF SECTION 23 09 93

SECTION 23 21 12 - GROUND LOOP HEAT EXCHANGER

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section contains specifications for the ground-coupled heat exchanger and connections to building piping system for this project. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Delivery, Storage, and Handling
 - 9. Design Criteria
 - 10. Definitions
 - 11. Environmental Considerations
 - 12. Permit, Laws and Regulations
 - 13. Water Supply
 - 14. Warranty
- C. PART 2 - Products
 - 1. High Density Polyethylene (HDPE) Pipe
 - 2. Interior Manifolds
 - 3. Grout
 - 4. Miscellaneous Materials
- D. PART 3 - EXECUTION
 - 1. General
 - 2. Vertical Heat Exchanger Construction
 - 3. Excavation, Lateral Piping and Backfill
 - 4. Polyethylene Piping
 - 5. Cleaning and Protection
 - 6. Flushing, Purging, Pressure Testing and Charging of System
 - 7. Piping System Test Report
 - 8. Piping System Flush Report

1.2 RELATED WORK

- A. Section 23 21 13 - Hydronic Piping
- B. Section 23 21 17 - Antifreeze (Ground Loop Heat Exchanger)

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ASHRAE HVAC Applications Handbook - Chapter 35, Geothermal Energy
- B. IGSHPA (GROUT) Grouting Procedures for GHP Systems

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Local and State laws and ordinances as they pertain to buried pipe systems and closed loop geothermal vertical bore construction shall be strictly followed.
- B. Annular space around boring must be sealed in a manner that meets or exceeds State Board of Health Requirements in the State of the Work.
- C. The Geothermal Contractor must be a Limited Well/Boring or Water Well contractor licensed in the State of the work.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of documented experience on projects with geothermal loop heat exchanger work similar to that required for this project and accredited by IGSHPA.
- E. Manufacturer's Qualifications: Firms regularly engaging in manufacturing geothermal loop heat exchanger products and tools of the types, materials, and sizes required, whose products have been in satisfactory use in similar services not less than 5 years.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals
- B. Product Data, Polyethylene Piping: Provide manufacturer's data for piping and pipe fittings, showing compliance with specified requirements. Provide manufacturer's installation instructions.
- C. Product Data, Grout and Slurry: Provide information on thermal conductivity of proposed materials and mixture procedures.
- D. Product Data: Manufacturer's descriptive literature for piping, fittings, valves, interior manifold, circulating solution, grout and other products incorporated in ground heat exchanger design. Include manufacturers' installation and handling instructions.
- E. Guarantees and Warranties: Provide copies of any guarantees and/or warranties extended by the contractor and/or pipe manufacturers.
- F. Project Records: The following must be submitted to the engineer prior to approval of final payment.
 - 1. Fully surveyed and dimensioned site layouts showing the as-built location of the bore holes and buried lateral piping relative to the initial entry point of the building the ground heat exchanger serves.
- G. Test Reports, Piping: Indicate test method and results of hydrostatic pressure tests.
- H. Provide company experience, the Geothermal Contractor must have an approved Field Supervisor on site at all times during the ground heat exchanger installation.
 - 1. To obtain approval to supervise DRILLING AND HORIZONTAL HEAT EXCHANGER INSTALLATION, the following criteria must be submitted:
 - a. Evidence of current IGSHPA Installer Accreditation.
 - b. Evidence of a minimum of 3 years personal experience supervising or performing drilling and installation of horizontal bore, closed-loop ground heat exchangers on non-residential projects.

- I. Provide Heat Fusion Technician Certification: IGSHPA training and certification, certified within three years from the date of project commencement.
 - 1. A Qualified Fusion Technician must perform or directly supervise lateral pipe fusion operations at all times. No contractor employee may perform pipe fusion related duties including, but not limited to, fusion tool maintenance or adjustment, pipe preparation, trimming, shaping and/or fusion, unless supervised by or personally Qualified as a Fusion Technician as defined above.
 - a. A Qualified Fusion Technician is defined as someone who has completed and obtained suitable proof of training/retraining on butt and socket fusion procedures as administered by an IGSHPA Certified Trainer or by a pipe manufacturer's recognized trainer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping and fittings to project site in shipping containers with labeling in place.
 - 1. Verify that labels on piping indicate manufacturer's name, pipe or tube size, one-foot markings, and PE cell classification.
 - 2. Verify that piping complies with specifications and is undamaged.
- B. Protect from weather, humidity and temperature variations, dirt and dust, and other environmental contaminants.
- C. Store piping capped or plugged until time of installation.

1.9 DESIGN CRITERIA

- A. This design has been prepared according to the materials standards and accepted installation practices of the International Ground Source Heat Pump Association (IGSHPA). The contractor shall comply with these standards and practices along with all state and local regulations pertaining to the installation.
- B. The Geothermal Contractor is responsible for all aspects involved with the complete geothermal ground loop heat exchanger (GLHE) installation. All materials, mobilization, horizontal directional drilling (HDD), water supply, excavation, hauling of backfill and cuttings, pumping, soil compaction, and labor required shall be included in the bid price.
- C. Geothermal contractor shall take note: There is no guarantee that the locations of any existing or proposed utilities, or other underground infrastructure, are exactly as indicated on the plans. Some areas may require hand digging to locate. Geothermal Contractor shall be responsible for any repair costs to utilities or infrastructure that is damaged during installation of ground loop heat exchanger.
- D. Geothermal Contractor shall provide system flushing of loop field to specified glycol concentration.
- E. Coordinate the installation of purging, and filling of the ground loop heat exchanger with site utility installations.

1.10 DEFINITIONS

- A. Bentonite - "Bentonite" means an aluminum silicate clay that contains at least 85 percent on the mineral montmorillonite and meets API specification 13A-04.
- B. Bentonite Grout - "Bentonite Grout" means water and a minimum of 15 percent by weight of powdered or granular bentonite, with no additives to promote temporary viscosity. An additional 15 percent by weight of either washed sand or cuttings taken from the borehole may be mixed into the bentonite and water slurry. The bentonite must be designed by the manufacturer as a grout or well and boring sealant, and must be mixed according to the manufacturer's specification.
- C. Grout - "Grout" means a low permeability material used to fill the annular space around a casing or to seal a well or boring. Grout is either neat-cement grout, cement-sand grout, or bentonite grout.
- D. Unconsolidated Materials - "Unconsolidated Materials" means geological material that are not bedrock and includes alluvium, glacial drift, glacial outwash, glacial till, lacustrine deposits, loess, saprolite, and soil.

- E. Thermally Enhanced Bentonite Grout - "Thermally Enhanced Bentonite Grout" means a fluid mixture of not more than 17.5 gallons of water, not more than 200 pounds of sand with 80 percent or more of the sand smaller than 0.0117 inch (passing US Sieve #50) and a minimum of 50 pounds of bentonite.

1.11 ENVIRONMENTAL CONSIDERATIONS

- A. The contractor shall be fully responsible for the directional drilling operation.
- B. The contractor shall take all measures necessary to protect surrounding public and private property, structures, buildings, roads, utilities, driveways, sidewalks, and appurtenances from damage due to the directional drilling work. Responsibility and payment for correction of such damage shall be the sole responsibility of the contractor.
- C. The HDD operation is to be performed in a manner to eliminate the discharge of water, drilling mud and cuttings to nearby waterways. The contractor shall provide equipment and procedures to maximize the recirculation or reuse of drilling mud to minimize waste. If required, the contractor shall line all excavated pits used in the drilling operations with heavy-duty plastic sheeting with sealed joints to prevent the migration of drilling fluids and/or groundwater. If inadvertent returns of drilling fluids near a structure or into a waterway occur, the contractor shall immediately provide environmental controls and clean up to the satisfaction of, and at no additional expense to, the Owner.
- D. When working adjacent to waterways, the general work area on the entry and exit sides of the crossing shall be enclosed by a berm to contain unplanned spills or discharge.
- E. Equipment (graders, shovels, etc.) and materials (such as groundsheets, hay bales, booms, and absorbent pads) for cleanup and contingencies shall be provided in sufficient quantities by the contractor and maintained at the site for use in the event of inadvertent leaks, seeps, or spills

1.12 PERMIT, LAWS AND REGULATIONS

- A. The contractor shall procure and pay for all permits, licenses, municipal inspections, or approvals necessary for the execution of the GLHE contract.
- B. The contractor shall comply with all laws, ordinances, rules, orders and regulations relating to the performance of the work, protection of property, maintaining of surface passageways to buildings, fences and/or other facilities.
- C. All applicable Federal and State laws, regulations, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over the project shall apply to the contractor throughout and they shall be deemed to be included in the contract as a part, therefore, the same as though herein described in full.
- D. All regulations of the Occupational Safety and Health Act (OSHA) are in effect on this contract. It will be the contractor's responsibility to make himself aware of all appropriate County, State and Federal regulations that apply to the contract.
- E. Any violations incurred from improper execution of the above shall be paid by the contractor. Loss of time on the project from such violations will not be tolerated.

1.13 WATER SUPPLY

- A. There will be no water available at site. The contractor is responsible for obtaining potable water as necessary to perform the work. Additionally, the contractor shall provide pumps, water trucks or trailers, storage tanks and all other items necessary to provide adequate supply of potable water. The source of such water shall be subject to approval of the engineer.

1.14 WARRANTY

- A. The contractor shall warrant to the owner the following with respect to the ground heat exchanger system for a period of five years from date of owner acceptance.
 - 1. Every Horizontal heat exchanger has been grouted according to state regulations.
 - 2. Installation conforms to the final construction specifications and/or as-built plans as delivered to the Owner upon close-out of the system.

3. Unless otherwise specified, all materials used in the system are new.
4. All system piping is high density polyethylene and carry a manufacturer's warranty of not less than 50 years.
5. For a period of 5 years and so long as the Owner undertakes reasonable maintenance and prevents system breach or other damage, the GLHE will operate with that quantity of circulating solution set forth in the specifications without leakage that would result in a material impairment of the functioning of the system.
6. The GLHE will provide fluid flow volume through each circuit equal to the fluid flow volume introduced to it by the circulating pumps without exceeding the specified pressure drop.
7. The GLHE is delivered to the Owner, completely flushed of construction debris, purged completely of air trapped during installation and filled with the circulating fluid specified.

PART 2 - PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

- A. All pipe and heat fused materials shall be manufactured from a virgin polyethylene extrusion compound material according to ASTM D-2513, Sections 4.1 and 4.2. Pipe shall be manufactured to outside diameters, wall thicknesses and respective tolerances as specified in ASTM D-3035, D-2447, or F-714.
- B. The material shall be PE3408 HDPE with minimum cell classification 345464C, with a UV stabilizer of C, D, or E as specified in ASTM D3350. Resistance to environmental stress cracking is critical to long life expectancy. Therefore, as a more stringent requirement, the piping shall experience zero failures (F0) after 5,000 hours under condition "C" (100% reagent at 100 degrees C) when tested according to ASTM D1693.
- C. U-bend pipe shall be factory assembled, fusing two continuous lengths of pipe to a U-bend fitting at one end. Pipe shall be capped on each end prior to shipment.
- D. A minimum 50-year limited warranty (in writing) must be issued by the pipe manufacturer.
- E. HDPE Fittings:
 1. Pipe fittings shall be of the same material designation as detailed above and shall meet the requirements of ASTM D2683 (for socket fusion) or ASTM D3261 (for butt/saddle fusion). Each fitting shall be identified with the manufacturer's name, nominal size, pressure rating, relevant ASTM standard(s) and date of manufacture.

2.2 INTERIOR MANIFOLDS

- A. Manufacturers: GHP systems, Inc. or prior approved equal.
- B. The manifold shall be factory assembled using high-density polyethylene (HDPE) pipe and fittings, joined together with heat fusion.
- C. All HDPE pipe and heat fused materials shall be manufactured from high-density, high molecular weight PE 3408 polyethylene compound that meets or exceeds ASTM D 3350 cell classification 345464C, and is listed by the Plastic Pipe Institute in PPI TR-4 with HDB ratings of 1600 psi at 73 degrees F and 800 psi at 140 degrees F.
- D. All circuits 2 inch and greater shall include butterfly valves constructed of steel stem, rated at 200 psi on the supply header. Provide balancing valve on each circuit of the return headers.
- E. Circuits smaller than 2 inch and all fill ports shall be ball valves with full port opening with blow out proof stem, 600 psi non-shock cold WOG.

- F. Pressure/temperature ports shall be brass and have a dual seal core of Nordel, good up to 350 degrees F for water and shall be rated zero leakage from vacuum to 1000 psig. Port shall be capable of receiving an 1/8-inch pressure or temperature probe.
- G. Provide temperature and pressure gauges.

2.3 GROUT

- A. Unconsolidated Grouting:
 - 1. Manufacturers:
 - a. High Solids Bentonite (Thermally Enhanced) grout shall be similar to Thermal Grout Lite manufactured by Black Hill Bentonite L.L.C. or as deemed equal by engineer.
 - b. Baroid Fluid Services; Barotherm Gold: www.baroididp.com.
 - 2. Mix shall yield a 1.0 thermal conductivity Btu/hr. ft. °F.
- B. Grout Requirements:
 - 1. Sealing with grout, general requirements. A well or boring must be sealed by filling the well or boring, including an open annular space, with grout or approved sealing materials to within two feet of the established ground surface or floor. Grout must be pumped through a tremie pipe or the casing from the original bottom of the well or boring upward. The bottom of the tremie pipe must be inserted to within ten feet of the bottom of the well or boring, and remain submerged in grout while grouting.
 - 2. Approved grout for sealing well or boring in unconsolidated materials. The portion of a well or boring in unconsolidated material must be filled with bentonite grout or thermally enhanced. The grout must be pumped through a tremie pipe or the casing from the bottom of the well or boring upward to within two feet of the established ground surface. Clean sand or cuttings equal to the volume of bentonite grout may be mixed with the bentonite grout, or poured into the well or boring while bentonite grout is pumped through a tremie pipe. The sand or cuttings must be poured at a rate which prevents bridging.
- C. Sand:
 - 1. Washed, dried, pre-packaged silica sand which is graded and shall beave an AFS GFN between 55.0 and 85.0.
 - 2. Silica Dioxide Content: Greater than 99 percent.
 - 3. Grain Shape: Rounded.

2.4 MISCELLANEOUS MATERIALS

- A. Warning Tape: Warning tape shall consist of a 4 mil inert plastic film specifically formulated for prolonged use underground. The tape shall have metallic content to enable location by metal detectors. Tape shall be a continuous imprinted message repeated every 16 to 36 inches warning of the installation buried below. The message shall read "CAUTION HEAT EXCHANGER PIPE BURIED BELOW."
- B. DETECTION WIRE: TW, THW, THWN, or HMWPE insulated copper, 10 gauge or thicker wire.

PART 3 - EXECUTION

3.1 GENERAL

- A. Examine areas and conditions under which geothermal loop heat exchanger systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

3.2 VERTICAL HEAT EXCHANGER CONSTRUCTION

A. General:

1. The Geothermal Contractor shall provide, as shown on the plans, a complete system of piping including valves and manifolds.
2. The piping plans are diagrammatic and indicate general locations and connections. The piping may need to offset, lowered or raised as required or as directed by the Construction Manager.

B. Drilling: Vertical.

1. Drilling Operation:

a. Drilling Fluids:

- 1) Dispose of drilling fluid and other spoils at location following laws, ordinances, rules and regulations of local jurisdiction.
- 2) Transport excess fluids and other spoils to the disposal site, at no additional cost to the Owner.

2. Each vertical borehole shall be sufficiently drilled to allow the complete insertion of the U-bend pipe to the specified depth. Excessive ground water expelled from bore holes shall be contained in settling ponds prior to final discharge. No drilling waste or ground water shall be introduced to any stream, river, lake, pond, or in any manner which violates local, State, and Federal laws and regulations.
3. The engineer shall be notified prior to altering the location or depth of any proposed bores or if any unusual drilling conditions are encountered.
4. Only State approved drilling fluids and potable water may be introduced into the bores.
5. Throughout the entire project, the Drilling Contractor must make all attempts to prevent any material that could be construed as a contaminant from entering the bore holes. In the event a borehole or boreholes become contaminated due to negligence, Drilling Contractor shall, at his expense, perform such work and supply materials as necessary to re mediate the contamination.

C. Vertical Pipe Installation:

1. Extreme care shall be taken not to crush, cut, or otherwise damage the pipe. No field fusions shall be utilized to repair damaged U-bend pipe.
2. After installation into the bore, both ends of each U-bend pipe shall then be taped or capped to prevent the introduction of soils or other debris.

D. Grouting:

1. Grouting material shall be mixed according to manufacturer's written instructions.
2. To prevent collapse of the bore wall, grouting must start immediately after insertion of U-bend pipe into the borehole.
3. Grout material shall be pressure pumped through the drill stem into the annular space from end to end. Grouting process shall conform to State and Local Health guidelines

3.3 EXCAVATION, LATERAL PIPING AND BACKFILL

A. Excavation:

1. The contractor shall perform all excavating, shoring, bailing, and pumping necessary for the installation of this work and perform any grading necessary to prevent surface water from flowing into trenches or other excavations. Sewer lines shall not be used for draining trenches and the ends of all pipe shall be kept sealed. Only material suitable for backfilling shall be piled a sufficient distance from banks and trenches to avoid overloading. Unsuitable backfill material shall be removed as directed by the Construction Manager.

2. Sheathing and shoring shall be done as necessary for protection of work and personnel safety. Unless otherwise indicated, excavation shall be open cut.
 3. Circuit piping trenches shall be excavated to 96" below rough grade.
 4. Main piping trenches shall be excavated to 96" below rough grade.
- B. Lateral Piping:
1. Piping shall be properly supported and adequate provisions shall be made for expansion and contraction. Pipe shall be placed without springing, forcing or other interferences.
 2. All pipe shall have burr and cutting slag removed by reaming or other cleaning methods.
 3. All pipe shall be arranged so as to minimize interference with other trades or block access.
 4. Bed circuit piping within a minimum of 10" of granular fill.
 5. Bed main piping within a minimum 12" of granular fill.
 6. If on site materials is to be used: Prevent rocks larger than 1" or those with sharp edges from coming into contact with pipe. Also, prevent clumps of soil or clay from coming into contact with pipe, only granular fill to be around the pipes.
 7. Separate supply and return pipes or bundles a minimum of 12" to minimize thermal interference. Minimize the number of points where supply and return lines cross one another.
 8. Avoid sharp bends whenever possible, use elbows when required.
 9. Install tracer wire at base of trench along the entire length of each circuit and each pair of mains. Terminate one end of each wire in vault and attach label to each signifying which circuit or which pair of mains it serves. Utilize uninterrupted length of wire or otherwise ensure continuity from vault to distal end of circuit.
 10. Cap open ends of pipe to prevent entry of soils and debris.
 11. Polyethylene butt or socket fusion is approved. Saddle fittings are approved only when fabricated under factory conditions by approved manufacturers. No field fusion utilizing saddle fittings is approved. Follow the manufacturer's written installation instructions.
- C. Compliance Verification after Installation: An Owner's representative shall inspect and approve excavations, lateral piping, and pressure testing before backfill. DO NOT PROCEED WITH BACKFILL UNTIL INSPECTIONS ARE COMPLETE AND APPROVAL FOR BACKFILL HAS BEEN GRANTED. Contact engineer to coordinate.
- D. Backfill and Compaction:
1. Do not backfill trenches or otherwise obscure piping until pressure testing of pipe section.
 2. Maintain pressurization of all piping during backfilling operations. Monitor pressure to recognize the indication of pipe breach or fusion failure during and after backfilling.
 3. Install warning tape 36" above all lateral piping.
 4. Backfill remaining trenches and compact according to Division 31 requirements.

3.4 POLYETHYLENE PIPING

- A. Install piping according to manufacturer's written instructions.
- B. Join piping and fittings using socket or butt heat fusion or electrofusion; do not use solvents, adhesives, or mechanical fittings.
- C. Provide flanges or unions to connect heat exchanger piping to equipment or piping of different type; locate all transitions between piping of different types inside the building or otherwise accessible (i.e., above grade).

- D. Keep dirt, water, and debris out of pipe assemblies; cap or plug open ends until connected to adjacent piping.
- E. Do not bend piping to shorter radius than recommended by pipe manufacturer; do not kink piping; use elbow or other fittings for sharp bends.
- F. Partially backfill radius bends in narrow trenches by hand to ensure that piping is properly supported and to prevent kinking.
- G. Testing: Perform hydrostatic test on all piping; portions of assembled piping may be tested separately.
 - 1. Prior to testing, isolate piping from all connections to building systems.
 - 2. Flush all dirt and debris using potable water flowing at twice the normal operating flow rate for a minimum of four hours or until no dirt or debris is visible, whichever is longer.
 - 3. Plug or cap piping.
 - 4. Pressurize piping to 100 psi for 30 minutes and monitor.
 - 5. If there is any pressure loss or visible leakage, identify leak and repair according to manufacturer's recommendations.
 - 6. Repeat test until there is no loss of pressure for the duration of the test.
- H. Where piping passes through foundation walls, provide sleeves sealed with non-hardening, waterproof material.

3.5 CLEANING AND PROTECTION

- A. During installation, ends of pipe shall be taped or capped until pipe is joined to circuit.
- B. Leave adjacent paved areas broom clean.
- C. Clear debris, including excess backfill and excavated dirt and rock, from heat exchanger area.
- D. Protect area during excavation from excess runoff and erosion.
- E. Protect pipe protrusions from damage until connections to building systems are installed.

3.6 FLUSHING, PURGING, PRESSURE TESTING AND CHARGING OF SYSTEM

- A. Consult component manufacturers written instructions and observe all safety precautions before performing any pressure test.
- B. Upon completion of the piping from building to each circuit of bores, utilize purging unit to remove debris and air. Flush circuits at not less than 70 GPM to ensure a fluid velocity of not less than 2 feet per second. Flush mains and each circuit repeatedly and at short intervals until twice the circuit water capacity has been flushed through.
- C. Test Pressure: Supply/return mains, manifold and each circuit shall be pressure tested at the lesser of (a) 150% of the design operating pressure provided that all components in the test section are rated for the test pressure, or (b) the pressure rating of the lowest pressure rated component in the test section.
- D. Test Duration: When testing at pressures above system design pressure, not exceeding 150% of the system design pressure, the maximum test duration is 8 hours including time to pressurize, time for initial expansion, time at test pressure, and time to de pressurize the test section. If the test is not completed due to leakage, equipment failure, or for any other reason, de pressurize the test section completely and allow it to relax for at least 8 hours before pressurizing the test section again. CAUTION: Testing at excessive pressure or for excessive time may damage the piping system.
- E. Test Fluid: The recommended test medium is water. Pneumatic testing is not approved.

- F. Test Procedures: Gradually pressurize the test section to test pressure and maintain for 3 hours. Additional water will be required to maintain pressure as pipe will expand slightly. It is not necessary to monitor the amount of water added during this initial expansion phase. Immediately after 3 hours have elapsed, reduce test pressure by 10 psi and stop adding water. If pressure remains within 5% of target value for 1 additional hour, no leakage is indicated.
- G. After all circuits have been connected to manifold, flushed and purged of air, open all valves and flush entire system again with clean water.
- H. Provide purified water: Use either distilled or deionized fluids for dilution.
- I. Inhibited Propylene Glycol Charging: Follow all manufacturer's instructions for product handling.
 - 1. Circuits: Isolate and charge one circuit at a time. Close all main valves and all other circuits. Gradually introduce Inhibited Propylene Glycol solution, through the fill port, until a concentration of 25% is obtained. Repeat procedure for each remaining circuit.
 - 2. Mains: Close valves to all circuits, isolate and charge one pair of mains at a time. Open valves on primary supply/return mains in mechanical room. Open bypass valve in mechanical room. Repeat procedure for auxiliary mains.
 - 3. Allow untreated water to be displaced from the system as solution is introduced. Handle discharged water according to manufacturer's recommendations, state, and local regulations.
 - 4. While charging, repeatedly check concentration at manifold to minimize product loss. Immediately discontinue introducing solution when testing confirms a concentration of 25%.
- J. Charge system to a fill pressure between 18 - 20 psig.
- K. Install system label at charging valves, indicating:
 - 1. Heat exchanger fluid, including antifreeze type and concentration.
 - 2. Service date.
 - 3. Company name.
 - 4. Company phone number and responsible person.

3.7 PIPING SYSTEM TEST REPORT

Date Submitted: _____

Project Name: _____

Location: _____ Project No: _____

Contractor: _____

☐ HVAC	☐ Refrigeration	☐ Controls
☐ Power Plant	☐ Plumbing	☐ Sprinkler

Test Medium: ☐ Air ☐ Water ☐ Other _____

Test performed per specification section No. _____

Specified Test Duration _____ Hours Specified Test Pressure _____ psig

System Identification: _____

Describe Location: _____

Test Date: _____	
Start Test Time: _____	Initial Pressure: _____ psig
Stop Test Time: _____	Final Pressure: _____ psig

Tested By: _____ Witnessed By: _____

Title: _____ Title: _____

Signed: _____ Signed: _____

Date: _____ Date: _____

Comments: _____

3.8 PIPING SYSTEM FLUSH REPORT

Date Submitted: _____

Project Name: _____

Location: _____ Project No: _____

Contractor: _____

System Identification (check one):

☐ Heating Hot Water

☐ Chilled Water

☐ Geothermal Water

☐ Heat Reclaim

☐ Process Chilled Water

☐ Other _____

Describe Procedure: _____

Flush Date: _____ Start Time: _____ Stop Time: _____

Pressure of Water Source: _____ psig

Describe water source and method of connection to source: _____

Flushed By: _____ Witnessed By: _____

Title: _____ Title: _____

Company: _____ Company: _____

Signed: _____ Signed: _____

Date: _____ Date: _____

Describe results: _____

END OF SECTION 23 21 12

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section contains specifications for all HVAC hydronic pipe and pipe fittings for this project. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Delivery, Storage, and Handling
 - 9. Design Criteria
 - 10. Welder Qualifications
- C. PART 2 - Products
 - 1. Heating Hot Water
 - 2. Chilled Water
 - 3. Makeup Water
 - 4. Vents and Relief Valves
 - 5. Cooling Coil Condensate
 - 6. Unions and Flanges
 - 7. Gaskets
 - 8. Mechanical Grooved Pipe Connections
- D. PART 3 - EXECUTION
 - 1. Erection
 - 2. Welded Pipe Joints
 - 3. Threaded Pipe Joints
 - 4. Mechanical Grooved Pipe Connections
 - 5. Copper Pipe Joints
 - 6. Water Systems
 - 7. Makeup Water
 - 8. Vents and Relief Valves
 - 9. Cooling Coil Condensate
 - 10. Unions and Flanges
 - 11. Gaskets
 - 12. Piping System Leak Tests
 - 13. Hydronic Piping System Flushing

- 14. Initial Fill and Vent
- 15. Piping System Test Report
- 16. Piping System Flush Report

1.2 RELATED WORK

- A. Section 23 05 23 - General-Duty Valves for HVAC Piping
- B. Section 23 05 15 - Piping Specialties
- C. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- D. Section 23 07 00 - HVAC Insulation
- E. Section 23 25 00 - HVAC Water Treatment

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ANSI B16.3 Malleable Iron Threaded Fittings
- B. ANSI B16.4 Cast Iron Threaded Fittings
- C. ANSI B16.5 Pipe Flanges and Flanged Fittings
- D. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
- E. ASME B16.51 Copper and Copper Alloy Press-Connect Pressure Fittings
- F. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
- G. ASTM A74 Cast Iron Soil Pipe and Fittings
- H. ASTM A105 Forgings, Carbon Steel, for Piping Components
- I. ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings
- J. ASTM A181 Forgings, Carbon Steel for General Purpose Piping
- K. ASTM A197 Cupola Malleable Iron
- L. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- M. ASTM A380 Practice for Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems
- N. ASTM B75 Seamless Copper Tube
- O. ASTM B88 Seamless Copper Water Tube
- P. ASTM F1476 Performance of Gasketed Mechanical Couplings for Use in Piping Applications

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and according to the appropriate ASTM specification.

- B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.
- C. All grooved joint couplings, fittings, valves, and specialties shall be of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- D. All castings used for fittings, couplings, valve bodies, etc., shall include a cast date stamp for quality assurance and traceability.
- E. Installers of Press-Connect Joints: Installers shall be certified by press-connect joint manufacturer as having been trained and qualified to join piping with press-connect pipe couplings and fittings.
- F. Installer shall be a qualified installer, licensed within the jurisdiction, and familiar with the installation of press joint systems.
- G. Press fittings shall be installed using proper tool, actuator, jaws, and rings as instructed by the press fitting manufacturer.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.
- C. TYPE F STEEL PIPE: Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification contained in this section.
- D. TYPE E OR S STEEL PIPE: Mill certification papers, also known as material test reports, for the pipe furnished for this project, in English. Heat numbers on these papers to match the heat numbers stenciled on the pipe. Chemical analysis indicated on the mill certification papers to meet or exceed the requirements of the referenced ASTM specification.
- E. COPPER TUBE: Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification contained in this section.
- F. Grooved joint couplings and fittings shall be referred to on drawings and product submittals and shall be identified by the manufacturer's style or series designation. Trade names and abbreviations are not acceptable.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
- B. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- D. Storage and protection methods must allow inspection to verify products.

1.9 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system according to ANSI B31, but not less than 125 psig unless specifically indicated otherwise.
- C. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

- D. Where ASTM A53 type F pipe is specified, ASTM A53 grade A type E or S, or ASTM A53 grade B type E or S may be substituted at contractor's option. Where ASTM A53 grade A pipe is specified, ASTM A53 grade B pipe may be substituted at contractor's option. Where the grade or type is not specified, contractor may choose from those commercially available.
- E. Where ASTM B88, type L hard temper copper tubing is specified, ASTM B88, type K hard temper copper tubing may be substituted at contractor's option.

1.10 WELDER QUALIFICATIONS

- A. Before any metallic welding is performed, the contractor shall submit his Standard Welding Procedure Specifications, Procedure Qualification Records and Qualification Test Records for each Welder along with associated continuity records to demonstrate compliance with ASME Section IX, paragraph QW-322.
- B. The contractor shall maintain a complete set of welder qualification documents at the jobsite, including Test Records and Continuity Records for each welder.
- C. The A/E reserves the right to test the work of any welder employed on the project, at the contractor's expense. Testing will include a visual examination of the pipe and weld and may include radiography of any suspect welds. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project. Any welds deemed unacceptable will be repaired at the contractor's expense.

PART 2 - PRODUCTS

2.1 HEATING HOT WATER

- A. 2" and Smaller: ASTM A53, type F, standard weight (schedule 40) black steel pipe with ASTM A126/ANSI B16.4, class 125, standard weight cast iron threaded fittings or ASTM F3226 carbon steel press-connect fittings with EPDM or FKM sealing element, stainless steel separator and grip ring, and smart connect technology suitable for 200 psig working pressure at 250°F (Viega MegaPress).
- B. 2-1/2" and Larger: ASTM A53, standard weight (schedule 40) black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings or ASTM F3226 carbon steel press-connect fittings (2½" to 4") with EPDM or FKM sealing element, stainless steel separator and grip ring, and smart connect technology suitable for 200 psig working pressure at 250°F (Viega MegaPress).
- C. Contractor may use ASTM B88 seamless, type L, hard temper copper tube in lieu of steel pipe for all sizes with ANSI B16.22 wrought copper solder-joint fittings or ASME B16.51/ASTM F3226 copper or bronze press-connect fittings (½" to 4") with EPDM sealing element, stainless steel separator and grip ring, and smart connect technology suitable for 300 psig working pressure at 250°F (Viega ProPress). Mechanically formed tee fittings may be used in lieu of wrought copper solder-joint tee fittings for branch takeoff up to one-half (1/2) the diameter of the main.

2.2 CHILLED WATER

- A. 2" and Smaller: ASTM A53, type F, standard weight (schedule 40) black steel pipe with ASTM A126/ANSI B16.4, class 125, standard weight cast iron threaded fittings or ASTM F3226 carbon steel press-connect fittings with EPDM or FKM sealing element, stainless steel separator and grip ring, and smart connect technology suitable for 200 psig working pressure at 250°F (Viega MegaPress).
- B. 2-1/2" and Larger: ASTM A53, standard weight (schedule 40) black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings or ASTM F3226 carbon steel press-connect fittings (2½" to 4") with EPDM or FKM sealing element, stainless steel separator and grip ring, and smart connect technology suitable for 200 psig working pressure at 250°F (Viega MegaPress).

- C. Contractor may use ASTM B88 seamless, type L, hard temper copper tube in lieu of steel pipe for all sizes with ANSI B16.22 wrought copper solder-joint fittings or ASME B16.51/ASTM F3226 copper or bronze press-connect fittings (½" to 4") with EPDM sealing element, stainless steel separator and grip ring, and smart connect technology suitable for 300 psig working pressure at 250°F (Viega ProPress). Mechanically formed tee fittings may be used in lieu of wrought copper solder-joint tee fittings for branch takeoff up to one-half (1/2) the diameter of the main.

2.3 MAKEUP WATER

- A. Extend from where left by the Plumbing Contractor with the same materials.

2.4 VENTS AND RELIEF VALVES

- A. Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

2.5 COOLING COIL CONDENSATE

- A. ASTM B88, type L hard temper copper tubing with ASTM B145/ANSI B16.23 cast red bronze or ASTM B75/ANSI B16.29 wrought solder-type drainage fittings.

2.6 UNIONS AND FLANGES

- A. 2" and Smaller: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use ANSI B16.18 cast copper alloy unions on copper piping. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service but not less than 250 psi.
- B. 2-1/2" and Larger: ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding and of a pressure class compatible with that specified for valves, piping specialties and fittings of the respective piping service. Flanges smaller than 2-1/2" may be used as needed for connecting to equipment and piping specialties. Use raised face flanges ANSI B16.5 for mating with other raised face flanges on equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.
- C. Unions and flanges for servicing or disconnect are not required on installations using grooved joint couplings. The couplings shall serve as disconnect points.

2.7 GASKETS

- A. Water and Glycol Systems: Branded, compressed, non-asbestos sheet gaskets. Klingersil C4401, Garlock 3000, JM Clipper 978 or approved equal.

2.8 MECHANICAL GROOVED PIPE CONNECTIONS

- A. Manufacturers: Victaulic, Anvil Corp., or Tyco/Grinnell.
- B. Mechanical grooved pipe couplings and fittings may be used with steel pipe on the systems indicated below. Either cut-groove or equivalent roll-groove products are acceptable providing the system temperature and pressure requirements are met. Where ductile iron fittings are indicated, they shall conform to ASTM A536. Where forged steel fittings are indicated, they shall conform to ASTM A234, Grade WPB. Where factory-fabricated steel fittings are indicated, they shall be manufactured from pipe conforming to ASTM A53, type F in sizes ¾" through 1-1/2" and type E or S, grade B in sizes 2" through 20". Do not use fabricated fittings where malleable iron or forged steel fittings are available. Gaskets in all cases shall be EPDM suitable for temperatures to 230°F.
- C. The following services may use mechanical grooved pipe connections within the building in mechanical spaces and above accessible ceilings. Mechanical chases are not considered accessible unless approved by the engineer.
- Heating Hot Water
 - Chilled Water
 - Geothermal Water (Interior)
- D. Mechanical grooved pipe connections shall not be used in below grade utility distribution systems.

- E. Mechanical grooved pipe connections shall not be used in chilled water piping between the cooling coil and the isolation valve for that cooling coil.
- F. Fittings and couplings must be suitable for the temperature and pressure involved. In no case is the final system to have a pressure rating of less than 250 psig at the design temperature of the fluid.
- G. Acceptable fittings and couplings are listed below, based on Victaulic. When used on galvanized piping, fittings and couplings shall be galvanized. When used on black steel piping, fittings and couplings shall have an enamel coating.
 - 1. Ductile iron standard couplings: Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12, with pressure-responsive elastomer gasket conforming to ASTM D-2000, and zinc-electroplated carbon steel bolts and nuts conforming to ASTM A-449 and ASTM A-183. Couplings shall comply with ASTM F1476.
 - 2. Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging according to ANSI B31.1, and B31.9. Victaulic Style 107H/107N (Quick-Vic™). Installation ready rigid coupling for direct stab installation without field disassembly. Gasket shall be Grade "EHP" EPDM designed for operating temperatures from -30 deg F to +250 deg F.
 - 3. Flexible Type: Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors at equipment connections. Three couplings, for each connector, shall be placed in close proximity to the vibration source. Victaulic Installation-Ready Style 177 or Style 77.
 - 4. Victaulic AGS Mechanical Couplings, 14 inch (DN350) through 60 inch (DN1500): Couplings shall consist of two housing segments with lead-in chamfer on the housing key, a wide elastomer pressure responsive FlushSeal gasket. Victaulic Style W07 (rigid) and Style W77 (flexible).
- H. Couplings: Reducing couplings are not acceptable.
- I. Flanges: Ductile iron Style 741 / W741 or 743 except at lug type butterfly valves where standard welding flanges shall be used.
- J. Fittings: Ductile iron elbows and tees of the manufacturer's standard line may be used in all sizes except bullhead tees will not be accepted. Factory-fabricated steel fittings may be used in all sizes where fitting wall thickness conforms to standard weight pipe. Mechanical-T Style 920/920N fittings with ductile iron housings may be used for up to 2" outlet size.

PART 3 - EXECUTION

3.1 ERECTION

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be rejected and removed from the job site immediately. Excluding minor surface rust, piping that exhibits significant oxidation or corrosion will be rejected.
- B. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any item that is not clean.
- C. Remove all loose dirt, scale, oil, chips, burrs and other foreign material from the internal and external surfaces of all pipe and piping components prior to assembly, including debris associated with cutting, threading and welding.
- D. During fabrication and assembly, remove slag and weld spatter from internal pipe surfaces at all joints by peening, chipping and wire brushing.

- E. During construction, until system is fully operational, keep all openings in piping and equipment closed except when actual work is being performed on that item of the system. Use plugs, caps, blind flanges or other items designed for this purpose.
- F. Furnish and install all flanges, caps, bypasses, drains, valves, etc. required to facilitate flushing and draining all heating and cooling system piping.
- G. Unions and flanges for servicing or disconnect are not required on installations using grooved joint couplings. The couplings shall serve as disconnect points.
- H. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- I. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.
- J. "Weldolets" and "Thredolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main.
- K. Install drains throughout the systems to permit complete drainage.
- L. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment
- M. Install all valves, control valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

3.2 WELDED PIPE JOINTS

- A. Make all welded joints by fusion welding according to ASME Codes, ANSI B31, and State Codes where applicable.
- B. All pipe welding shall be completed by Qualified Welders according to the Contractor's Procedure Specifications.
- C. Contractor will ensure that these steps are followed where pipe sections will be joined by welding:
 - 1. Cleaning – Welding surfaces will be clean and free of defects.
 - 2. Alignment – Inside diameter of piping components will be aligned as accurately as possible. Internal misalignment shall not exceed 1/16".
 - 3. Spacing – Pipe sections will be spaced to allow deposition of weld filler material through the entire weld joint thickness.
 - 4. Girth Butt Welds:
 - a. Girth butt welds shall be complete penetration welds.
 - b. Concavity will not exceed 1/32"
 - c. Under cuts will not exceed 1/32"
 - d. As welded surfaces are permitted however surfaces will be free from coarse ripples, grooves, abrupt ridges and valleys.
- D. Electrodes shall be Lincoln, or approved equal, with coating and diameter as recommended by the manufacturer for the type and thickness of work being done.

3.3 THREADED PIPE JOINTS

- A. Use a Teflon based thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.4 MECHANICAL GROOVED PIPE CONNECTIONS

- A. Use pipe factory grooved according to the coupling manufacturer's specifications or field grooved pipe according to the same specifications using specially designed tools available for the application.
- B. Lubricate pipe and coupling gasket, align pipe, and secure joint according to the coupling manufacturer's specifications.
- C. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
- D. Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer.
- E. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.
- F. Support pipe as indicated in Section 23 05 29 of these specifications except as modified below. Support each horizontal pipe section at least once between couplings and whenever a change in direction of line flow takes place. Support vertical pipe at every other floor or every other pipe length, whichever is most frequent. Set the base of the riser or the base fitting on a pedestal or foundation.
- G. Follow coupling manufacturer's installation recommendations if they are more stringent than the above requirements.

3.5 COPPER PIPE JOINTS

- A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux, and assemble joint. Use 95-5 solder or brazing to secure joint as specified for the specific piping service.
- B. Press-Connect Joints for Copper Tubing: Join copper tube and press-connect fittings with tools recommended by fitting manufacturer.
 - 1. Pipe ends must be marked at the required location, using a manufacturer-supplied gauge, to ensure full insertion into the coupling or fitting during assembly.
 - 2. Pipe shall be square cut, properly deburred, and cleaned.
 - 3. Utilize press tool approved by fitting manufacturer.
- C. Where mechanically formed tee fittings are allowed, form mechanically extracted collars in a continuous operation, consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. Use an adjustable collaring device. Notch and dimple the branch tube. Braze the joint, applying heat properly so that pipe and tee do not distort; remove distorted connections.

3.6 WATER SYSTEMS

- A. Run water mains level or pitch horizontal mains up 1 inch in 40 feet in the direction of flow. Install manual air vents at all high points where air may collect. If vent is not in an accessible location, extend air vent piping to the nearest code acceptable drain location with vent valve located at the drain.
- B. Main branches and runouts to terminal equipment may be made at the top, top 45 degree, side, and/or bottom 45 degree of the main provided that there are drain valves suitably located for complete system drainage and manual air vents are located at all top and top 45 degree connections.
- C. Use top or top 45 degree connection to main for upfeed risers and bottom 45 degree connection to main for downfeed risers.

- D. Use a minimum of two elbows in each pipe line to a piece of terminal equipment to provide flexibility for expansion and contraction of the piping systems. Offset pipe connections at equipment to allow for service, such as removal of the terminal device.
- E. Use eccentric fittings for changes in horizontal pipe sizes with the fittings installed for proper air venting. Concentric fittings may be used for changes in vertical pipe sizes.

3.7 MAKEUP WATER

- A. Install where indicated and/or specified, including all valves, piping specialties and dielectric unions required for a functional system.

3.8 VENTS AND RELIEF VALVES

- A. Install vent and relief valve discharge lines as indicated on the drawings, as detailed, and as specified for each specific valve or piping specialty item. In no event is a termination to occur less than six feet above a roof line.

3.9 COOLING COIL CONDENSATE

- A. Trap each cooling coil drain pan connection with a trap seal of sufficient depth to prevent conditioned air from moving through the piping. Extend drain piping to nearest code approved drain location. Construct trap with plugged tee for cleanout purposes as detailed.

3.10 UNIONS AND FLANGES

- A. Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

3.11 GASKETS

- A. Store horizontally in cool, dry location and protect from sunlight, water and chemicals. Inspect flange surfaces for warping, radial scoring or heavy tool marks. Inspect fasteners, nuts and washers for burrs or cracks. Replace defective materials.
- B. Align flanges parallel and perpendicular with bolt holes centered without using excessive force. Center gasket in opening. Lubricate fastener threads, nuts and washers with lubricant formulated for application.
- C. Draw flanges together evenly to avoid pinching gasket. Tighten fasteners in cross pattern sequence (12 – 6 o'clock, 3 – 9 o'clock, etc.), one pass by hand and four passes by torque wrench at 30% full torque, 60% full torque and two passes at full torque per ASME B16.5.

3.12 PIPING SYSTEM LEAK TESTS

- A. Verify that the piping system being tested is fully connected to all components and that all equipment is properly installed, wired, and ready for operation. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.
- B. Provide all piping, fittings, blind flanges, and equipment to perform the testing.
- C. Conduct pressure test with test medium of water as indicated. Minimum test time is indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by the Owner or Owner's representative. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.
- D. Do not insulate pipe until it has been successfully tested.
- E. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

System	Pressure	Medium	Duration
Heating Hot Water	100 psig	Water	8 hr
Chilled Water	100 psig	Water	8 hr
Geothermal Water	100 psig	Water	8 hr

F. All pressure tests are to be documented on the form included in this specification.

3.13 HYDRONIC PIPING SYSTEM FLUSHING

- A. All new chilled water and heating hot water system piping shall be flushed thoroughly before the systems are put in to operation. Subsequent to executing the chemical cleaning processes specified in Section 23 25 00 – HVAC WATER TREATMENT, and prior to adding scale and corrosion inhibitors, flush all piping and components with a clean source of water until the discharge from the system is clean. Discharge shall be from drains provided at all low points in the piping, ends of headers and as otherwise necessary to flush and drain the entire system.
- B. Project specific procedures shall be established prior to flushing. Before beginning flushing operations, submit proposed flushing procedures to the Owner's Project Representative for review and approval. Provide sufficient notice to the Owner to allow the flushing operations to be observed.
- C. A clean water source shall be tapped into the system downstream of the main circulation pump(s). Contractor shall identify proposed clean water source along with the method/location of drain discharge and review with the Owner and A/E prior to installing flushing connections to water source and drain outlets. Provide code required temporary backflow prevention for the clean water source if needed. Provide all temporary taps, valves, piping, bypasses and hoses as needed to accomplish flushing procedures.
- D. Flushing sequence for hot water and chilled water systems is as follows:
 1. Close isolation valves at all coils and wall fin.
 2. Open the temporary bypasses that connect the ends of supply and return mains.
 3. Flush mains by turning on flushing water source and sequentially opening drains on mains on each floor until the discharge is clean. This will flush the mains without forcing water/debris into the branches and run out pipes.
 4. Close isolation valves located downstream of coils/wall fin.
 5. Open isolation valves located upstream of coils/wall fin.
 6. Open individual drain valves upstream of coils/wall fin until the discharge is clean. This will flush the supply branch and run out lines between the mains and the coils/wall fin without running water/debris through the TCV or coils/wall fin.
 7. Close the individual drain valves upstream of coils/wall fin.
 8. Open drain valves at low points in the return piping mains.
 9. Open the individual isolation valves located downstream of the coils/wall fin. This will flush the return branch and run out lines located between the coils/wall fin and the mains back into the mains and out the drains on the return mains. The water going through the coil/wall fin should be already be clean since this section was flushed previously.
 10. Repeat steps 1-3 to clean debris from the mains.
- E. Isolate all coils while flushing risers and mains. Flush the mains on each floor individually, starting at the top of the building and working down towards the basement level. After risers and mains have been flushed clean, individually open the drain valves in each branch circuit to discharge any debris that may have accumulated in the branch piping.

- F. As directed by Owner, the Contractor will be required to open drain valves at selected locations in the system to verify the effectiveness of flushing procedures. If sediment or debris is identified in the system, it will be flushed again and reinspected at no expense to the Owner.
- G. After flushing operations are complete, drain and/or blow out any residual water, clean and replace all strainers, and add scale and corrosion inhibitors as specified in Section 23 25 00. Leave flushing connections/valves in place and cap.
- H. All flushing procedures shall be documented by completing and submitting the report form included at the end of this Section.

3.14 INITIAL FILL AND VENT

- A. Fill hydronic systems with appropriate working fluids as specified. All system fluids shall be chemically treated as specified in Section 23 25 00 – HVAC WATER TREATMENT.
- B. For closed piping systems, all air trapped at high points shall be relieved through the manual air vents prior to notifying T&B Contractor that the systems are ready to be tested and balanced.

3.15 PIPING SYSTEM TEST REPORT

Date Submitted: _____

Project Name: _____

Location: _____ Project No: _____

Contractor: _____

☐ HVAC	☐ Refrigeration	☐ Controls
☐ Power Plant	☐ Plumbing	☐ Sprinkler

Test Medium: ☐ Air ☐ Water ☐ Other _____

Test performed per specification section No. _____

Specified Test Duration _____ Hours Specified Test Pressure _____ psig

System Identification: _____

Describe Location: _____

Test Date: _____	
Start Test Time: _____	Initial Pressure: _____ psig
Stop Test Time: _____	Final Pressure: _____ psig

Tested By: _____ Witnessed By: _____

Title: _____ Title: _____

Signed: _____ Signed: _____

Date: _____ Date: _____

Comments: _____

3.16 PIPING SYSTEM FLUSH REPORT

Date Submitted: _____

Project Name: _____

Location: _____ Project No: _____

Contractor: _____

System Identification (check one):

☐ Heating Hot Water

☐ Chilled Water

☐ Heat Pump Water

☐ Heat Reclaim

☐ Process Chilled Water

☐ Other _____

Describe Procedure: _____

Flush Date: _____ Start Time: _____ Stop Time: _____

Pressure of Water Source: _____ psig

Describe water source and method of connection to source: _____

Flushed By: _____ Witnessed By: _____

Title: _____ Title: _____

Company: _____ Company: _____

Signed: _____ Signed: _____

Date: _____ Date: _____

Describe results: _____

END OF SECTION 23 21 13

SECTION 23 21 17 - ANTIFREEZE (GROUND LOOP HEAT EXCHANGER)

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for chemical treatment of the ground loop heat exchanger (geothermal) systems. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Reference
 - 3. Related Work
 - 4. Federal Bidding Requirements
 - 5. Quality Assurance
 - 6. Submittals
 - 7. Operation and Maintenance Data
 - 8. Design Criteria
 - 9. Contractor Requirements
 - 10. Maintenance Service
 - 11. Delivery, Storage, and Handling
 - 12. Warranty
- C. PART 2 - Products
 - 1. Inhibited Propylene Glycol Specifically Manufactured for Geothermal Systems
 - 2. Prohibited Materials
- D. PART 3 - EXECUTION
 - 1. System Cleaning and Flushing

1.2 REFERENCE

- A. Applicable provisions of Division 1 shall govern work under this Section.

1.3 RELATED WORK

- A. Section 23 05 15 - Piping Specialties
- B. Section 23 21 12 - Ground-Loop Heat Exchanger
- C. Section 23 21 13 - Hydronic Piping
- D. Section 23 21 23 - Hydronic Pump

1.4 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.5 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions

1.6 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Required for all equipment and chemicals specified including data concerning dimensions, capacities, materials of construction, weights, operating sequence, composite wiring diagrams and appropriate identification. Chemical data to include the description of the chemical, its composition, its function, and the associated material safety data sheet.

1.7 OPERATION AND MAINTENANCE DATA

- A. Provide for the services of the manufacturer's trained representative to approve the installation and instruct the Owner in the operation of each system.
- B. Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.8 DESIGN CRITERIA

- A. All system materials in contact with Inhibited Propylene Glycol heat transfer fluid in normal use, testing, repair or servicing shall be fully compatible with 25% by volume propylene glycol and the inhibitors, antifoam additives, buffers and dyes contained in the propylene heat transfer fluid at the temperatures and pressures in the system. Fully compatible in this paragraph means free from corrosion within the limits of ASTM Standard D1384, free from erosion and scaling, free from fluid leaks, capable of performing the stated or implied function without binding, sticking or plugging, free from degradation of system materials, leaching of the system materials or degradation of the ethyl alcohol solution and the inhibitors. Only premix is allowed.
- B. Manual valves, gauge valves, pressure-temperature taps and other components in the system shall not require periodic "exercising" in order to maintain function or leak tightness.
- C. The seating materials of all valves shall be compatible with the propylene glycol. Valves include but are not limited to isolation valves, control valves, pressure relief valves, balancing and check valves.
- D. The contractor shall inform all manufacturers and suppliers of propylene glycol system components of the specific fluid to be used in the system and shall obtain written acknowledgement from the supplier that material and components are fully 20 year compatible with the fluid.
- E. Mechanical and Geothermal Contractor shall coordinate on using the same brand of antifreeze for interior and exterior

1.9 CONTRACTOR REQUIREMENTS

- A. Geothermal Loop Field Contractor requirements:
 - 1. Provide final fill of antifreeze and de-ionized water for the entire loop field and interior header.
 - 2. Responsible for flushing and purging entire loop field.
 - 3. Provide documentation to mechanical contractor stating total loop field system volume, gallons of inhibited propylene glycol added to system, and final freeze protection test results.
- B. Mechanical Contractor requirements:
 - 1. Comply with all provisions of inhibited propylene glycol system specifications unless specifically stated differently.
 - 2. Provide final fill of Inhibited Propylene Glycol and de-ionized water for the entire interior geothermal piping system starting at interior Geothermal manifold.
 - 3. Responsible for flushing and purging entire interior geothermal piping system starting at interior Geothermal manifold.

4. Responsible for documenting TOTAL system volume, TOTAL gallons of pre-mix Inhibited Propylene Glycol added to system, and final freeze protection test results. This shall include all interior and exterior piping.
5. Mechanical Contractor is ultimately responsible for entire geothermal system once project is completed

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of treatment systems for one year from date of substantial completion. Mechanical Contractor shall re-pressurize the system as required for a period of one year; add required solution to achieve proper system pressure.
- B. Provide technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Provide a dolly suitable for transporting 55 gallon drums from the loading dock to the charging station. Dollies shall be suitable for storing a drum in the horizontal position so that solution may be drained into a transfer pail.
- B. Provide a 15 gallon plastic transfer pail.

1.12 WARRANTY

- A. The manufacturer shall provide yearly solution laboratory analysis at no cost. The analysis shall accurately report propylene glycol concentration, freeze point temperature, inhibitor level, alkalinity, particulate and recommended additions of propylene glycol, inhibitor and buffers to ensure twenty year minimum fluid life
- B. Mechanical Contractor shall replace Inhibited Propylene Glycol solution lost from the system from any cause other than neglect by the owner or building operators during the first year of operation.
- C. Maintain a log of Inhibited Propylene Glycol replacement quantities and dates.
- D. If Inhibited Propylene Glycol solution loss in the first year of operation after acceptance is greater than 0.5% of the system volume, make necessary corrections to the system to eliminate future fluid loss. In addition, repair or replace all defective manual valves, automatic valves, pipe fittings, gaskets and flanges and pressure temperature taps which leak within warranty period.
- E. Mechanical Contractor to recharge the entire system after 6 months, one year, or as required to original fill pressure.

PART 2 - PRODUCTS

2.1 INHIBITED PROPYLENE GLYCOL SPECIFICALLY MANUFACTURED FOR GEOTHERMAL SYSTEMS

- A. Manufacturers: Dowfrost Geo 20, Wausau Chemical Company, Interstate Chemical Company, or approved equal.
- B. Product:
 1. Industrial grade inhibited pre-mix propylene glycol heat transfer fluid approved and listed for use as a heat transfer/antifreeze with geothermal systems.
 2. Containing corrosion inhibitors specifically formulated for cool storage service to keep internal surfaces free from corrosion and fouling and shall include buffers, reserve alkalinity agents, antifoaming additives, and a fluorescent dye to aid in leak detection.
 3. The solution shall be easily reinhibited using specially formulated inhibitor readily available from the fluid manufacturer.
 4. The fluid has a NFPA rating of 0 (least risk).
- C. Concentration: 25% by volume, as installed, to provide freeze protection to 15 degrees F.

- D. Performance:
1. Viscosity is no more than 5.00 centipoise at 30°F with blend for 15°F freeze protection.
 2. Specific Heat is 1.05 at 70°F freeze protection.
 3. Specific Gravity is 0.982 at 50°F with blend for 15°F freeze protection.
 4. Pressure drop and Reynold's Number for a 3 gpm flow in ¾" IPS SDR11 PE pipe of a 30°F mixture for a freeze protected blend is no more than 2.83 feet of hd per 100 feet of pipe and no less than RE=2028 respectively.
- E. Corrosion:
1. Conforming to ASTM D-1384 with less than 0.5 mils penetration per year.
 2. Compatible with High-Density Polyethylene, iron, copper, red and yellow brass, polyEnvironol, PVC, viitron, buna "N", neoprene, and nylon, and contains an oxygen scavenger blend to reduce any corrosion capability. It does not have low surface tension to prevent leakage.
- F. Prohibited materials shall not be allowed in the system during installation, testing, operation or service.

2.2 PROHIBITED MATERIALS

- A. The following are prohibited for use in the propylene glycol system:
1. Galvanized pipe valves or fittings or any other component utilizing galvanizing or zinc-bearing materials. Solders containing zinc.
 2. Chromates.
 3. Automobile antifreeze or automotive glycol.
 4. Lubricated plug valves.
 5. Any petroleum-based solution in the mixture.
 6. Any solutions containing silicates, chlorides, sulfates, acetone, paint thinner.
 7. Direct connection to a water supply either through a valve or a pressure reducing valve to prevent dilution of the heat transfer fluid and to comply with cross-connection restrictions in codes. Manual filling helps ensure that operators check the system for leaks and replenish lost fluid with premixed and properly inhibited industrial grade ethyl alcohol.
 8. Automatic air vents. Exception - a high quality industrial grade automatic air vent may be located at the system air separation device.

PART 3 - EXECUTION

3.1 SYSTEM CLEANING AND FLUSHING

- A. Provide temporary fine mesh screens inside strainer baskets for startup cleaning. Replace these screens when clogged and remove at the conclusion of cleaning
- B. The system shall be thoroughly flushed using clean water and circulated for a minimum of 72 hours at which time water samples shall be taken by the cleaning specialist who shall certify that the system is free of particulate, mil scale, weld scale, solder flux, rust, metal filings, oil, grease, chlorides, sulphates, silicates and other foreign matter that could degrade the ethyl alcohol.
- C. If industrial premixed inhibited propylene glycol concentrate is to be used, it shall be diluted and mixed prior to introducing it into the system.
- D. Dilution water must meet these standards: Less than 25 parts per million chloride, less than 25 parts per million sulfate, less than 50 parts per million hard water ions (Ca+Mg++).

- E. After the system is charged with approved heat transfer fluid, air is eliminated from the system, and the heat transfer fluid is circulated for 72 hours through all components, the contractor shall test and adjust the concentration to achieve 25% by volume inhibited propylene glycol. Contractor shall take fluid samples after initial charging, three months, six months and twelve months of fluid installation, have samples analyzed by the antifreeze manufacturer, adjust fluid concentrations, inhibitor, buffer and reserve alkalinity levels as recommended by the manufacturer and forward copies of each analysis sheet and subsequent contractor corrective action to the owner. If the antifreeze manufacturer recommends particulate filtering, the contractor shall provide filtering equipment and filters as recommended by the antifreeze manufacturer and provide continuous filtering and treatment until the solution meets the manufacturer's standards.

END OF SECTION 23 21 17

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for water pumps used for HVAC applications. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Federal Bidding Requirements
 - 5. Quality Assurance
 - 6. Submittals
 - 7. Operation and Maintenance Data
 - 8. Design Criteria
- C. PART 2 - Products
 - 1. Vertical In-Line Centrifugal Pumps (Close Coupled)
 - 2. Small In-Line Pumps
 - 3. Wet Rotor Circulators (ECM)
 - 4. Dry Rotor Circulators (ECM)
- D. PART 3 - EXECUTION
 - 1. Installation

1.2 RELATED WORK

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.5 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.6 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Include data concerning dimensions, capacities, materials of construction, ratings, weights, pump curves with net positive suction head requirements, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.
- C. Pump curves shall identify design point of operation.

1.7 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.8 DESIGN CRITERIA

- A. Pump sizes, capacities, pressures and operating characteristics shall be as scheduled.
- B. Pumps shall meet or exceed operating efficiencies scheduled.
- C. Provide all pumps with motors, impellers, drive assemblies, bearings, coupling guard, and other accessories specified. Statically and dynamically balance all rotating parts. Provide flanged connections on all pumps unless specified otherwise. Service or repair of base mounted pumps shall not require breaking piping connections or removal of motor.
- D. Where a pump is specified for parallel operation, the scheduled conditions are for that pump with both pumps operating; i.e., total system flow rate is twice that scheduled for a single pump. When only one of the parallel pumps is operating, the operating point of that pump must fall within the manufacturer's recommended operating range.
- E. Provide pump with a motor sized for non-overloading over the entire pump curve. Motors to be 1750 rpm unless specified otherwise.
- F. Furnish each pump and motor with a nameplate giving the manufacturer's name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current.
- G. Test all pumps, clean and paint before shipment. The manufacturer shall certify all pump ratings.
- H. All pumps to operate without excessive noise or vibration.
- I. After completion of balancing, provide replacement of impellers, or trim impellers to provide specified flow at actual pumping head, as installed.
- J. Furnish one spare seal and casing gasket for each pump to Owner.
- K. Provide bearing protection grounding rings for motors used on variable frequency drives as specified in Section 23 05 13.

PART 2 - PRODUCTS

2.1 VERTICAL IN-LINE CENTRIFUGAL PUMPS (CLOSE COUPLED)

- A. Manufacturers: Armstrong, Bell and Gossett, Taco, Grundfos, or approved equal.
- B. Type: Single stage, direct connected, resiliently mounted motor for in-line mounting, oil lubricated, 175 psig maximum working pressure at operating temperature of 225°F. continuous, 250°F. intermittent.
- C. Casing: Cast iron or stainless steel; flanged suction and discharge connection; with plugged taps for vent, drain, suction and discharge gauges.
- D. Impeller: Brass or bronze, keyed to the shaft, single suction enclosed type, hydraulically and dynamically balanced.
- E. Shaft: Stainless steel or carbon steel with stainless steel or bronze sleeve, integral thrust collar.
- F. Seal: For water systems, use mechanical type, carbon rotating against a stationary ceramic seat, 225°F maximum continuous operating temperature. For glycol systems, use tungsten or silicon carbide. Provide factory installed flush line with manual vent.
- H. Drive: Close coupled.
- I. Optional Pump Support: Provide factory pump base for floor mount applications.
- J. Control: Integral sensor or sensorless controls complete with fused disconnect switch and BACnet MS/TP communication card and menu-driven graphical keypad interface. Ensure software for sensor or sensorless control includes automatic speed control without the need for remotely mounted differential pressure sensor. Operating mode under sensor or sensorless control shall utilize quadratic pressure control. Linear or proportional pressure control without sensor is unacceptable. Control mode setting and minimum/maximum head set points shall be user adjustable using built-in programming interface. Integrated control software shall be capable of flow rate display and data output of $\pm 5\%$ accuracy to

BAS and on the pump display. Controls shall be able to display and digitally transmit real-time flow and values.

2.2 SMALL IN-LINE PUMPS

- A. Manufacturer: Armstrong, Bell and Gossett, Taco, Grundfos, or approved equal.
- B. Type: Horizontal shaft, single stage, direct connected with permanently oil lubricated bearings or wet rotor pump for in-line mounting, for 125 psi maximum working pressure, 230°F maximum water temperature.
- C. Casing: Cast iron, stainless steel or bronze with flanged pump connections.
- D. Impeller, Shaft, Rotor: Stainless Steel or Non-Metallic.
- E. Seal: For dry rotor pumps on water systems, mechanical with metal Impregnated carbon (graphite) and ceramic. For glycol systems, use tungsten or silicon carbide.

2.3 WET ROTOR CIRULATORS (ECM)

- A. MANUFACTURER: Armstrong, Bell and Gossett, Taco, Grundfos or approved equal.
- B. TYPE: Horizontal shaft, single stage, close coupled wet rotor pump for in-line mounting with EC (Permanent Magnet) motor and integrated speed controller.
- C. CASING: Cast iron or stainless steel.
- D. IMPELLER, SHAFT, ROTOR: Stainless Steel or Non-Metallic.
- E. CONTROL MODES:
 - 1. AUTOADAPT – During operation, the pump automatically reduces the factory-set setpoint and adjusts it to the actual system characteristic. Manual setting of the setpoint is not possible.
 - 2. FLOWLIMIT - It shall be possible for the user to select a maximum flow that the pump shall not exceed in order to eliminate the need for additional throttling valves. The pump shall operate per selected control mode but will limit speed to not exceed the user specified flow limit.
 - 3. FLOWADAPT – The pump shall operate in the AUTOADAPT control mode with FLOWLIMIT enabled.
 - 4. Proportional Pressure – The head delivered shall be reduced from a manual setpoint linearly according to decrease in flow demand in the system.
 - 5. Constant Pressure – A manual set, constant head is maintained, irrespective of flow up to the maximum speed of the pump.
 - 6. Constant Curve – The pump runs as an uncontrolled pump by the means of a set of pump curves. The pump curve adjustable between maximum and minimum from the control panel or through a wireless remote control.
 - 7. Constant Temperature – the pump shall adjust speed to maintain a constant media temperature in the flow pipe in which the pump is installed.
 - 8. Constant Differential Temperature - the pump shall adjust speed to maintain a constant temperature drop between the flow pipe in which the pump is installed and a user installed temperature sensor.
 - 9. Alternating Operation – Two single head pumps or two heads of a dual head pump shall communicate wirelessly to one another. In alternating operation, only one pump shall operate at a time. The operation shall alternate based on time or energy to ensure even run time of both pumps. If a pump stops due to fault the other pump shall take over automatically.
 - 10. Back-Up Operation – Two single head pumps or two heads of a dual head pump shall communicate wirelessly to one another. In Back-Up operation one pump shall operate continuously. If the duty pump stops due to fault, the back-up pump shall take over automatically.

11. Cascade Operation - Two single head pumps or two heads of a dual head pump shall communicate wirelessly to one another. Two pumps shall operate together in constant pressure control. The pump controller shall determine when to operate a single pump or both pumps to meet demands. While both pumps operate they shall run at the same speed.

2.4 DRY ROTOR PUMPS (ECM)

- A. MANUFACTURER: Armstrong, Bell and Gossett, Taco, Grundfos or approved equal.
- B. TYPE: Base Mounted, Vertical Inline, Small Inline or Vertical Multi-stage as described in this section with EC (Permanent Magnet) motor and integrated speed controller. Pump, Motor and Speed Controller to all be manufactured by the pump company.
- C. CONTROL MODES:
 1. Proportional Pressure – The head delivered shall be reduced from a manual setpoint linearly according to decrease in flow demand in the system.
 2. Constant Pressure – A manual set, constant head is maintained, irrespective of flow up to the maximum speed of the pump.
 3. Constant Curve – The pump runs as an uncontrolled pump by the means of a set of pump curves. The pump curve adjustable between maximum and minimum from the control panel or through a wireless remote control.
 4. Constant Temperature – the pump shall adjust speed to maintain a constant media temperature in the flow pipe in which the pump is installed.
 5. Constant Flow.
 6. Constant Level.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all pumps in strict accordance with manufacturer's instructions. Access/service space around pumps shall not be less than minimum space recommended by pump manufacturer.
- B. Support piping adjacent to pump such that no weight is carried on pump casings.
- C. Decrease from line size at pump connections with suction diffusers where specified, long radius reducing elbows or concentric reducers/increasers in the vertical piping, and eccentric reducers/increasers for horizontal piping. Install eccentric reducers/increasers with the top of the pipe level.
- D. All valves and piping specialties must be full line size as indicated on the drawings.
- E. Lubricate pumps before startup.
- F. Install a full line size spring loaded check valve and balancing valve in the pump discharge piping. At contractor's option, combination shut-off, check, balancing valve may be substituted instead of separate valves. Reference section 23 05 23.

END OF SECTION 23 21 23

SECTION 23 25 00 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for chemical treatment of all water systems. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Reference
 - 3. Related Work
 - 4. Federal Bidding Requirements
 - 5. Quality Assurance
 - 6. Submittals
 - 7. Operation and Maintenance Data
 - 8. Design Criteria
 - 9. Maintenance Service
- C. PART 2 - Products
 - 1. Manufacturers
 - 2. System Cleaner
 - 3. System Inhibitor
 - 4. Glycol
 - 5. Closed Water System Treatment
 - 6. Treatment Equipment
- D. PART 3 - EXECUTION
 - 1. Preparation
 - 2. Cleaning Sequence
 - 3. Glycol Water Systems
 - 4. Closed Water Systems
 - 5. Pipe Cleaning and Treatment Report

1.2 REFERENCE

- A. Applicable provisions of Division 1 shall govern work under this Section.

1.3 RELATED WORK

- A. Section 23 05 15 - Piping Specialties

1.4 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.5 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.6 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Required for all equipment and chemicals specified including data concerning dimensions, capacities, materials of construction, weights, operating sequence, composite wiring diagrams and appropriate identification. Chemical data to include the description of the chemical, its composition, its function, and the associated material safety data sheet.

1.7 OPERATION AND MAINTENANCE DATA

- A. Provide for the services of the manufacturer's trained representative to approve the installation and instruct the Owner in the operation of each system.
- B. Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.8 DESIGN CRITERIA

- A. Recommend a periodic test procedure and chemical treatment program for each system.
- B. Treat the following systems:
 - Chilled water
 - Hot water
 - Geothermal water (glycol)
- C. Provide the initial chemical treatment for all systems based on a complete system fluid analysis prior to the equipment installation. The initial chemical treatment supply of chemicals for each system shall be adequate for the start-up and testing period, for the time the systems are being operated by the contractor for temporary heating and cooling, and for one year after start-up of the system.
- D. The chemicals used in the condenser water treatment system shall use only liquid chemicals and shall contain no phosphates or chromates.
- E. Provide electrical devices, motors, wiring and conduit according to the applicable sections of the Electrical Specifications.

1.9 MAINTENANCE SERVICE

- A. Furnish service and maintenance of treatment systems for one year from date of substantial completion.
- B. Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.
- C. Provide laboratory and technical assistance services for the warranty period.
- D. Include two hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of the treatment systems. Arrange course at startup of systems.
- E. Provide site inspection of equipment during scheduled shutdown to evaluate success of the treatment program. Make recommendations in writing based on these inspections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Betz Entac, Dearborn Div. - W. R. Grace & Co., Fremont Industries, Mitco Water Labs, Mogul Corporation, Nalco Chemical Co., Rhomar Water Management, Western Water Management, or approved equal.

2.2 SYSTEM CLEANER

- A. Blend of organic alkaline penetrants, emulsifiers, surfactants and corrosion inhibitors that remove grease and petroleum products from the interior of piping systems. Cleaners that contain trisodium phosphate are specifically not acceptable.

2.3 SYSTEM INHIBITOR

- A. Scale and corrosion inhibitor consisting of boron nitrite, benzol thiazol, benzotriazole, mercapto-benzo-thiazole, and tolyltrizole silicates.

2.4 GLYCOL

- A. Inhibited propylene glycol based material specifically designed for use in closed heat transfer systems. Dow Chemical DOWFROST, Union Carbide UCAR Thermofluid, Fremont 9134FG, or approved equal. Glycol to provide system protection to 10°F burst/20°F freeze at 20% glycol volume/80% water volume, and -20°F burst/10°F freeze at 30% glycol volume/70% water volume.

2.5 CLOSED WATER SYSTEM TREATMENT

- A. Sequestering agent to reduce deposits and adjust pH: polyphosphate.
- B. Corrosion inhibitors: boron-nitrite, sodium nitrite and borax, sodium tolyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
- C. Conductivity enhancers: phosphates or phosphonates.

2.6 TREATMENT EQUIPMENT

- A. Bypass Feeder: 5 gallon minimum capacity, 125 psig working pressure, either a screw type cover or a valved funnel opening to feed chemical into the system, prime coat of paint.
- B. Water Meter: Displacement type cold water meter with sealed, tamper-proof magnetic drive, bronze housing, 125 psig minimum working pressure, impulse contact register when required by the sequence, single pole double throw dry contact switch. Meters must be capable of being used with remote readout heads and capable of being sealed to prevent tampering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to cleaning, verify that systems are operational, filled, started, and vented. Use water meter to record capacity in each system.
- B. Place terminal control valves in the full-open position.

3.2 CLEANING SEQUENCE

- A. General:
 - 1. Systems are to be cleaned before they are used for any purpose except conduct pressure test before cleaning. Add cleaner to closed systems at concentrations as recommended by the manufacturer. Remove water filter elements from the system before starting circulation. For steam systems, fill boilers only, using the water and cleaner solution.
 - 2. Use neutralizer agents on recommendation of the system cleaner supplier and approval of the Architect/Engineer.
 - 3. Flush open systems with clean water for one hour minimum. Drain completely and refill.
 - 4. Remove, clean, and replace strainer screens.
 - 5. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.
 - 6. Use the form included in this specification to document system cleaning, flushing, and proper startup.

- B. Hot Water Heating Systems: Add cleaner to the system water until the M alkalinity value is 250 above that of the initial fill water. Verify the M alkalinity level before and after the addition of the cleaner by means of chemical tests that are observed by the Owner's construction representative; include results of all tests in the Operating and Maintenance manuals. Apply heat while circulating, slowly raising temperature to 160°F and maintain for 12 hours minimum; vent all high points to assure 100% system circulation. Remove heat and circulate to 100°F or less; drain system as quickly as possible and refill with clean water. Circulate for 6 hours at design temperature, vent air at all high points, then drain. Refill with clean water and repeat until the system cleaner is removed and the M alkalinity level returns to normal. Remove and clean all strainers. Re-vent the system and install clean filter elements in water filters. Treat with scale and corrosion inhibitors before using the system for building heating.
- C. Chilled Water Systems: Add cleaner to the system water until the M alkalinity value is 250 above that of the initial fill water. Verify the M alkalinity level before and after the addition of the cleaner by means of chemical tests that are observed by the Owner's construction representative; include results of all tests in the Operating and Maintenance manuals. Circulate for 48 hours, then drain system as quickly as possible. Refill with clean water, circulate for 24 hours, then drain. Refill with clean water and repeat until system cleaner is removed and the M alkalinity level returns to normal. Remove and clean all strainers. Re-vent the system and install clean filter elements in water filters. Treat with scale and corrosion inhibitors before using the system for building cooling.
- D. Glycol Water Systems: Clean and flush as indicated above for hot water heating systems. Verify complete drainage by measuring amount of water used for the initial fill versus the amount actually drained to assure complete removal of the cleaning solution. Remove all traces of chloride from the system; test to verify this removal and submit test results.

3.3 GLYCOL WATER SYSTEMS

- A. The geothermal system is a glycol water system.
- B. Completely flush all traces of cleaning chemicals before adding the glycol water mixture to the system. Verify this by chemical test.
- C. Premix glycol water solution in a polyethylene drum to a concentration of 25% by volume. Use distilled water to make the solution. Use a pump to fill system from the mixing tank. Circulate fluid for several hours, vent all high points where air may collect, add more solution to the system if needed, and test the system for proper concentration of glycol; include copy of test report in the Operating and Maintenance manuals.

3.4 CLOSED WATER SYSTEMS

- A. Install a separate bypass type feeder at the pumps for each closed hot water heating and chilled water cooling system. Provide a separate set of supply and return lines from each pump in the system and install ball valves in each of these lines. Locate the system connection that supplies the feeder upstream of the discharge shutoff valve for the pump. Locate the system connection that returns treatment back to the system at a convenient point downstream of the pump discharge shutoff valve. Provide a drain valve at the bottom of the feeder.
- B. Install a water meter upstream of the pressure reducing valve in the makeup line to each closed system. Locate the meter on the domestic water side of the pressure reducing valve and in such a manner that the meter can be easily read.

3.5 PIPE CLEANING AND TREATMENT REPORT

Project Number: _____

Date Submitted: _____

Project Name: _____

Location: _____

Contractor: _____

System Tested: _____

☐ Hot Water ☐ Glycol Water ☐ Chilled Water ☐ Fuel Oil
☐ Condenser Water ☐ Steam ☐ Condensate

System Volume: _____

Materials Used (Provide MSDS for each)

Cleaner: _____ Quantity Used: _____

Inhibitor: _____ Quantity Used: _____

Sequestering Agent: _____ Quantity Used: _____

Algaecide: _____ Quantity Used: _____

Neutralizer: _____ Quantity Used: _____

Glycol: _____ Quantity Used: _____

Glycol Sol. Water Source: _____ % Glycol by Vol: _____

M Alkalinity

Prior to Cleaning: _____ During Cleaning: _____ After Flushing: _____

System Temperature

Prior to Cleaning: _____ During Cleaning: _____

Duration	Date/Time Start	Date/Time Stop
Initial Circulation	_____	_____
Drain-down	_____	_____
System Refill	_____	_____
Final Circulation	_____	_____
Heating System Warm-up	_____	_____

Component Checklist (Describe procedures performed at each)

Filters
: _____

Vents: _____

Drains: _____

Traps: _____

Branch Lines: _____

Terminal Units: _____

Boilers: _____

Chillers: _____

Comments: _____

END OF SECTION 23 25 00

SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for all duct systems used on this project. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Design Criteria
 - 9. Delivery, Storage, and Handling
- C. PART 2 - Products
 - 1. General
 - 2. Ductwork Pressure Class
 - 3. Materials
 - 4. High Pressure Ductwork (Pressure class 3 inch and over)
 - 5. Low Pressure Ductwork (Maximum 2 inch pressure class)
 - 6. Underground Ductwork
 - 7. Fabric Air Dispersion System (Fabric Duct)
 - 8. Duct Sealant
 - 9. Gaskets
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Ductwork Support
 - 3. High Pressure Duct (Pressure class 3 inch and over)
 - 4. Low Pressure Duct (Maximum 2 inch pressure class)
 - 5. Underground Ductwork
 - 6. Fabric Air Dispersion System (Fabric Duct)
 - 7. Cleaning
 - 8. Leakage Test
 - 9. Structural Test
 - 10. Duct Leakage Test Report
 - 11. Duct Structural Test Report

1.2 RELATED WORK

- A. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- B. Section 23 33 00 - Air Duct Accessories

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ASTM A90 Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
- B. ASTM A167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- C. ASTM A623 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
- D. ASTM A527 Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
- E. ASTM 924 Standard Specification for General Requirements for Sheet Steel, Metallic-coated by the Hot-dip Method
- F. ASTM C 1071 Specification for Fibrous Glass Duct Lining Insulation
- G. ASTM C 411 Test Method for Hot Surface Performance of High Temperature Thermal Insulation
- H. ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials
- I. ASTM C 1338 Test Method for Determining Fungal Resistance of Insulation Materials and Facings
- J. ASTM G 21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
- K. ASTM C 916 Standard Specification for Adhesives for Duct Thermal Insulation
- L. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems
- M. UL 181 Standard for Safety for Factory Made Air Ducts and Air Connectors

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Include manufacturer's data and/or contractor data for the following:
- Fabrication and installation drawings.
 - Schedule of duct systems including material of construction, gauge, pressure class, system class, method of reinforcement, joint construction, fitting construction, and support methods, all with details as appropriate.
 - Duct sealant and gasket material.

1.8 DESIGN CRITERIA

- A. Construct all ductwork to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions.

- B. Use material, weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA publications, unless noted otherwise:
 - HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005
 - HVAC Air Duct Leakage Test Manual, 2nd Edition, 2012
 - HVAC Systems - Duct Design, 4th Edition, 2006
 - Rectangular Industrial Duct Construction Standard, 2nd Edition, 2004
 - Round Industrial Duct Construction Standards, 2nd Edition, 1999
 - Thermoplastic Duct (PVC) Construction Manual, 2nd Edition, 1995
- C. Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke developed rating no higher than 50.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to ensure that Ductwork is undamaged and complies with the specification.
- B. Protect Ductwork against damage.
- C. Protect Ductwork by storing inside or by durable, waterproof, above ground packaging. Do not store material on grade. Protect Ductwork from dirt, dust, construction debris and foreign material. Where end caps/packageing are provided, take precautions so caps/packageing remain in place and free from damage.
- D. Offsite storage agreements do not relieve the contractor from using proper storage techniques.
- E. Storage and protection methods must allow inspection to verify products.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All sheet metal used for construction of duct shall be 24 gauge or heavier except for round and spiral ductwork and spiral duct take-offs 12" and below may be 26 gauge where allowed in SMACNA HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005.
- B. Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are net, inside of liner.

2.2 DUCTWORK PRESSURE CLASS

- A. Minimum acceptable duct pressure class, for all ductwork except transfer ductwork, is 2 inch W.G. positive or negative, depending on the application. Transfer ductwork minimum acceptable duct pressure class is 1 inch W.G. positive or negative, depending on the application. Duct system pressure classes are indicated on the drawings.

2.3 MATERIALS

- A. **GALVANIZED STEEL SHEET:** Use ASTM A 653 galvanized steel sheet of lock forming quality. Galvanized coating to be 1.25 ounces per square foot, both sides of sheet, G90 according to ASTM A90. Provide "Paint Grip" finish or galvaneal sheet metal for ductwork that will be painted.

2.4 HIGH PRESSURE DUCTWORK (Pressure class 3 inch and over)

- A. Manufacturers: Ajax, Semco, United Sheet Metal, Sheet Metal Connectors or approved equal.
- B. Machine formed round and/or flat oval spiral lock seam duct constructed of galvanized steel.
- C. Rectangular high pressure duct using a transverse joint system as manufactured by Ductmate, Nexus, TDC, TDF, or approved equal, may be used at contractor's option. Duct to be flanged, gasketed and sealed

- D. Contractor fabricated ductwork meeting specified construction standards is acceptable with prior approval of Architect/Engineer. Submit construction details, a description of materials to be used, type of service, reinforcing methods, and sealing procedures.
- E. Use a perforated inner liner on double wall high-pressure duct. Annular space between inner liner and outer duct to be filled with 1 inch glass fiber insulation.
- F. Use cemented slip joints with 2" minimum overlap, flanged connections, or welded/brazed connections, unless noted otherwise for special applications. Prime coat welded joints.
- G. Provide standard 90 degree conical tee takeoffs except for exhaust at velocities over 2000 feet per minute, use 45 degree lateral connections; straight taps or bullhead tees are not acceptable.
- H. Internal bracing will not be accepted on ductwork below 48".
- I. Use turning vanes as specified in Section 23 33 12.
- J. Provide bellmouth fittings or expanded fittings at each duct connection to air plenums.
- K. Provide pressure relief fittings as indicated on the plans and/or details.
- L. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.

2.5 LOW PRESSURE DUCTWORK (Maximum 2 inch pressure class)

- A. Fabricate and install ductwork in sizes indicated on the drawings and according to SMACNA recommendations, except as modified below.
- B. Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction when fabricating rectangular ductwork. Use spiral lock seam construction when fabricating round spiral ductwork. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if the screw does not extend more than 1/2 inch into the duct.
- C. Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits. When a shorter radius must be used due to limited space, install single wall sheet metal splitter vanes according to SMACNA publications, Type RE 3. Where space will not allow and the C value of the radius elbow, as given in SMACNA publications, exceeds 0.31, use rectangular elbows with turning vanes as specified in Section 23 33 00. Square throat-radius heel elbows will not be acceptable. Straight taps or bullhead tees are not acceptable.
- D. Where rectangular elbows are used, provide turning vanes according to Section 23 33 00.
- E. Provide expanded take-offs or 45 degree entry fittings for branch duct connections with branch ductwork airflow velocities greater than 700 fpm. Square edge 90-degree take-off fittings or straight taps will not be accepted.
- F. Button punch snaplock construction will not be accepted on aluminum ductwork.
- G. Round ducts may be substituted for rectangular ducts if sized according to ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except as permitted by the Architect/Engineer.
- H. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

2.6 UNDERGROUND DUCTWORK

- A. Underground ducts shall be polyvinyl coated galvanized steel or PVC with two inch rigid insulation with sand backfill, or two inch insulated concrete encasement. Fittings and rectangular taps shall be two gauges heavier than standard. This contractor shall excavate for underground ducts and remove excess earth from the site. Where mechanical compaction has been done, this contractor shall compact backfill around ducts to original conditions.

- B. PVC ducts shall have a minimum pipe stiffness of 8 psi (55 kPa) at 5 percent deflection when tested according to ASTM D2412. Duct fittings shall be constructed of either PVC or high density polyethylene.
- C. All pipe and fittings shall be factory fabricated and plastic coated. Repair any scratched surfaces and coat all fasteners with epoxy coating. All joints shall be sealed with self-curing plastic or approved equal with U.L. label and FHA approval. Gauge of material used shall be as follows:

- Ducts to 8" diameter - 26 gauge
- Ducts 9" to 14" diameter - 24 gauge

2.7 FABRIC AIR DISPERSION SYSTEM (FABRIC DUCT)

- A. Manufacturers: FabricAir, DuctSox, KE Fibertec.
- B. Round fabric air dispersion system shall be constructed of fabric. The fabric is a woven fire retardant and permeable fabric complying with the following characteristics:
 - Duct Shape: Round.
 - Fabric: 100% Flame Retardant Polyester.
 - Weight: 7.67 oz./yd² per ASTM D3776.
 - Shrinkage: Max. 0.5% per DIN EN 26 630.
 - Color: STANDARD. Color choice by Architect.
 - Temperature Range: -40°F and +284°F.
 - Base Permeability @ 0.5" WG: 2.28 CFM/SQFT per ASTM D737, Shall be verified by the Frazier Permeability Test.
 - Fire Retardancy: Shall meet the requirements of NFPA 90-A, ICC AC167 and UL 2518.
- C. System Fabrication Requirements:
 1. The system shall be made with sewn in but removable aluminum hoops. The hoops shall:
 - Maintain the ducts' cylindrical shape at all times.
 - Be made to a circular arc angle of 180° (8" - 48"), 120° (49" - 60"), 90° (61" - 68") or 60° (69" - 80") depending on duct diameter.
 - Be centered at the 12:00 o'clock position of the duct.
 - Be installed at the factory, on-site installation shall not be allowed.
 2. Diameter and spacing of hoops shall be determined by the manufacturer based on duct diameter.
 3. Elbows of 70° or more shall have at least two hoops.
 4. Air dispersion shall be accomplished with linear or polar arrays of laser cut orifices. Size of laser cut orifices shall be from 1" to 5" diameter. Due to exact throw requirements and NC requirements alternative flow models are not acceptable.
 5. Number of orifices shall be determined by manufacturer.
 6. The system shall be made of permeable fabric. Base permeability of fabric shall be reached based on a combination of weave construction and a thermo fixation process in order to prevent permeability degradation after wash. Fabric permeability based on a calendaring process is not acceptable.
 7. Fabric system shall include connectors to attach to suspension system listed below.
 8. Provide system in sections optimized for maintenance, connected by zippers. Zippers shall provide closure completely around the circumference to prevent leakage. Required number of zippers shall be specified by the manufacturer.

9. Each section to have a unique tag including information about manufacturers order number, position, diameter of section, length of section, maintenance instruction, code compliance and contact details for spare parts.
- D. Design Parameters:
1. Use fabric air diffusers only for positive pressure air distribution.
 2. Do not use fabric air diffusers in concealed locations.
 3. Fabric diffusers shall be designed from minimum 0.25" water gage to 3" as the maximum - 0.5" being the standard.
 4. Design temperatures shall be between -40°F and +284°F.
 5. Manufacturer shall approve all technical design parameters.
- E. Hangers and Supports:
1. Type 1: One row cable system located 2" above 12 o'clock of system. System shall be attached to hardware using one single row of plastic hooks located at 12 o'clock spaced 20" apart. Hardware to include cable, cable clamps, turnbuckles, and tie down straps as required.
 2. Hardware: PVC Coated Galvanized Steel Tensioning and Suspension Cable - Cable clamps, cable tensioners, and all other factory supplied metal components shall be Galvanized Steel.
- F. Air Handler Requirements:
1. Provide adequate pre-filtering prior to the fabric duct system, all according to manufacturer's specifications.
 2. Air handler filters shall be changed per unit manufacturer's requirements. Failure to maintain clean filters may result in a voided warranty.
 3. Provide fans capable of delivering the specified air volume at the specified static pressure.
- 2.8 DUCT SEALANT
- A. Manufacturer: 3M 800, 3M 900, H.B. Fuller/Foster, Hardcast, Hardcast Peel & Seal, Lockformer cold sealant, Mon-Eco Industries, United Sheet Metal, or approved equal. Silicone sealants are not allowed in any type of ductwork installation.
 - B. Install sealants in strict accordance with manufacturer's recommendations, paying special attention to temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup of air handling systems.
- 2.9 GASKETS
- A. 2" pressure class and lower: Soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.
 - B. 3" pressure class and higher: Butyl gaskets.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify dimensions at the site, making field measurements and drawings necessary for fabrication and erection. Check plans showing work of other trades and consult with Architect in the event of any interference.
- B. Make allowances for beams, pipes or other obstructions in building construction and for work of other contractors. Transform, divide or offset ducts as required, according to SMACNA HVAC Duct Construction Standards, Figure 4-7, except do not reduce duct to less than six inches in any dimension and do not exceed an 8:1 aspect ratio. Where it is necessary to take pipes or similar obstructions through ducts, construct easement as indicated in SMACNA HVAC Duct Construction Standards, Figure 4-8, Fig. E. In all

cases, seal to prevent air leakage. Pipes or similar obstructions may not pass through high pressure or fume exhaust ductwork.

- C. Test openings for test and balance work will be provided under Section 23 05 93.
- D. Provide frames constructed of angles or channels for coils, filters, dampers or other devices installed in duct systems, and make all connections to such equipment including equipment furnished by others. Secure frames with gaskets and screws or nut, bolts and washers.
- E. Install duct to pitch toward outside air intakes and drain to outside of building. Solder or seal seams to form watertight joints.
- F. Where two different metal ducts meet, the joint shall be installed in such a manner that metal ducts do not contact each other by using proper seal or compound.
- G. Install all motor operated dampers and connect to or install all equipment furnished by others. Blank off all unused portions of louvers, as indicated on the drawings, with 2" board insulation with galvanized sheet metal backing on both sides.
- H. Do not install ductwork through dedicated electrical rooms or spaces unless the ductwork is serving this room or space.
- I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- J. Provide adequate access to ductwork for cleaning purposes.
- K. Protect diffusers, registers and grilles with plastic wrap or some other approved form of protection to maintain dirt and dust free and to prevent entry of dirt, dust and foreign material into the ductwork.
- L. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- M. Ductwork required to be prepared for painting:
 - 1. Surface shall be clean, dry and free from manufacturer's lubricants.
 - 2. Remove dirt and grease from galvanized ductwork with VM&P, Naphtha, or water based commercial detergent and wipe dry with a clean cloth.
 - 3. Surface shall be free of foreign materials that will be adversely affect adhesion or appearance of applied paint coating.

3.2 DUCTWORK SUPPORT

- A. Support ductwork according to SMACNA HVAC Duct Construction Standards, Figure 5-5, except supporting ductwork with secure wire method is not allowed.
- B. Stainless steel air-craft cable hanging systems are allowed on round ductwork under 12" diameter if installed utilizing two fasteners with two cable loops. Support with 3/32", 7 x 7, stainless steel air-craft cable, with matching serrated spring loaded wedge mechanism fasteners rated for actual load. Comply with the manufacturer's installation instructions.

3.3 HIGH PRESSURE DUCT (Pressure class 3 inch and over)

- A. Seal all duct according to SMACNA seal class "A"; all seams, joints, and penetrations shall be sealed.
- B. Single wall high pressure ductwork shall be installed as shown on the plans from air handling units to variable air volume boxes.

3.4 LOW PRESSURE DUCT (Maximum 2 inch pressure class)

- A. Seal all duct, with the exception of transfer ducts, according to SMACNA seal class "A"; all seams, joints, and penetrations shall be sealed.
- B. Install a manual balancing damper in each branch duct and for each diffuser or grille. The use of splitter dampers, extractors, or grille face dampers will not be accepted for balancing dampers.

- C. Hangers must be wrapped around bottom edge of duct and securely fastened to duct with sheet metal screws or pop rivets. Trapeze hangers may be used at contractor's option.

3.5 UNDERGROUND DUCTWORK

- A. Round ductwork shall be fabricated by the spiral lockseam method. Fittings shall be fabricated of material heavy enough to prevent distortion but in no case shall fittings be lighter than connecting ductwork. Take necessary precautions to prevent damage to duct work during installation. Compact fill material around duct using methods that will not damage ducts or disturb installation. Ductwork shall slope at a minimum of 1/8" per foot to sump or point of collection.

3.6 FABRIC AIR DISPERSION SYSTEM (FABRIC DUCT)

- A. Examine area and conditions under which the Fabric Air Dispersion systems are to be installed. Do not continue any installation until unsatisfactory conditions have been corrected.
- B. Install chosen suspension system according to the requirements of the manufacturer. Installation instructions shall be provided by the manufacturer with product.
- C. Coordinate layout with suspended ceiling, lighting layouts, and all other trades that may interfere with the installation.
- D. Cleaning: Clean air handling unit and other ductwork prior to the Fabric Air Dispersion system as it is installed. Ensure that all construction debris, including dust, is removed from the air handling unit and other ductwork before connecting the Fabric Air Dispersion system. If the Fabric Air Dispersion system becomes soiled during the installation, it should be removed and cleaned following the manufacturers cleaning instructions.

3.7 CLEANING

- A. Remove all dirt and foreign matter from the entire duct system and clean diffusers, registers, grilles and the inside of air-handling units before operating fans.
- B. Clean duct systems with high power vacuum machines where systems have been used for temporary heat, air-conditioning, or ventilation purposes during construction. Protect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning.

3.8 LEAKAGE TEST

- A. Test all ductwork according to test methods described in Section 5 of SMACNA HVAC Air Duct Leakage Test Manual. Do not insulate ductwork until it has been successfully tested. Test pressure shall be equal to the duct pressure class.
- B. If excessive air leakage is found locate leaks, repair the duct in the area of the leak, seal the duct, and retest.
- C. Leakage rate shall not exceed more than 5% of the system air quantity for low pressure ductwork, determined according to Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.
- D. Leakage rate shall not exceed more than 1% of the system air quantity for high pressure ductwork, determined according to Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.
- E. Leakage test for ductwork downstream of air terminal devices may be omitted but will not relieve the contractor from duct sealing requirements.
- F. Submit a signed report to the Owner's Construction Representative, indicating test apparatus used, results of the leakage test, and any remedial work required to bring duct systems into compliance with specified leakage rates.

3.9 STRUCTURAL TEST

- A. Random test all ductwork per A/E direction. Do not insulate ductwork until it has been successfully tested. Test pressure shall be equal to the duct pressure class.
- B. Deflection limits shall not exceed those listed according to Chapter 11 of SMACNA HVAC Duct Construction Standards, 3.0 Performance Requirements.
- C. Submit a signed report to the Owner's Construction Representative, indicating test apparatus used, results of the structural test, and any remedial work required.

3.10 DUCT LEAKAGE REPORT

Date Submitted: _____

Project Name: _____

Location: _____ **Project No:** _____

Contractor: _____

System Data Fan No. _____ Leakage Class (C_L): _____

Fan Design Airflow: CFM Duct Press. Class (P_C):

Test Pressure (P_T):

<u>Test Equip.</u>	<u>Mfgr.</u>	<u>Model No.</u>	<u>Serial No.</u>

For large systems, use the reverse side for a simple sketch of the entire duct system. Then use letter designations to indicate the various duct sections being tested at one time. Also use the reverse side for test comments.

Note that due to normal construction sequencing it is usually necessary to test risers separately prior to enclosing chases.

[illegible]

3.11 DUCT STRUCTURAL TEST REPORT

Date Submitted: _____

Project Name: _____

Location: _____ **Project No:** _____

Contractor: _____

System Data Fan No. _____

Description of Test Method: _____

<u>Test Equip.</u>	Mfgr.	Model No.	Serial No.

Indicate the various duct sections being tested at one time. Also use the reverse side for test comments.

[illegible]

END OF SECTION 23 31 00

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes accessories used in the installation of duct systems. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Operation and Maintenance Data
- C. PART 2 - Products
 - 1. Manual Volume Dampers
 - 2. Turning Vanes
 - 3. Fire Dampers
 - 4. Control Dampers
 - 5. Smoke Detectors
 - 6. Access Doors
 - 7. Flexible Duct
 - 8. Duct Lining
 - 9. Flashings
 - 10. Duct Flexible Connections
 - 11. Sound Attenuators
 - 12. Hoods for Intake and Exhaust
 - 13. Louvers
 - 14. Air Flow Stations
- D. PART 3 - EXECUTION
 - 1. Manual Volume Dampers
 - 2. Turning Vanes
 - 3. Fire Dampers
 - 4. Control Dampers
 - 5. Smoke Detectors
 - 6. Access Doors
 - 7. Flexible Duct
 - 8. Duct Lining
 - 9. Flashings
 - 10. Duct Flexible Connections
 - 11. Sound Attenuators

- 12. Hoods for Intake and Exhaust
 - 13. Louvers
 - 14. Air Flow Stations
- 1.2 RELATED WORK
- A. Section 23 05 29 - Hanger and Supports for HVAC Piping and Equipment
 - B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
 - C. Section 23 31 00 - HVAC Ducts and Casings
- 1.3 REFERENCE
- A. Applicable provisions of Division 1 govern work under this section.
- 1.4 REFERENCE STANDARDS
- A. NFPA 90A Standard for Installation of Air Conditioning and Ventilating Systems
 - B. SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition, 1995
 - C. UL 214
 - D. UL 555(6th edition) Standard for Fire Dampers and Ceiling Dampers
 - E. UL 555S (4th edition) Leakage Rated Dampers for Use in Smoke Control Systems
- 1.5 FEDERAL BIDDING REQUIREMENTS
- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
 - B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.
- 1.6 QUALITY ASSURANCE
- A. Refer to Division 1, General Conditions, Equals and Substitutions.
- 1.7 SUBMITTALS
- A. Refer to Division 1, General Conditions, Submittals.
 - B. Submit for all accessories and include dimensions, capacities, ratings, installation instructions, and appropriate identification.
 - C. Include certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance of sound attenuators.
 - D. Submit manufacturer's color charts where finish color is specified to be selected by the Architect/Engineer.
- 1.8 OPERATION AND MAINTENANCE DATA
- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

- 2.1 MANUAL VOLUME DAMPERS
- A. Manufacturers: Ruskin, Vent Products, Air Balance, Pottorff, or approved equal.
 - B. Dampers must be constructed according to SMACNA Fig. 2-12, Fig. 2-13, and notes relating to these figures, except as modified below.

- C. Reinforce all blades to prevent vibration, flutter, or other noise. Construct dampers in multiple sections with mullions where width is over 48". Use rivets or tack welds to secure individual components; sheet metal screws will not be accepted. Provide operators with locking devices and damper position indicators for each damper; use an elevated platform on insulated ducts. Provide end bearings or bushings for all volume damper rods penetrating ductwork constructed to a 3" w.c. pressure class or above.

2.2 TURNING VANES

- A. Manufacturers: Aero Dyne, Anemostat, Barber-Colman, Hart & Cooley, or approved equal.
- B. Construct turning vanes and runners for square elbows according to SMACNA Fig. 2-3 and Fig. 2-4 except use only airfoil type vanes. Construct turning vanes for short radius elbows and elbows where one dimension changes in the turn according to SMACNA Fig. 2-5 and Fig. 2-6.

2.3 FIRE DAMPERS

- A. Manufacturers: Air Balance, Advanced Air, Pottorff, American Warming and Ventilating, Greenheck, NCA, Phillips-Aire, Prefco, Ruskin, Safe-Air or approved equal.
- B. Static Fire Dampers: Static fire damper assemblies must be UL 555 (6th edition) listed and labeled for static applications (where air systems do not operate during a fire) and meet requirements of NFPA 90A. Damper must be type B curtain type with blades out of the air stream; dampers with blades in the air stream will not be accepted. Damper fire rating to be compatible with the rating of the building assembly in which the damper is used.

2.4 CONTROL DAMPERS

- A. Control dampers are specified in section 23 09 14.

2.5 SMOKE DETECTORS

- A. Smoke detectors are furnished and installed by the Electrical Contractor or Fire Alarm Contractor. Mechanical Contractor to install in return air ducts where indicated.

2.6 ACCESS DOORS

- A. Access door to be designed and constructed for the pressure class of the duct in which the door is to be installed. Doors in exposed areas shall be hinged type with cam sash lock. Hinges shall be steel full length continuous piano type. Doors in concealed spaces may be secured in place with cam sash latches. For both hinged and non hinged doors provide sufficient number of cam sash latches to provide air tight seal when door is closed. Do not use hinged doors in concealed spaces if this will restrict access. Use minimum 1" deep 24 gauge galvanized steel double wall access doors with minimum 24 gauge galvanized steel frames. For non-galvanized ductwork, use minimum 1" deep double wall access door with frame that shall use materials of construction identical to adjacent ductwork. Provide double neoprene gasket that shall provide seals from the frame to the door and frame to the duct. When access doors are installed in insulated ductwork or equipment provide insulated doors with insulation equivalent to what is provided for adjacent ductwork or equipment. Access doors constructed with sheet metal screw fasteners will not be accepted.

2.7 FLEXIBLE DUCT

- A. Manufacturers: Anco Products, Clevaflex, Thermaflex, Flexmaster or approved equal.
- B. Factory fabricated, UL 181 listed as a class 1 duct, and having a flame spread of 25 or less and a smoke developed rating of 50 or under according to NFPA 90A.
- C. Suitable for pressures and temperatures involved but not less than a 180°F service temperature and ± 2 " pressure class, depending on the application.
- D. Duct to be composed of polyester film, aluminum laminate or woven and coated fiberglass fabric bonded permanently to corrosion resistant coated steel wire helix. Two-ply, laminated, and corrugated aluminum construction may also be used.

- E. Where duct is specified to be insulated, provide a minimum 1" fiberglass insulation blanket with maximum thermal conductance of 0.23 K (75°F) and vapor barrier jacket of polyethylene or metalized reinforced film laminate. Maximum perm rating of vapor barrier jacket to be 0.1 perm.

2.8 DUCT LINING

- A. Manufacturers: Manville, Owens-Corning, Knauf, or approved equal.
- B. 1" thick, flexible, mat faced insulation made from inorganic glass fibers bonded with a thermosetting resin with thermal conductivity of .25 Btu inch / hour sq.ft. deg F.
- C. Meet erosion testing per UL 181 or ASTM C 1071 for 5000 fpm maximum air velocity. ASTM C 411 maximum operating temperature rating of 250°F. ASTM E84 flame spread less than 25 and smoke developed less than 50.
- D. Meet requirements of ASTM C 1338 and ASTM G21 for fungi resistance.
- E. Install liner using adhesive conforming to ASTM C 916.

2.9 FLASHINGS

- A. Flashing and counterflashing for roof curbs will be provided by others.
- B. Flashing and curbs for duct and pipe penetrations of roof assemblies to be according to details.

2.10 DUCT FLEXIBLE CONNECTIONS

- A. Material to be fire retardant, be UL 214 listed, and meet the requirements of NFPA 90A.
- B. Connections to be a minimum of 3" wide, crimped into metal edging strip, and air tight. Connections to have adequate flexibility and width to allow for thermal expansion/contraction, vibration of connected equipment, and other movement.
- C. Use coated glass fiber fabric for all applications. Material for inside applications other than corrosive environments, fume exhaust, or kitchen exhaust to be double coated with neoprene, air and water tight, suitable for temperatures between -10°F and 200°F, and have a nominal weight of 30 ounces per square yard. Material used for outdoor applications other than corrosive environments, fume exhaust, or kitchen exhaust to be double coated with Hypalon®, air and water tight, suitable for temperatures between -10°F and 250°F, and have a nominal weight of 26 ounces per square yard.

2.11 SOUND ATTENUATORS

- A. Manufacturers: Industrial Acoustics Company, Environmental Elements Corporation, Semco, Dynasonics, United McGill, VAW Systems, Price, or approved equal.
- B. Construct of a 22 gauge galvanized steel outer casing, and 26 gauge galvanized, perforated steel inner liner. Seams and joints of outer casing to be air tight.
- C. Fill annular space between outer casing and inner liner with acoustic fill that is inert, inorganic, and of a density sufficient to obtain the specified acoustic performance. Material must meet requirements of NFPA 90A with a flame spread index of 25 or less and smoke developed rating of 50 or less.
- D. Acoustical and aerodynamic performance is indicated on schedules on the drawings.

2.12 HOODS FOR INTAKE AND EXHAUST

- A. Manufacturers: Acme, Ammerman, Carnes, Cook, Greenheck, Louvers and Dampers, PennBarry, Twin City Fan, United Enertech, or approved equal.
- B. Use louvered penthouse type hoods with drainable blade louvers.
- C. Construct hoods of aluminum as indicated with a baked enamel finish; color to be selected by the Architect during the submittal stage.
- D. Provide bird screen for each hood.

2.13 LOUVERS

- A. Manufacturers: Greenheck, Cesco, Kees, Arrow, Airolite, Industrial Louvers, American Warming and Ventilating, Air Balance, Ruskin, Pottorff, Nailor, United Enertech, or approved equal.
- B. Similar to Greenheck ESD-635, extruded aluminum alloy not less than 12 gauge (.081" thick), 6063 series frame and blades, all-welded assembly, 35 degree or 45 degree blades with water baffle, 6" thick. Provide with bird screen of ½" x ½" mesh aluminum in 12 gauge aluminum frame and an aluminum sill. Locate the bird screen inside of the louver unless noted otherwise.
- C. Louver to bear the AMCA certified ratings seal for both air performance and water penetration, having a free area not less than 50% based on a 48" x 48" section, a water penetration less than 0.05 oz/square foot per 15 minutes under AMCA test at 1000 feet per minute, and an intake pressure drop less than 0.15 inches of water at 1000 feet per minute.
- D. Finish to be baked enamel in a standard manufacturer color to be selected by the Architect. Furnish sufficient paint in the same color as the louver to paint the outer surface of panels over unused portions of louvers and to paint the interior portion of ductwork visible through the louvers.

2.14 AIR FLOW STATIONS

- A. Air flow stations are specified in section 23 09 14.

PART 3 - EXECUTION

3.1 MANUAL VOLUME DAMPERS

- A. Install manual volume dampers in each branch duct and for each grille, register, or diffuser as far away from the outlet as possible while still maintaining accessibility to the damper. Install so there is no flutter or vibration of the damper blade(s).

3.2 TURNING VANES

- A. Install turning vanes in all rectangular, mitered elbows according to SMACNA standards and/or manufacturer's recommendations.
- B. Install double wall, airfoil, 2" radius vanes in ducts with vane runner length 18" or greater and air velocity less than 2000 fpm. Install double wall, airfoil, 4-1/2" radius vanes in ducts with vane runner length 18" or greater and air velocity 2000 fpm or greater.
- C. If duct size changes in a mitered elbow, use single wall type vanes with a trailing edge extension. If duct size changes in a radius elbow or if short radius elbows must be used, install sheet metal turning vanes according to SMACNA Figure 2-5 and Figure 2-6.

3.3 FIRE DAMPERS

- A. Install dampers in strict accordance with manufacturer's installation instructions. Install damper sleeves with retaining angles on both sides of rated partition. Connections of ductwork to fire damper assemblies to be as specified on the installation instructions. Where it is necessary to set dampers out from the rated wall, install a sleeve extension encased in two hour rated fire proofing insulation. Install an access door at each fire damper, located to permit resetting the damper replacing the fusible link.
- B. Manually test each fire damper for proper operation by removing the fusible link. Repair or replace any fire damper that does not close completely. Re-install fusible link after test.

3.4 CONTROL DAMPERS

- A. Install dampers in locations indicated on the drawings, as detailed, and according to the manufacturer's instructions. Install blank-off plates or transitions where required for proper mixing of airstreams in mixing plenums. Provide adequate operating clearance and access to the operator. Install an access door adjacent to each control damper for inspection and maintenance.

3.5 SMOKE DETECTORS

- A. Wiring of detectors will be by the Electrical Contractor or Fire Alarm Contractor. Install an access door at each detector location.

3.6 ACCESS DOORS

- A. Install access doors where specified, indicated on the drawings, and in locations where maintenance, service, cleaning or inspection is required. Examples include, but are not limited to motorized dampers, fire and smoke dampers, smoke detectors, fan bearings, heating and cooling coils, filters, valves, and control devices needing periodic maintenance.
- B. Size and numbers of duct access doors to be sufficient to perform the intended service. Minimum access door size shall be 8" x 8" size for hand access, 18" x 18" size for shoulder access, or other size as indicated. Install access doors on both inlet and outlet sides of reheat coils as well as other duct mounted coils.
- C. Label fire, smoke and combination fire smoke dampers on the exterior surface of ductwork directly adjacent to access doors using a minimum of 0.5" height lettering reading, "SMOKE DAMPER" or "FIRE DAMPER". Smoke and combination fire smoke dampers shall also include a second line listing the individual damper tag. The tags must be coordinated with the mechanical schedules. Utilize stencils or manufactured labels. All other forms of identification are unacceptable. All labels shall be clearly visible from the ceiling access point.

3.7 FLEXIBLE DUCT

- A. Flexible duct may only be used for final connections of air inlets and outlets at diffuser, register, and grille locations. Where flexible duct is used, it shall be the minimum length required to make the final connections, but no greater than 5 feet in length, and have no more than one 90 degree bend.
- B. Secure inner jacket of flexible duct in place with stainless steel metal band clamp. Secure insulation vapor barrier jacket in place with steel or nylon draw band. Sheetmetal screws and/or duct tape will not be accepted.
- C. Flexible duct used to compensate for misalignment of main duct or branch duct will not be accepted.
- D. Individual sections of flexible ductwork shall be of one piece construction. Splicing of short sections will not be accepted.
- E. Flexible ductwork used as transfer duct shall be sized for a maximum velocity of 300 fpm.
- F. Penetration of any partition, wall, or floor with flexible duct will not be accepted.

3.8 DUCT LINING

- A. Apply lining to ductwork as scheduled.
- B. Do not apply lining to the following ductwork:
 - Outside air ductwork.
- C. Install liner in compliance with the latest edition of NAIMA's Fibrous Glass Duct Liner Standard. Locate longitudinal joints at the corners of duct only. Cut and fit to assure lapped, compressed joints. Coat all transverse and longitudinal joints and edges with adhesive. Provide metal nosing on leading edge where lined duct is preceded by unlined duct. Adhere liner to duct with full coverage area of adhesive. Additionally secure liner to duct using mechanical fasteners spaced as recommended by the liner manufacturer without compressing liner more than 1/8" with the fasteners.

3.9 FLASHINGS

- A. Flashing for roof curbs, equipment supports or rails located on roof will be installed by others.

3.10 DUCT FLEXIBLE CONNECTIONS

- A. Install at all duct connections to rotating or vibrating equipment, including air handling units (unless unit is internally isolated), fans, or other motorized equipment according to SMACNA Figure 2-19. Install thrust restraints to prevent excess strain on duct flexible connections at fan inlets and outlets; see Related Work.

3.11 SOUND ATTENUATORS

- A. Install sound attenuators in locations indicated on the drawings. Where modular installation is required, install units in a galvanized steel frame equipped with gaskets or seals between modules to prevent bypass of air.

3.12 HOODS FOR INTAKE AND EXHAUST

- A. Install in locations indicated on the drawings, coordinating the roof opening location with the General Contractor. Curbs are covered in Section 23 05 29.

3.13 LOUVERS

- A. Furnish louvers to the General Contractor for mounting in exterior walls. Connect outside air intake duct to the louver, sealing all connections air and watertight.
- B. Provide bird screen on inside of active louver area where none is provided with louvers. Where louvers are equipped with inside bird screen, remove screen at all locations where duct connections are not made.
- C. Install insulated metal panel on unused portion of louver. Panels must be sealed weathertight to louver assembly with flashing as required for proper drainage to outside of building. Paint outside surface of panel to match louver prior to installation. Where ductwork is visible through louver when viewed from outside the building, paint inside of duct to match louver color.

3.14 AIR FLOW STATIONS

- A. Install where indicated on the drawings and/or as scheduled and according to manufacturer's recommendations.

END OF SECTION 23 33 00

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for fans that are not an integral part of a manufactured device. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Operation and Maintenance Data
 - 9. Design Criteria
- C. PART 2 - Products
 - 1. General
 - 2. Backdraft Dampers
 - 3. Fan Inlet Airflow Stations
 - 4. Power Roof Exhaust Fans
 - 5. Ceiling Exhaust Fans
 - 6. Destratification Fans (HVLS)
- D. PART 3 - EXECUTION
 - 1. Installation

1.2 RELATED WORK

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment
- B. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- C. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. AMCA 203 AMCA Fan Application Manual - Troubleshooting
- B. AMCA 204 Standard Balance Quality and Vibration Levels for Fans
- C. AMCA 210 Laboratory Method of Testing Fans for Rating
- D. AMCA 211 Certified Ratings Program Product Rating Manual for Fan Air Performance
- E. AMCA 300 Reverberant Room Method for Sound Testing of Fans
- F. AMCA 500-D Laboratory Methods for Testing Dampers for Ratings
- G. ANSI 11 Method of Evaluating Load Ratings of Bearings
- H. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems
- I. UL 705 Standard Power Ventilators

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Include dimensions, capacities, fan curves, materials of construction, ratings, weights, motors and drives, sound power levels, appropriate identification, and vibration isolation for all equipment. Sound power levels to be based on tests performed according to AMCA Standard 300.
- C. Fan curves shall indicate the relationship of CFM to static or total pressure for various fan speeds. Brake horsepower, recommended selection range, and limits of operation are to also be indicated on the curves. Indicate operating point on the fan curves at design air quantity and indicate the manufacturer's recommended drive loss factor for the specific application. Tabular fan performance data is not acceptable.
- D. For variable air volume application, include data which indicates the effect of capacity control devices on performance.
- E. Submit color selection charts for equipment where applicable.

1.8 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.9 DESIGN CRITERIA

- A. Tested and certify all fans according to the applicable AMCA test code.
- B. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.
- C. Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA Publication 203, Appendix L.
- D. Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, provide any motor, drive and/or wiring changes required due to increased static pressure or baffling necessary to prevent uneven airflow or improve mixing.
- E. All internal insulation and other components exposed to the airstream are to meet the flame spread and smoke ratings contained in NFPA 90A.
- F. All roof mounted equipment to be provided with curbs or equipment stands according to specification in Section 23 05 29.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Use fan size, class, type, arrangement, and capacity as scheduled.
- B. Furnish complete with motors, wheels, drive assemblies, bearings, vibration isolation devices, and accessories required for specified performance and proper operation. All single phase motors to have inherent thermal overload protection.
- C. Statically and dynamically balance all fans so they operate without objectionable noise or vibration.

- D. All direct drive fan motors shall be provided with a means for balancing fan speed. E.g., solid state speed controller, potentiometer, VFD, etc.

2.2 BACKDRAFT DAMPERS

- A. Manufacturers: Backdraft dampers shall be provided by the same manufacturer as the specified exhaust fan. Acceptable fan manufacturers are listed under each fan type. Where motorized dampers are indicated, refer to section 23 09 14 and/or 23 33 00 for requirements.
- B. Construction: 18 gauge damper frame, minimum 0.025" thick damper blades with vinyl edge seals, axle, axle bearings and internal linkage. Material and finish shall match duct material where damper is installed, unless otherwise noted.
- C. Performance: Dampers shall have an air leakage rate not greater than 20 cfm/ft² where not less than 24" in either dimension and 40 cfm/ft² where less than 24" in either dimension. The rate of air leakage shall be determined at 1.0" water gauge when tested according to AMCA 500D for such purpose. The dampers shall be labeled by an approved agency.

2.3 FAN INLET AIRFLOW STATIONS

- A. For fans that are specified or scheduled to have fan inlet airflow station, provide a piezometer ring airflow station mounted on the fan inlet bell housing. Pressure tubes from the piezometer ring shall be extended to a termination plate labeled with the high and low pressure connections. Provide an initial flow rate coefficient that will be adjusted by the balancing contractor for measured flow reading. Piezometer ring airflow station shall measure static pressure drop through the fan inlet cone to provide an overall airflow measurement to within +/- 5% accuracy. In lieu of a piezometer ring airflow station, a fan inlet probe airflow station as specified under Section 23 09 14 may be furnished and factory mounted in the fan inlet. Differential pressure transducers for measuring the velocity pressure for airflow measurement shall be supplied under Section 23 09 14 and be mounted in the temperature control panel.

2.4 POWER ROOF EXHAUST FANS

- A. Manufacturers: Carnes, Greenheck, PennBary, Jenn-Air, Cook, ACME, Twin City Fan, CaptiveAire, or approved equal.
- B. Provide upblast or downblast units as scheduled.
- C. Construction: Fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. The discharge baffle shall have a rolled bead for added strength. A two-piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Aluminum bird screen at discharge.
- D. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency and minimize noise and turbulence
- E. Motor: AC induction or EC motor as indicated. Motors that are single phase shall have thermal overload protection with integral disconnect switch.
- F. Electrical Contractor will provide disconnect switches and thermal overload protection for units with three phase motors.

2.5 CEILING EXHAUST FANS

- A. Manufacturers: Broan, Carnes, Greenheck, PennBarry, Jenn-Air, Cook, ACME, Twin City Fan, Panasonic or approved equal.

- B. Centrifugal forward-curved blower wheel, minimum 22 gauge galvanized steel housing with acoustical lining, integral exhaust grille, adjustable mounting brackets to allow for any ceiling thickness, isolation kit, permanently lubricated motor, integral junction box with permanently lubricated and thermally protected motor factory wired, and integral backdraft damper.
- C. Provide wall, eave, or roof discharge assembly, as indicated on the drawings.

2.6 DESTRATIFICATION FANS (HVLS)

- A. Manufacturers: Big Ass Fans, MacroAir, Hunter, Greenheck or approved equal.
- B. Industrial Control Panel: The fan controller shall consist of a Variable Frequency Drive (VFD) enclosed in an aluminum enclosure. This enclosure is designed to contain the VFD for maximum cooling efficiency and is remoted mounted or pre-mounted on the downrod along with receptacles and electrical whip for a plug-n-play install. Provide an external relay for integration into fire alarm system where indicated.
- C. Airfoil System: The fan shall be equipped with airfoils made from aluminum alloy. Each airfoil shall be connected to the hub by high strength set screws with pivoting saddles or bolts with lock washers and then by a secondary locking pin system. Each airfoil shall be manufactured with a precision cut, swept style tip
- D. Hub Motor: The fan motor shall be a high torque permanent magnet motor (brushless DC, electronically commutated, or synchronous) rated for continuous operation at maximum speed without the use of a gearbox or other mechanical torque multiplier. The motor shall be a totally enclosed non-ventilated design with the capacity for continuous operation in 32°F to 140°F ambient conditions. Where used in nonheated spaces, protections shall be provided to allow for operation down to -25°F. The hub motor enclosure shall be cast aluminum or zinc plated steel for high strength and durability.
- E. Mounting System: The mounting system shall be designed for quick, secure installation to a wide variety of ceiling structural supports. All components of the mounting system shall be made from low-carbon steel and ERW tubing. The downrod shall be pre-wired with a pin and sleeve connection for simple, safe and economical installation. All mounting bolts shall be stainless or carbon steel SAE Grade 5 or equivalent.
- F. Safety Cables: The fan shall be equipped with a 1/4" or 3/16" safety cable composed of high-tensile ANSI 316 stainless or galvanized steel. The minimum breaking strength of the cable assembly supplied is 4,750 lbs. Wire rope conforms to ASTM A492 and shall be provided with wire rope clamps as required per manufacturer.
- G. Guy Wires: Guy wires shall be included for all installations and shall include beam clamps, turnbuckle, locking fasteners, and accessories to limit the potential for lateral movement.
- H. Digital Variable Speed Wall Control: The fan shall be equipped with a low-voltage wired remote wall control providing control of all fan functions. The wall control shall be capable of mounting to a standard electrical box or directly to a wall surface. The wall control shall include a touchscreen for controlling the fan's power, speed, rotation, and fault readout information. Communication with the fan drive and controller shall be by a standard, commercially available CAT5 (or higher) Ethernet cable that is field installed and provided by the installer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as shown on the drawings, as detailed, and according to manufacturer's installation instructions.
- B. Install thrust restraints according to the requirements of Section 23 05 48.
- C. Dampers shall be installed according to manufacturer's installation instructions and be installed square and free from racking. Dampers must be accessible to allow inspection, adjustment, and replacement of components. Provide access door as specified under section 23 33 00.

END OF SECTION 23 34 00

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for air terminal equipment. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Operation and Maintenance Data
 - 9. Design Criteria
- C. PART 2 - Products
 - 1. Supply Air Terminal Boxes
 - 2. Access Doors
 - 3. Insulation
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Adjusting

1.2 RELATED WORK

- A. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC
- B. Section 23 09 93 – Sequence of Operation for HVAC Controls
- C. Section 23 31 00 - HVAC Ducts and Casings
- D. Section 23 33 00 - Air Duct Accessories
- E. Section 23 82 00 - Convection Heating and Cooling Units

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- B. UL 181 - Factory-Made Air Ducts and Connectors.
- C. ARI-ADC Standard 880.
- D. ASTM E84 – Surface Burning Characteristics of Building Materials.
- E. UL 723 – Surface Burning Characteristics of Building Materials.

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Contractor shall submit air terminal unit data including materials of construction, dimensions, scheduled flow rates, pressure drops, radiated and discharge sound power levels, reset volume controller data, actuator spring range and torque data.

1.8 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.9 DESIGN CRITERIA

- A. Select sizes, capacities, configuration, and operating characteristics as shown on the plans and/or as scheduled.

PART 2 - PRODUCTS

2.1 SUPPLY AIR TERMINAL BOXES

- A. Units shall be single duct and pressure independent.
- B. Manufacturers: Carnes, Envirotec, Metal-Aire, Titus, Trane, Nailor, Price or equal.
- C. Construction:
 - 1. Unit casing shall be minimum 22 gauge steel and internally insulated with 1" rigid fiberglass insulation with a foil scrim face or 1" polyolefin closed cell insulation. Construction to meet UL 181 and NFPA 90A. Casing shall be sealed to limit leakage to a maximum of 20 cfm at 3.0 inches of static pressure. Casing outlet shall have slip and drive joint for connection to discharge ductwork.
 - 2. Metal damper blade shall be mounted to shaft having self-lubricated bearings. Shaft end shall be marked to indicate damper position and shall have a built-in stop to prevent overstroking. Damper blade shall close off against gasket to limit leakage to 10 cfm at 6.0 inches of differential static pressure. Damper linkage shall be sized to accept at least 40 inch-pounds of torque to the damper shaft. Damper shaft shall be provided with a marking indicating damper position.
 - 3. Round inlet collar shall be equipped with a multi-point flow sensor that shall amplify the measured velocity pressure. Pneumatic tubing from flow sensor to differential pressure transducer shall be UL listed, fire retardant (FR) type.
- D. Hot Water Reheat Coil: Reference section 23 82 00 for hot water reheat coil specifications

2.2 ACCESS DOORS

- A. Standard Access Doors: Access door to be designed and constructed for the pressure class of the duct in which the door is to be installed. Doors in exposed areas shall be hinged type with cam sash lock. Hinges shall be steel full length continuous piano type. Doors in concealed spaces may be secured in place with cam sash latches. For both hinged and non hinged doors provide sufficient number of cam sash latches to provide air tight seal when door is closed. Do not use hinged doors in concealed spaces if this will restrict access. Use minimum 1" deep 24 gauge galvanized steel double wall access doors with minimum 24 gauge galvanized steel frames. For non-galvanized ductwork, use minimum 1" deep double wall access door with frame that shall use materials of construction identical to adjacent ductwork. Provide double neoprene gasket that shall provide seals from the frame to the door and frame to the duct. When access doors are installed in insulated ductwork or equipment provide insulated doors with insulation equivalent to what is provided for adjacent ductwork or equipment. Access doors constructed with sheet metal screw fasteners will not be accepted.

2.3 INSULATION

- A. Materials or accessories containing asbestos will not be accepted.
- B. Use composite insulation systems (insulation, jackets, sealants, and adhesives) that have a flame spread rating of 25 or less and smoke developed rating of 50 or less.
- C. The following two internal insulation options may be utilized.
 - 1. Rigid Fiberglass Insulation:
 - a. Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75°F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450°F.
 - b. Foil-scrim-kraft vapor barrier jacket, factory applied to insulation, maximum permeance of .02 perms. All exposed insulation edges shall be covered with metal nosing.
 - 2. Polyolefin Insulation: Flexible closed cell, minimum nominal density of 1.5 lbs. per cu. ft., thermal conductivity of not more than 0.24 at 75°F, minimum compressive strength of 5 psi at 25% deformation, maximum water vapor permeability of 0.0 perm inch, maximum water absorption of 0% by weight and volume, rated for service range of -165°F to 210°F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units as indicated on project drawings and according to the manufacturer's installation instructions.
- B. Mount air terminal boxes with a minimum 3' of straight ductwork upstream of inlet flow sensor for sizes 12" diameter and below. Provide a minimum of 3X the inlet diameter of straight duct upstream of the inlet flow sensor for inlet sizes above 12" diameter.
- C. Provide at least 24" of clearance on controller side of the air terminal unit. The clearance area shall extend the full length of the supply air terminal unit and the full length (including the access door) of the exhaust/return air terminal unit.
- D. Support air terminal units from building structure using sheet metal straps or trapeze hanger with rods. Do not mount air terminal units off of adjacent ductwork or piping
- E. Access Doors.
 - 1. Duct Access Doors – Square Duct: Provide duct access doors in duct or extended supply air terminal unit upstream and downstream of the reheat coil. Duct access doors shall be as large as duct allows with a maximum size of 18"x18". Install heating coils according to Section 23 73 12 - Air Handling Unit Coils.
- F. Insulation:
 - 1. Rigid Fiberglass Insulation: All rigid duct insulation edges shall be covered with metal nosing. Foil scrim face must completely separate the rigid fiberglass duct material from the air stream.
 - 2. Polyolefin Insulation: Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints. Place insulation with edge joints firmly butted pressing to surface for full adhesion. Seal seams and joints vapor tight.
- G. For supply air terminal units, provide 5' to 10', as indicated, of 1" thick lining immediately downstream from air terminal unit discharge. Where hot water reheat coils are field or factory installed, provide 5' to 10', as indicated, of 1" thick lining in ductwork immediately downstream of reheat coil. Refer to specification section 23 33 00 – Air Duct Accessories for liner specification.

3.2 ADJUSTING

- A. Coordinate adjustment of air terminal units with section 23 05 93 - Testing, Adjusting and Balancing.

END OF SECTION 23 36 00

SECTION 23 37 13 - DIFFUSERS, REGISTERS & GRILLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for air terminal equipment. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Design Criteria
- C. PART 2 - Products
 - 1. Manufacturers
 - 2. Linear Bar Supply Registers and Grilles (Floor Application)
 - 3. Square Ceiling Diffusers - Plaque
 - 4. Side-Wall Registers and Grilles
 - 5. Eggcrate Grille
- D. PART 3 - EXECUTION
 - 1. Installation

1.2 RELATED WORK

- A. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
- B. Section 23 31 00 - HVAC Ducts and Casings
- C. Section 23 33 00 - Air Duct Accessories

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- B. UL 181 - Factory-Made Air Ducts and Connectors.
- C. ARI-ADC Standard 880.

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Furnish submittal information including, but not limited to, the following:
 - Manufacturer's name and model number
 - Identification as referenced in the documents
 - Capacities/ratings
 - Materials of construction
 - Sound ratings
 - Dimensions
 - Finish
 - Color selection charts where applicable
 - Manufacturer's installation instructions
 - All other appropriate data

1.8 DESIGN CRITERIA

- A. All performance data shall be based on tests conducted according to Air Diffusion Council (ADC) Test Code 1062 GRD 84.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers for specific products are listed under each item.

2.2 LINEAR BAR SUPPLY REGISTERS AND GRILLES (FLOOR APPLICATION)

- A. Krueger P1800, Titus Series CT, Carnes CC, CT or CW, Metal Aire Series 2000, Price series LBP, Tuttle & Bailey.
- B. Steel or extruded aluminum as scheduled with frame type appropriate for floor installation as indicated.
- C. Fixed blades at 0, 15 or 30 degree deflection as scheduled.
- D. Aluminum finish unless otherwise indicated.

2.3 SQUARE CEILING DIFFUSERS - PLAQUE

- A. Titus model OMNI, Carnes series SFPA/SHPA, Price model ASDP, Tuttle & Bailey series 1100, Metal Aire series 5750, Krueger series PLQ/5PLQ, and Raymon PRO-2.
- B. Aluminum unless otherwise indicated, plaque face furnished with frame type appropriate to installation.
- C. Diffuser shall have throw characteristics of a round diffuser having a 360° horizontal blow pattern.
- D. One-piece removable square face plaque with one-piece backpan.
- E. White, baked enamel finish or powder coat finish, unless otherwise indicated.

2.4 SIDE-WALL REGISTERS AND GRILLES

- A. Titus Series 300 (supply) and Series 350 (return/exhaust), Carnes Model R Series, Price Model 520 (Supply) or 530 (return/exhaust), Metal Aire Series V4000 or H4000, Krueger Series 880, Tuttle & Bailey A54 (supply) and A70D (return/exhaust), Raymon Series RA.
- B. Aluminum unless otherwise indicated, with frame type appropriate to installation.
- C. Double deflection type blade supply registers and supply grilles allow deflection adjustment in all direction.
- D. Opposed blade volume control damper supply registers, operable from face.

- E. Fixed blade, 45 degree core return and exhaust registers and grilles unless otherwise indicated.
- F. Opposed blade volume control damper return registers, operable from face, where indicated.
- G. Register and grille sizes as shown on drawings and/or as scheduled.
- H. White, baked enamel finish or powder coat finish, unless otherwise indicated.
- I. Screw holes on surface counter sunk to accept recessed type screws.

2.5 EGGCRATE GRILLE

- A. Titus model 50, Carnes model RAE or RAT, Price model 80, Metal Aire model CC, Krueger model EGC, Tuttle & Bailey CRE 500, or Raymon model ECR.
- B. Aluminum construction with frame type appropriate to installation.
- C. Grille face 1/2" x 1/2" or 1" x 1" grid pattern 1/2" deep with a minimum of 85% free area.
- D. Grille sizes and finishes as shown on drawings and/or as scheduled.
- E. White, baked enamel finish or powder coat finish, unless otherwise indicated.
- F. Screw holes on surface counter sunk to accept recessed type screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install grilles, registers and diffusers as shown on drawings and according to manufacturer's instructions.
- B. Unless otherwise indicated, size ductwork drops to diffusers or grilles to match unit collar size.
- C. Seal connections between ductwork drops and diffusers/grilles airtight.
- D. Where diffusers, registers and grilles cannot be installed to avoid seeing inside duct, paint inside of duct with flat black paint to reduce visibility.

END OF SECTION 23 37 13

SECTION 23 41 00 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for air system filters. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Operation and Maintenance Data
 - 9. Design Criteria
- C. PART 2 - Products
 - 1. Manufacturers
 - 2. Panel Filters
 - 3. MERV 8 Filters
 - 4. MERV 13 Filters
 - 5. Housings for Panel Filters
 - 6. Housings for MERV 8 Filters
 - 7. Side Access Filter Housings
 - 8. Front Access Filter Holding Frames
 - 9. Filter Gauges
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Filter Gauges

1.2 RELATED WORK

- A. Section 23 07 00 - HVAC Insulation
- B. Section 23 73 13 - Modular Indoor Central-Station Air-Handling Units
- C. Section 23 72 00 - Air-to-Air Energy Recovery Equipment
- D. Section 23 82 00 - Heating and Cooling Terminal Units

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ASHRAE Standard 52
- B. UL 181 – Standard for Factory-Made Air Ducts and Air Connectors
- C. UL 586 – Standard for High Efficiency Particulate Air Filter Units
- D. UL 900 – Standard for Air Filter Units

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Include data concerning dimensions, materials, efficiencies, installation instructions and appropriate identification.
- C. Independent test reports verifying filter performance, test procedures and ratings.
- D. Provide two (2) extra sets of filters for each unit that contains filters.

1.8 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.9 DESIGN CRITERIA

- A. Use UL Class 1 or Class 2 filters unless noted otherwise (Reference applicable UL standard referenced).
- B. Efficiencies indicated in this section are based on ASHRAE Standard 52.
- C. Fan motors have been selected to operate against the resistance of dirty filters as specified in this section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. American Air Filter, Barnebey-Cheney, Cambridge, Continental, Flanders, Camil-Farr, Mine Safety Appliances, Research Products, BLC Industries or approved equal.

2.2 PANEL FILTERS

- A. Use 1" (or as scheduled) thick fiberglass blanket enclosed in a cardboard frame and reinforced with a perforated metal retainer on the air leaving side. Coat media with flameproof, non- volatile adhesive.
- B. Media nominal rating to be 500 FPM face velocity, 0.15 inch WG initial resistance, 0.50 inches WG recommended final resistance. Average arrestance of filter media shall be 80%.
- C. Provide filter holding frame.

2.3 MERV 8 FILTERS

- A. Use 2" thick, pleated panels, 100% synthetic, self supported media fully bonded and sealed in cardboard frame.
- B. Media nominal rating to be 500 FPM face velocity, 0.20 inch WG initial resistance, 1.0 inches WG recommended final resistance. Average arrestance of filter media shall be 90 92%.
- C. Furnish a side access housing or holding frame as scheduled.
- D. Filter tracks shall be constructed to provide clearance between the pre-filter and final-filter media to facilitate the installation of static pressure taps.

2.4 MERV 13 FILTERS

- A. Where indicated, use bag type, non-supported pockets, polypropylene media with synthetic backing scrim, fully bonded and sealed in a factory fabricated frame.
- B. Where indicated, use box type, ultra-fine microglass pleated media, water resistant, plastic or aluminum separators, fully bonded and sealed in a factory fabricated frame. Media pleats to be self-supporting under varying airflow conditions
- C. Media nominal rating to be 500 FPM face velocity, 0.35 inch WG initial resistance, 1.0 inches WG recommended final resistance.
- D. Furnish a side access filter housing or holding frame as scheduled. Filter tracks shall be constructed to provide clearance between the pre-filter and final-filter media to facilitate the installation of static pressure tips.

2.5 HOUSINGS FOR PANEL FILTERS

- A. Manufactured by air handling unit manufacturer, filter media manufacturer, or contractor fabricated. Casing and tracks constructed of galvanized or enameled steel or aluminum. Provide access to the media tracks from outside the casing so media and be readily changed.

2.6 HOUSINGS FOR MERV 8 FILTERS

- A. Housing or holding frame to be of the same manufacturer as filter media or provided by the air handling unit manufacturer. Contractor fabricated housings or filter racks will not be accepted. Casing and tracks constructed of galvanized or enameled steel or aluminum. Provide access to the media tracks from outside the casing so media and be readily changed. Filter tracks shall be constructed to provide clearance between the pre-filter and final-filter media to facilitate the installation of static pressure tips.

2.7 SIDE ACCESS FILTER HOUSINGS

- A. Galvanized steel housing with aluminum or galvanized steel filter mounting tracks. Mounting tracks and access doors to have gaskets to minimize air bypass around the filters. Housing assembly to be suitable for use in duct systems per scheduled system pressure.
- B. Standard filter sections provided by air handling unit manufacturers may be used for MERV 13 filters.
- C. Insulate housings where adjacent duct or air handling apparatus is insulated. Insulation to be contained within a 2" thick, double wall steel panel and meet the requirements specified for adjacent duct or apparatus.
- D. Furnish a door on each end of the housing to facilitate filter changing. Doors to be hinged and provided with lever handle latches to secure the door. Doors shall not be secured with nuts, bolts, wing nuts, or sheet metal screws.
- E. Furnish housings for MERV 13 filters with a lever action sealing mechanism to secure media in tracks.
- F. Include an integral prefilter track for installation of MERV 8 prefilters. Filter tracks shall be constructed to provide clearance between the pre-filter and final-filter media to facilitate the installation of static pressure tips.

2.8 FRONT ACCESS FILTER HOLDING FRAMES

- A. Construct frames of aluminum or corrosion resistant coated steel with provisions for assembly in a bank.
- B. Frames for MERV 13 filters to have provisions for installation of MERV 8 prefilters upstream of high efficiency media. Secure prefilters by means of spring clips or a spring loaded mechanism. Spring clips or latches shall be on the upstream side of the prefilter. Provide leakproof gaskets between prefilter media and holding frame. Prefilters shall be removable without removal of final filters.

2.9 FILTER GAUGES

- A. Manufacturers: Dwyer, or approved equal.
- B. Direct reading, dial type, diaphragm actuated, in a metal case. Lettering shall be black figures on white background. Provide front recalibration adjustment.
- C. Provide gauges with the following ranges:

<u>Filter Type</u>	<u>Scale Range (inch W.G.)</u>
Panel Filters	0.0 to 0.5
MERV 8	0.0 to 1.0
MERV 13	0.0 to 2.0
- D. Provide one gauge for each filter bank, suitable for flush or surface mounting. Include an air filter gauge accessory package consisting of mounting bracket, aluminum tubing, two static pressure tips, and vent valves for each gauge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Where air handling equipment is to be used for temporary heating or ventilation of a facility, do not operate the equipment until specified filter media has been installed. Contractor shall be responsible for maintaining the cleanliness of air handling apparatus and air distribution systems during construction through regular inspection and changing of filter media throughout the construction period.
- B. Where air handling apparatus is used during the construction period, install new filter media prior to start of air balancing. Additionally, deliver two new sets of media to the owner prior to substantial completion.
- C. Install units as shown on drawings and details according to manufacturer's instructions.
- D. Reinforce filter holding frames per manufacturer's instructions.
- E. Maintain necessary clearance for changing filters.

3.02 FILTER GAUGES

- A. Install filter gauge static pressure tips upstream and downstream of filters. Mount gauge on outside of filter housing or filter plenum in accessible position outside of the unit housing, install tubing and gauge valves between gauge and sensor tips. Adjust and level each gauge.

END OF SECTION 23 41 00

SECTION 23 51 00 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for all breechings, chimneys, vents, and stacks. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Design Criteria
- C. PART 2 - Products
 - 1. Vents for Condensing Appliances
 - 2. Double Wall Type "B" Vents and Breeching
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Cleaning and Protection

1.2 RELATED WORK

- A. Section 23 07 00 - HVAC Insulation

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. UL 103 Safety Factory-Built Chimneys for Residential Type and Building Heating Appliances
- B. UL 378 Draft Equipment
- C. UL 441 Gas Vents
- D. UL 959 Medium Heat Appliance Factory-Built Chimneys
- E. UL 1738 Venting Systems for Gas-Burning Appliances, Categories II, III, and IV
- F. UL 2561 1400 Degree Fahrenheit Factory-Built Chimneys
- G. ANSI/ASTM C64
- H. ANSI/ASTM C105
- I. ANSI/ASTM A525 Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dipped Process
- J. ASTM A527 Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dipped Process, Lock-Forming Quality
- K. ASTM A53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

- L. ASTM A234 Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- M. NFPA 211 Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Include materials of construction, dimensions, weight, support and layout of breechings. Where factory-built units are used, submit layout drawings indicating plan view and elevations. Identify all methods of support and building structural members utilized for such support.
- C. Submit manufacturer's installation instructions including required clearance to combustible materials.
- D. If project includes new boilers and venting, the venting shall be provided and/or approved by the boiler representative.

1.8 DESIGN CRITERIA

- A. Follow the requirements of NFPA 211 and State codes.
- B. Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labelled.

PART 2 - PRODUCTS

2.1 VENTS FOR CONDENSING APPLIANCES

- A. CPVC: Schedule 40 CPVC for use on condensing appliances or pressurized venting systems serving Category II, III or IV appliances and as allowed by the equipment manufacturer. The material used in the manufacture of the pipe shall be a rigid chlorinated polyvinyl chloride (CPVC) compound, Type IV Grade 1, with a Cell Classification of 23447 as defined in ASTM D1784, and be light gray in color. Size vents in strict accordance with appliance manufacturer's requirements.

2.2 SINGLE OR DOUBLE WALL TYPE "B" GAS VENTS AND BREECHING

- A. Manufacturer: Selkirk Metalbestos, Metal-Fab, Air-Jet, Hart & Cooley, General Products Co., or approved equal.
- B. Vent pipe, breeching, and accessory fittings to be UL listed type "B".
- C. Fabricate inner pipe of sheet aluminum or stainless steel, and outer pipe of galvanized sheet steel, tested in compliance with UL 441. Minimum thickness of inner and outer pipes to be as follows:

Pipe Size	Thickness Inner Pipe	Thickness Outer Pipe
Round up to 6"	0.012"	28 gauge
Round, 7" to 18"	0.014"	28 gauge

- D. Provide all necessary accessories including flashing, counter flashing, storm collar, insulated thimble, rain cap with bird screen, clean out, fittings and all necessary supports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. CPVC:

1. Provide vents, fittings, and accessories according to appliance manufacturer's recommendations.
2. Size vents in strict accordance with appliance manufacturer's requirements. Use CPVC only on appliances allowed by the manufacturer and where the appliance operating conditions allow its use.
3. Pitch exhaust vents up from appliance to point of termination outside building. Provide drain points as indicated and per the manufactures recommendation to allow proper draining of condensate. Provide Flue Gas Condensate pH Neutralization at each drain piping termination point.
4. Locate exhaust termination and combustion air intake according to appliance manufacturer's recommendations to prevent re-entry of products of combustion.
5. Termination of exhaust within 10 feet of operable windows, other building openings, or air intakes will not be accepted
6. Pitch combustion air vents from intake down toward appliance connection.
7. All joints of combustion air and exhaust vents shall be solvent welded and leak tight. Provide drain connection at base of exhaust vent, and pipe to nearest open site drain.

B. Single or Double Wall Metal Stacks and Breeching:

1. Install stack, breeching, and accessories according to the manufacturer's recommendations, maintaining minimum clearances from combustibles specified in UL listing.
2. Support breechings from building structure with suitable ties, braces, hangers and anchors to hold shape and prevent buckling. Minimum support for vertical sections shall be at all floor penetrations. Support from roof structure or adjacent structural surfaces.
3. Install breechings with a minimum of joints. Align connections accurately and maintain smooth internal surfaces.
4. Maintain UL listed minimum clearances from combustibles.
5. Install stacks plumb. Pitch breeching upward from fuel fired equipment to chimney or stack.
6. Clean breechings, chimneys, and stacks during installation, removing dust and debris.
7. At appliances, provide slip joints to allow removal of appliances without removal or dismantling of breechings, chimneys, or stacks.
8. Seal all joints of positive pressure stacks and breeching according to manufacturer's recommendations, using only sealants recommended by stack manufacturer.

3.2 CLEANING AND PROTECTION

- A. Clean breeching internally during installation to remove dust and debris.
- B. At ends of breeching and chimneys which are not completed or connected to equipment, provide temporary closure which will prevent entrance of dust and debris until final connections are made.

END OF SECTION 23 51 00

SECTION 23 52 00 - HEATING BOILERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for hot water heating equipment. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Energy Efficiency
 - 8. Submittals
 - 9. Operation and Maintenance Data
 - 10. Registration
 - 11. Warranty
- C. PART 2 - Products
 - 1. Sealed Combustion Boiler, Condensing, Hi-efficiency, 399MBH and Below
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Boilers
 - 3. Owner Training

1.2 RELATED WORK

- A. Section 23 05 23 - General-Duty Valves for HVAC Piping
- B. Section 23 21 13 - Hydronic Piping
- C. Section 23 51 00 - Breechings, Chimneys, and Stacks

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ASME CSD-1 Control and Safety Devices for Automatically Fired Boilers
- B. ASME Boiler and Pressure Vessel Code I - Rules of Construction of Power Boilers
- C. ASME Boiler and Pressure Vessel Code VIII - Rules for Construction of Pressure Vessels
- D. ASME Boiler and Pressure Vessel Code IX - Welding and Brazing Qualifications
- E. ASME Boiler and Pressure Vessel Code IV - Rules for Construction of Heating Boilers
- F. UL 795 Commercial Industrial Gas Heating Equipment
- G. NFPA 70 Electrical wiring and devices
- H. National Electric Code

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.

- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.
- 1.6 QUALITY ASSURANCE
- A. Refer to Division 1, General Conditions, Equals and Substitutions.
- 1.7 ENERGY EFFICIENCY
- A. All boilers with a capacity of less than 300,000 btu/hr input must be labeled as Energy Star by its manufacturer.
 - B. All boilers with a capacity of 300,000 btu/hr input must meet the efficiencies specified. Minimum boiler efficiencies are based on Federal Energy Management Program (FEMP) recommendations.
- 1.8 SUBMITTALS
- A. Refer to Division 1, General Conditions, Submittals.
 - B. Include data concerning dimensions, capacities, and material of construction, ratings, weights, manufacturer's installation requirements and performance limitations.
 - C. Submit manufacturer's installation instructions including required clearance to combustible materials.
- 1.9 OPERATION AND MAINTENANCE DATA
- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.
- 1.10 REGISTRATION
- A. Complete Boiler and Unfired Pressure Vessel (UPV) Installation Registration and forward to the Department of Safety and Professional Services according to the Wisconsin Administrative Code Chapter SPS 341.24.
- 1.11 WARRANTY
- A. 10-year heat exchanger, 5-year parts, except igniter. All other boiler, burner and control parts warranted for one year from startup.

PART 2 - PRODUCTS

- 2.1 SEALED COMBUSTION BOILER, CONDENSING, HI-EFFICIENCY, 399MBH AND BELOW
- A. Manufacturer: Triangle Tube Prestige Solo, NTI, or Lochinvar Knight.
 - B. Provide units with capacity and operating characteristics indicated on schedules.
 - C. Boiler ASME 'H' stamped and designed per ASME. Furnish a relief valve in compliance with ASME section IV, and set at 30 psig. All internal combustion chamber, and internal burner components, shall be manufactured with materials suitable to withstand constant operation under condensing conditions. Combustion chamber shall have a condensate drain to discharge any condensate buildup.
 - D. Boiler efficiency 90%+ per ANSI Z21.13, and operation in the condensing mode with inlet temperatures as low as 90°F.
 - E. Combustion air intake capable of accepting either free mechanical room air, or direct outside air through a sealed intake pipe of the length and diameter shown on drawings. Provide inlet/outlet combustion vent temperature fittings with direct outside air application.
 - F. Baked enamel finish boiler sheet metal jacket with removal panels for maintenance access.
 - G. Inlet and outlet temperature gauge to monitor inlet and outlet water temperatures.

- H. Provide each boiler with a low water cutout operationally testable, manually reset on loss of low-water and auto-reset on loss of power according to ASME Section IV and CSD-1.
- I. Provide each boiler with dual over temperature protection, including manual reset, according to ASME Section IV and CSD-1.
- J. Provide remote fault alarm contact for flame sensor and high temperature limit failure.
- K. Provide single point wiring for controls and fan.
- L. Natural gas-fired burners forced draft power type with a positive pressure at the boiler discharge. Stainless steel burner mixer. Maximum Nox emissions under 20 PPM.
- M. Furnish units with fuel trains and operating controls conforming to the latest UL or equivalent agency approval. Boiler/burner package shall be factory assembled, wired, mounted, and factory fire tested.
- N. Provide integral control capable of staging boilers to maintain peak seasonal efficiency. Control shall include a sensor to monitor main loop system temperature, and a sensor to monitor outside air temperature. Control shall be capable of outdoor reset, loop temperature span, and set loop temperature. Control shall have the capability to stage boilers based on loop temperature and outdoor reset for highest operating seasonal efficiencies. Control shall be capable of starting and stopping the system based on a remote contact closure, and have the ability to change setpoint from a remote location.
- O. Boiler shall be equipped to communicate with the building automation system via BACnet MS/TP protocol.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units as shown on plans, as detailed, and according to manufacturer's installation instructions.
- B. Install all items shipped loose by equipment manufacturer under supervision of equipment manufacturer's field service personnel.

3.2 BOILERS

- A. Pipe boiler drains to nearest floor drains.
- B. Provide factory start-up. If start-up is provided at a time that the conditions do not call for heating, a follow-up start-up shall be provided in October of that year.

3.3 OWNER TRAINING

- A. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 2 hours.

END OF SECTION 23 52 00

SECTION 23 55 00 - FUEL-FIRED HEATERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for fuel-fired heaters. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Operating and Maintenance Data
 - 9. Warranty
- C. PART 2 - Products
 - 1. Gas Fired Unit Heaters
 - 2. Direct Fired Makeup Air Units
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Gas Fired Unit Heaters
 - 3. Makeup Air Units

1.2 RELATED WORK

- A. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment
- C. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
- D. Section 23 51 00 - Breechings, Chimneys, and Stacks

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. AGA American Gas Association
- B. ANSI Z83.4 Direct Gas Fired Makeup Air Heaters
- C. ANSI Z83.6 Gas Fired Infrared Heaters
- D. GAMA Gas Appliance Manufacturers Association
- E. NEC National Electrical Code

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Include specific manufacturer and model numbers, equipment identification corresponding to project drawings and schedules, dimensions, capacities, materials of construction, ratings, weights, power requirements and wiring diagrams, filter information and information for all accessories.

1.8 OPERATING AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.9 WARRANTY

- A. Gas fired unit heaters heat exchangers warranted for five years. Remainder of unit heater components warranted for 1 year from startup.
- B. Direct fired make-up air units warranted for 12 months from date of startup.

PART 2 - PRODUCTS

2.1 GAS FIRED UNIT HEATERS

- A. Manufacturers: Modine, Reznor, Sterling or Trane.
- B. Horizontal discharge, direct vent sealed combustion type. AGA certified for use with natural gas. Minimum combustion efficiency (Ec) of 80%. All wiring shall comply with the National Electrical Code.
- C. Construct casing of cold rolled steel with baked enamel finish. Direct drive propeller type fan statically and dynamically balanced and including fan safety guard and adjustable vertical and horizontal louvers for control of air diffusion on discharge of unit. Aluminized steel burners, electronic spark ignition with electronic flame supervision and timed lockout control. Heavy gauge aluminized or stainless steel heat exchanger as indicated and factory installed induced draft blower for heat exchanger prepurge and combustion gas venting. Provide a hinged access panel on the bottom of the unit to access the burner or provide side access (pull out drawer) to burner assembly. Single point power connection. Unit must be approved for vertical or side wall venting
- D. Provide spark ignited intermittent pilot system with electronic flame supervision.
- E. AGA gas controls, including manual main shut off valve, 24 volt redundant combination gas control valve with 100 percent safety shut off valve and main gas pressure regulator.
- F. Provide fan controls and limit safety controls including but not limited to:
 - Pressure switch to verify combustion/exhaust gas airflow
 - High limit controls
 - Fan time delay to delay the fan start until the heat exchanger reaches a predetermined temperature and to allow the fan to operate, after burner shut down, to remove heat exchanger residual heat.
- G. Refer to Sections 23 09 24, 23 09 14 and 23 09 15 for temperature control work.
- H. Provide an air inlet/vent termination assembly and threaded hanger connections.

2.2 DIRECT FIRED MAKEUP AIR UNITS

- A. Manufacturers: AbsolutAire, CaptiveAire, Greenheck, Hastings, Rupp, Sterling, Titan Air, Thermotek or Weather-Rite.
- B. AGA certified for use with natural gas.

- C. Outdoor units cabinet constructed of 16 gauge aluminized steel with enamel finish or 16 gauge galvanized steel. Gasketed access panels and doors for access to all components including blower, burner and electrical components. All seams to be foam taped or caulked to prevent moisture from entering the unit. Provide a weatherhood constructed of 16 gauge galvanized steel with galvanized bird screen.
- D. Indoor units cabinet constructed of 16 gauge aluminized steel with enamel finish or 18 gauge galvanized steel, gasketed access panels and doors for access to all components including blower, burner and electrical components.
- E. Insulate cabinet with 1" thick dual wall construction.
- F. Provide centrifugal DWDI forward curved or mixed flow fan as indicated, with statically and dynamically balanced wheels and one piece through shaft and heavy-duty sealed ball bearings with extended grease fittings. Fan shall be isolated from unit with vibration isolators and flexible connectors to prevent vibration from transmitting to the building. As an option to internal vibration isolation provide isolators for floor mounting or suspending unit as indicated along with pipe flex connectors and duct flex connectors as indicated in section 23 05 48.
- G. Motors shall be open drip proof with adjustable belt drives or direct drive as scheduled.
- H. Modulating type direct fired burner shall be constructed of cast iron gas manifold connected to stainless steel mixing plates, turndown ratio of 25:1, suitable for heating air from -25°F.
- I. AGA certified gas controls, including flame safeguard relay with flame sensor, high and low gas pressure switches, intermittent spark or hot surface ignition system, manual main shut off valve, electronic modulating gas valve, pilot controls, electric safety shut off valve, main and pilot gas regulators suitable for inlet pressure indicated on the drawings.
- J. Provide complete with the following electric controls: Factory installed motor starter with auxiliary contacts, control transformer, high temperature limit switch, low outlet temperature shut off, high and low flow proving switches, automatic mild weather burner lockout. Contain all electrical in a NEMA 1 control box with fused disconnect.
- K. The unit shall be provided with a microprocessor which sequences all functions and modes of operations. Unit shall be capable to communicate through standard DDC protocols such as BACnet MS/TP.
- L. Refer to Sections 23 09 24, 23 09 14 and 23 09 15 for temperature control work.
- M. Provide filter section with 30% efficient throwaway filters. Provide dirty filter switch with indicating light. Filter section to be low velocity V bank type.
- N. Provide units complete intake or discharge shut off damper with actuator and end switch (as indicated). See plans and schedule for additional accessories.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units as shown on plans, as detailed and according to the manufacturer's installation instructions.

3.2 GAS FIRED UNIT HEATERS

- A. Install units and connect gas, combustion air and vent piping as instructed by the manufacturer and in compliance with applicable code requirements. Suspend from building structure to maintain headroom beneath units as indicated in section 23 05 29. Connect combustion air and venting to outside of building as indicated on the drawings and terminate per the manufacturer's instructions.

3.3 MAKEUP AIR UNITS

- A. Suspend from structure as indicated on the drawings and in section 23 05 29. Install per the manufacturer's written instructions and in compliance with applicable codes.
- B. Provide start-up by factory certified technician.

END OF SECTION 23 55 00

SECTION 23 72 00 - PACKAGED INDOOR ENERGY RECOVERY VENTILATOR

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for an energy recovery ventilator system used on this project. Energy Recovery Ventilator (ERV) shall be a packaged unit and shall utilize a rotary heat exchanger that transfers both sensible and latent energy. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Operating and Maintenance Data
- C. PART 2 - Products
 - 1. Manufacturers
 - 2. ERV Units
 - 3. Cabinet
 - 4. Coil Sections
 - 5. Filters
 - 6. Fans
 - 7. Energy Recovery Device
 - 8. Controls
 - 9. Sequence of Operation
- D. PART 3 - EXECUTION
 - 1. Installation

1.2 RELATED WORK

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment
- B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
- C. Section 23 09 93 – Sequence of Operation for HVAC Controls
- D. Section 23 31 00 - HVAC Ducts and Casings
- E. Section 23 33 00 - Air Duct Accessories
- F. Section 23 73 12 - Air Handling Unit Coils

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. AHRI 1060 Air to Air Heat Exchangers for Energy Recovery Ventilation Equipment
- B. ASHRAE Standard 90.1
- C. NFPA90A Standard for Installation of Air Conditioning and Ventilation Systems

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Submit shop drawings including the following information: specific manufacturer and model numbers, submittal equipment identification corresponding to project drawings and schedules, unit dimensional and weight data, materials of construction, capacities and ratings, fan curves, fan type, drive and motor information, vibration isolation, coil performance data, sound power levels, filter information, information for all accessories.

1.8 OPERATING AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Swegon, or approved equal.

2.2 ERV UNITS

- A. ERV units shall be factory assembled and tested. Units shall include insulated steel cabinet with steel base, total recovery enthalpy wheel, fan and motor assembly, filter rack, and integral controls. Unit shall have single point power connections.

2.3 CABINET

- A. Cabinet shall be nominal 2 inch double wall panel Roxul acoustic and thermal insulation. Insulation shall have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50. Cabinet exterior shall be 20 gauge prepainted steel that meets or exceeds 650 hour salt spray test based on ASTM B117. Liners and other steel components shall be galvalume steel. All seams shall be sealed to provide air tight casing. Outdoor unit roofs shall have 3 break standing seams.
- B. Doors shall be nominal 2 inch double wall panel with the same construction as cabinet. Doors shall be fitted hinges with flush mounted door handles. The doors shall have one lockable handle as standard and the handles shall have a two-stage opening for improved safety.
- C. The unit will be designed for service and maintenance on one side only to allow for a compact installation.
- D. Units shall be tested according to EN 1886 or equivalent and meet the following criteria:
 - 1. Casing air leakage = A
 - 2. Thermal transmittance = T3
 - 3. Thermal bridging factor = TB3
 - 4. Air tightness class L2
 - 5. Environmental Class C4

- E. Units shall be designed so they can be unbolted and broken down into sections for access to restricted locations. All interconnecting wiring shall have quick connect harnesses at each section.

2.4 COIL SECTIONS

- A. Coils shall be provided according to section 23 73 12.
- B. Air handling unit coils mounted in casing shall be accessible for removal from either side of unit casing without disturbing adjacent sections.
- C. Entire coil frame, headers and U-bends shall be enclosed within air handling unit casing. Extend coil piping connections, air vent and drain connections to exterior of casing.
- D. Support coils along entire length within casing and pitch coil for proper drainage.
- E. Blank off space between coil frames and air handling unit casing.
- F. Fabricate cooling coil drain pans from type 304 stainless steel. Install a drain pan under each cooling coil. Extend drain pans the entire width of each coil, including the header, and from the upstream face of each coil to a distance $\frac{1}{2}$ of the vertical coil height of the bottom coil or 6", whichever is greater, downstream from the downstream face. Pitch drain pans in two directions towards the outlet. Pipe drain pans individually down to the drain pan below using a minimum 1" type 304 stainless steel piping. The bottom drain pan shall be piped to the exterior of the unit base using a minimum of 1.25" type 304 stainless steel piping.

2.5 FILTERS

- A. Refer to section 23 41 00.
- B. Unit shall include 2" pre-filter rack for the supply air and return air paths upstream of energy recovery wheel. Filters shall be accessed through hinged filter access door. Supply two sets of MERV 8 pleated filters.
- C. Unit shall include side loaded cartridge filter rack suitable for 22", 10 pocket MERV 13 bag filters. Filters will be held in position by an expanding locking device that provides a seal on all four sides of filter. Supply two sets of MERV 13 bag filters.
- D. Provide factory mounted pressure sensors to measure filter pressure drop across pre-filter and main filter. Pressure drop shall be digitally feedback to controller for utilization in control and alarm sequencing. Unit controller shall monitor filter pressure level and report when filter changes are required.

2.6 FANS

- A. Fans shall be mixed flow plenum type with direct drive motor. Fan and motor assembly shall be mounted on common base with internal isolation. Fan shall be connected to fan bulkhead by a canvas type flex connector. The fans will be capable of operating in ambient temperatures of up to 104°F.
- B. Fan motors shall be permanent magnet, synchronous motor type with integral digital motor controller. Fan bearings shall be serviceable type with an L-10 life of 40,000 hours.
- C. All fans shall be equipped with integral airflow monitoring system connected to the unit controller.
- D. Provide means to easily remove fan-motor assembly for service through standard doors. Wiring must be quick-connect fittings. Hard wiring will not be acceptable.
- E. Fans should be designed such that all service can be performed in the field, including replacement of bearings

2.7 ENERGY RECOVERY DEVICE

- A. Units shall include AHRI 1060 certified rotary heat exchanger that transfers both sensible and latent energy. Wheel shall be constructed of corrugated aluminum coated with desiccant. Desiccant material shall be 3A or smaller molecular sieve. Wheel supports shall be galvanized steel with a rigid steel hub. Cassette shall be heavy duty reinforced galvanized steel with a built-in purge section. Bearings shall be permanently sealed type. Rotary heat exchanger shall include adjustable face and peripheral brush seals. Drive

motor shall be variable speed type capable of operating to 1 rpm and integrated into unit controller.

- B. Rotary Heat Exchanger carry over must not exceed 0.45% and be certified to EN308:1997.
- C. Provide airflow monitor to measure outdoor airflow through enthalpy wheel. Monitor shall be integrated into unit controller. Airflow accuracy shall be minimum $\pm 5\%$ of design airflow.

2.8 CONTROLS

- A. Unit shall include an integrated microprocessor-based unit controller. The controls shall be located in the integral controls cabinet. All controls shall operate off a transformer from the main power supply for single point power connection. All internal controls and sensors shall be factory prewired and tested. The microprocessor shall have dual Ethernet ports with an internal firewall to allow remote access via third party without compromising the clients internal Network.
- B. Include with each unit touch pad type human interface that allows monitoring and control of all unit functions. Human interface shall communicate with unit controller by hardwire connection. Human interface shall be remote mounted.
- C. The control system will regulate temperatures, airflows and other functions as required. Unit controller shall be pre-programmed with factory test software for all possible functions. Controller shall utilize "plug and play" feature that will automatically load and operate any necessary algorithm based on components and accessories that are connected to the controller such as air flow monitors, damper actuators, fans, rotary energy recovery, water control valves, etc.
- D. The controller shall provide the following, refer to sequence of operation for specific unit control sequences:
 - 1. Control of fans correcting for both changes in total static pressure and air density in both VAV and constant airflow applications.
 - 2. Fan performance monitoring.
 - 3. Ventilation airflow monitoring and control.
 - 4. Airflow density correction for winter and summer conditions.
 - 5. Energy recovery optimization including operation of rotary energy recovery device.
 - 6. Supplemental heating and cooling when included.
 - 7. Frost protection.
 - 8. Recirculation module when included.
 - 9. Monitoring alarms, faults and maintenance points including filter changeout.
 - 10. Time and date schedules.
 - 11. Building pressurization.
 - 12. Humidity control.
 - 13. Data logging and trending.
- E. Include wireless capability that will allow the client to access remotely via Smart Phone or iPad or Similar device without supplemental software.
- F. If non factory controls are proposed as an option, a factory witness test is required to show integration and functionality.
- G. Controller shall be native BACnet certified and also include Modbus communication. Communication shall include monitoring, control, alarms, faults and maintenance information.

- H. Provide factory installed and tested contactors, overloads, fusing, starters motor speed controllers for supply, exhaust and rotary energy recovery device. Include all necessary control transformers.
- I. Provide unit mounted non-fused disconnect switch with single point power connection.
- J. Supply all necessary temperature and pressure sensors complete with plug in wiring harnesses for proper option of unit.

2.9 SEQUENCE OF OPERATION

- A. Energy Wheel Heating Discharge Air Control: The energy recovery wheel shall be used as the first stage of heating and shall be sequenced with the heating coil and cooling coil to maintain the discharge temperature setpoint. The wheel VFD speed shall be modulated to maintain the discharge air temperature setpoint subject to the frost control override. The energy recovery wheel shall be indexed off above 50° F (adj.).
- B. Energy Wheel Cooling Discharge Air Temperature Switchover Control: The energy wheel shall be indexed to full speed whenever the return/exhaust air temperature is 5°F (adj.) less than the outside air temperature.
- C. When outdoor air temperature is above 75°F (adj.), the VRF (DX) coil shall be enabled and maintain a discharge temperature of 55°F (adj.).
- D. Frost Control: Reduce wheel VFD speed based on increased energy wheel pressure drop.
- E. Purge Control: When the energy wheel is deactivated, the wheel shall run for 20 seconds at minimum speed every 30 minutes to keep the rotor surface clean.
- F. Rotation Alarm: BACnet integration or the energy wheel shall come factory equipped with a proximity switch that shall provide a dry contact input to the DDC system. If the wheel is indexed to run and two switch closures are not seen within 10 minutes, an alarm will be sent through the DDC system signaling a wheel rotation failure.
- G. Discharge Air Temperature Setpoint Reset from Space Temperature (Heating and Cooling Unit): Reset the discharge air temperature setpoint based on the space temperature between 55°F (adj.) and 80°F (adj.) to maintain a zone heating and economizer setpoint of 70°F (adj.). Mechanical cooling shall maintain a space mechanical cooling setpoint of 75°F (adj.). Mechanical cooling shall be locked out below the mechanical cooling setpoint unless dehumidification control is required.
- H. Dehumidification Control: Override the cooling coil valve position open to maintain a cooling coil discharge air temperature of 53° F when the return air high limit humidity setpoint of 60% RH (adj.) is reached. The cooling coil dehumidification control shall be released to the discharge air setpoint as reset by space temperature control when the return air humidity falls to 55% RH (adj.), when transitioning out of the dehumidification mode, the cooling coil discharge air setpoint shall be ramped from the dehumidification cooling coil discharge air setpoint to the space or outside air reset discharge air setpoint over a 15 minute (adj.) period to prevent the cooling coil valve from closing completely when the dehumidification mode is terminated. Lockout this control when outside air is below 55°F.
- I. See specification section 23 09 93 for additional information.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units and accessories as indicated on drawings and/or as scheduled and according to manufacturer's installation instructions.
- B. Mount units at appropriate height above floor to ensure proper condensate trap depth and condensate drainage.
- C. Install unit to provide for adequate service access. Coordinate with other trades to assure unit does not infringe upon access or service clearances of other equipment.
- D. Lubricate fan bearings. Verify fan isolators have proper deflection.

- E. Upon completion of installation of units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning components, then retest to demonstrate compliance. Start-up and commission by factory authorized service technician.
- F. Installing Contractor shall train the Owner on equipment and accessories as indicated in Section 23 05 00 regarding operations, maintenance, and troubleshooting.

END OF SECTION 23 72 00

SECTION 23 73 12 - AIR HANDLING UNIT COILS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section contains specifications for coils used in all central station air handling units and field erected air handling units. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Operation and Maintenance Data
 - 9. Design Criteria
- C. PART 2 - Products
 - 1. Manufacturers
 - 2. Hot Water Coils
 - 3. Chilled Water Coils
- D. PART 3 - EXECUTION
 - 1. Hot Water Coils
 - 2. Chilled Water Coils

1.2 RELATED WORK

- A. Section 23 72 00 – Packaged Indoor Energy Recovery Ventilator
- B. Section 23 73 13 - Modular Indoor Central-Station Air-Handling Units
- C. Section 23 82 00 - Convection Heating and Cooling Units

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ARI 410 Forced Circulation Air-Cooling and Air-Heating Coils

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Including data concerning dimensions, capacities, flow rate, pressure drop, materials of construction, ratings, weights, and appropriate identification at the same time that the air handling equipment in which the coils will be located are submitted.

1.8 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.9 DESIGN CRITERIA

- A. Select coil sizes, capacities, configuration, and operating characteristics as shown on the plans and/or as scheduled. Coil capacity ratings shall be ARI 410 certified.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Aerofin, Carrier, Daikin, RAE Corporation, Trane, JCI, Marlo, Wing, Dunham Bush, or Control Air.

2.2 HOT WATER COILS

- A. Use galvanized steel casing, end supports, top channel, and bottom channel to produce a rigid frame with allowance for expansion and contraction of the finned tube section.
- B. Construct coils of 0.025 inch tube wall seamless copper tubes of 5/8 inch maximum outside diameter with maximum of 8 aluminum fins per inch suitable for working pressures to 125 psig and temperatures to 250°F. Coil fins may be the continuous serpentine or plate fin type. If more than two rows are required to meet the needed heating capacity at 8 fins per inch, then the fins may be increased up to 12 fins per inch as needed to keep the rows at two maximum.
- C. Coil headers may be constructed of cast iron, steel, or seamless copper. Where cast iron headers are used, expand tubes into the headers. Where steel or copper headers are used braze tubes to header.
- D. Provide coils with bronze spring turbulators where required to provide the capacities indicated.

2.3 CHILLED WATER COILS

- A. Use galvanized steel casing, end supports, top channel, and bottom channel to produce a rigid frame with allowance for expansion and contraction of the finned tube section.
- B. Construct coils of 0.025 inch tube wall seamless copper tubes of 5/8 inch maximum outside diameter with maximum of 8 aluminum fins suitable for working pressures to 200 psig. Coil fins may be the continuous serpentine or plate fin type. If more than eight rows are required to meet the needed cooling capacity at 8 fins per inch, then the fins may be increased up to 12 fins per inch as needed to keep the rows at eight maximum.
- C. Coil headers may be constructed of cast iron, steel, or seamless copper. Where cast iron headers are used, expand tubes into the headers. Where steel or copper headers are used braze tubes to header.
- D. Coils shall be drainable type with drain and vent plugs for each header.

PART 3 - EXECUTION

3.1 HOT WATER COILS

- A. Install in central station air handling unit casings or on structural support frames for field erected units, making allowance for pitching as recommended by the manufacturer. Mount coils in field erected units to allow for individual removal.

- B. Comb bent or crushed fins after installation. Clean dust and debris from each coil to ensure its cleanliness.
- C. Install a separate air vent and drain valve for each coil header in such a manner that the vent and drain valves are located outside of air handling unit casing. Provide offsets in piping to facilitate coil removal.
- D. Unless otherwise specified, pipe coils for counter flow arrangement.

3.2 CHILLED WATER COILS

- A. Install in central station air handling unit casings or on structural support frames for field erected units, making allowance for pitching as recommended by the manufacturer. Mount coils in field erected units to allow individual removal.
- B. Comb bent or crushed fins after installation. Clean dust and debris from each coil to ensure its cleanliness.
- C. Install a separate air vent and drain valve for each coil header in such a manner that the vent and drain valves are located outside of air handling unit casing. Provide offsets in piping to facilitate coil removal. Unless otherwise specified, pipe coils for counter flow arrangement.
- D. Where coils are installed in ductwork or field erected air handling units, provide a 1-1/2" deep 18 gauge welded stainless steel drain pan as an integral part of the duct or at coil support.
- E. Install condensate drain trap with proper depth from each cooling coil condensate drain to the nearest drain location.

END OF SECTION 23 73 12

SECTION 23 73 13 - MODULAR INDOOR CENTRAL-STATION AIR HANDLING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for indoor central station air handling units. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Operation and Maintenance Data
 - 9. Design Criteria
- C. PART 2 - Products
 - 1. Manufacturers
 - 2. Casing
 - 3. Access Doors
 - 4. Electrical and Lights
 - 5. Fan Sections
 - 6. Fan Inlet Air Flow Stations
 - 7. Coil Sections
 - 8. Humidifier Sections
 - 9. Filter Sections
 - 10. Access Sections
 - 11. Sound Attenuator Sections
- D. PART 3 - EXECUTION
 - 1. Installation

1.2 RELATED WORK

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment
- B. Section 23 05 14 - Variable Frequency Drives
- C. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
- D. Section 23 31 00 - HVAC Ducts and Casings
- E. Section 23 33 00 - Air Duct Accessories
- F. Section 23 34 00 - HVAC Fans
- G. Section 23 41 00 - Particulate Air Filtration
- H. Section 23 73 12 - Air Handling Unit Coils
- I. Section 23 84 13 - Humidifiers
- J. Division 26 - Electrical

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ARI 430 Standard for Central Station Air Handling Units
- B. NFPA 70 National Electrical Code
- C. NFPA 90A Standard for Installation of Air Conditioning and Ventilation Systems

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Submit shop drawings including the following information: specific manufacturer and model numbers, submittal equipment identification corresponding to project drawings and schedules, unit dimensional and weight data, materials of construction, capacities and ratings, fan curves, fan type, drive and motor information, vibration isolation, coil performance data, sound power levels, filter information, information for all accessories.
- C. Provide final reviewed submittal information to Division 26 contractor for coordination of motor protection and disconnects.

1.8 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.9 DESIGN CRITERIA

- A. Furnish factory fabricated modular indoor central-station air handling units complete meeting the configuration shown on drawings and/or as scheduled.
- B. Units to be tested, rated and certified according to ARI Standard 430 and bear ARI certification label.
- C. Units to conform with NFPA 70.
- D. All material shall meet NFPA 90A flame spread and smoke develop rating requirements.
- E. Any revisions made by the contractor to the inlet and outlet ductwork conditions from that shown on the drawings shall not increase system effect and/or static pressure and shall not decrease mixing efficiencies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Carrier, Daikin, Trane, or JCI.

2.2 CASING

A. WALL/ROOF CONSTRUCTION

- 1. Construct walls and roof from 2" thick double wall panel assemblies. Panels shall be injected with polyurethane foam insulation and shall have a minimum thermal conductivity (R) of at least 12.5. The outer shell shall be constructed of solid G90 galvanized steel with baked enamel or mill galvanized finish or G40 galvanized

steel with gardobond finish. The inner liner shall be constructed of solid G90 galvanized steel or G40 galvanized steel with gardobond finish. Panels shall be gasketed with permanently applied bulb-type gaskets and able to be removed without affecting the integrity of casing structure.

2. Under 55°F supply air temperature and design conditions on the exterior of the unit of 91°F dry bulb and 74°F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying or replacing units should external condensate form on them.
3. Wall/Roof panel deflection shall not exceed L/240 ratio at a maximum ±5 inches of static pressure. Deflection shall be measured at the midpoint of the panel.

B. FLOOR CONSTRUCTION

1. Construct floors from 2" thick double wall panel assemblies. Panels shall be injected with polyurethane foam insulation and shall have a minimum thermal conductivity (R) of at least 12.5. The outer shell shall be constructed of solid G90 galvanized steel with baked enamel or mill galvanized finish or G40 galvanized steel with gardobond finish. The inner liner shall be constructed of solid G90 galvanized steel or G40 galvanized steel with gardobond finish. Panels shall be gasketed with permanently applied bulb-type gaskets.
2. Under 55°F supply air temperature and design conditions on the exterior of the unit of 91°F dry bulb and 74°F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying or replacing units should external condensate form on them.
3. Floor panel deflection shall not exceed L/240 ratio based upon a 300 lb concentrated load at the mid-span of the panel.
4. A full perimeter base rail shall be installed at each air handling unit. The base rail shall be constructed from a minimum of 16 gauge G90 galvanized steel and shall be at least 8" high. Panels shall be able to be removed without affecting the integrity of casing structure.

C. LEAKAGE RATE. Leakage rate shall not exceed 1% of the total system air quantity when subjected to ±5" static pressure.

D. CASING PENETRATIONS

1. Install sealing collars to the interior and exterior of each penetration to prevent air leakage where coil piping, humidifier piping, air vents, drain piping, and electrical conduits penetrate air handling unit casing. Silicone sealants and duct sealants are not acceptable to seal pipe penetrations of the air handling unit casing.
2. Duct sealant and/or gaskets as indicated in specification section 23 31 00 may be utilized to seal duct connections to the air handling unit casing. Silicone sealants are not acceptable.

2.3 ACCESS DOORS

- A. Access doors shall be double wall, of same construction and thickness as casing, hinged, continuously gasketed with bulb type gaskets, reinforced nylon handles with cam type latches, and inspection windows (where indicated). Door swing shall open in direction against pressure of the section. If not possible, safety chains or secondary latches shall

be provided along with labels indicating that the access door opens with the pressure of the unit/section. Provide access doors on both sides of casing, or as indicated on drawings, for fan sections, access sections, air to air energy recovery sections, filter sections, damper sections, air blender sections and upstream and downstream of every coil and humidifier.

2.4 ELECTRICAL AND LIGHTS

- A. Electrical receptacles, switches and unit lighting shall be provided by the Division 26 contractor. Wiring and conduit for receptacles, motors, and unit lighting shall be field installed by the Division 26 contractor. Coordinate openings in the casing with the Division 26 contractor. Sealing of openings shall be the responsibility of the Division 26 contractor.

2.5 FAN SECTIONS

- A. Double width, double inlet, housed centrifugal type or single width single inlet plenum type, statically and dynamically balanced fans. For variable speed applications, fan shall be dynamically balanced through entire range of operation. Fan wheels shall be backward inclined, forward curved or airfoil type as specified or required by performance characteristics.
- B. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.
- C. Fans to be fastened to hollow or solid steel shafts and designed for continuous operation at maximum rated static pressure.
- D. Fan bearings shall be self-aligning, pillow block, regreasable ball type selected for a minimum average L-50 life of 200,000 hours. Provide bearing protection grounding rings for motors used on variable frequency drives as specified in Section 23 05 13.
- E. Furnish variable pitch sheaves for drives 3 hp and smaller, fixed pitch sheaves for drives 5 hp and larger. Drives shall be designed for 150% of motor rating. Furnish OSHA approved belt guards for all fans.
- F. Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA Publication 203, Appendix L.
- G. Furnish a metal access guard at the access door of all plenum fan sections. A wheel guard may be substituted if a metal access guard is not available from the manufacturer.
- H. Fan, drive and motor assembly shall be mounted inside fan casing section and integrally isolated within unit. Vibration isolation shall be in compliance with section 23 05 48. Provide flexible connection and thrust restraints at fan discharge connection to casing.
- I. Furnish galvanized mesh inlet screens for fans without inlet ductwork connections.
- J. Furnish a label inside the fan section that identifies the specifications of the v-belt drive kit. Include motor sheave, drive sheave and belt data.
- K. Fan motors shall be provided according to section 23 05 13.
- L. Isolation damper shall be provided according to section 23 09 14.

2.6 FAN INLET AIR FLOW STATIONS

- A. For fans that are specified or scheduled to have fan inlet air flow station, provide a piezometer ring air flow station mounted on the fan inlet bell housing. Pressure tubes from the piezometer ring shall be extended to a termination plate labeled with the high and low pressure connections. Provide an initial flow rate coefficient that will be adjusted by the balancing contractor for measured flow reading. Piezometer ring air flow station shall measure static pressure drop through the fan inlet cone to provide an overall air flow measurement to within $\pm 5\%$ accuracy. In lieu of a piezometer ring air flow station, a fan inlet probe air flow stations as specified under Section 23 09 14 may be furnished and factory mounted in the fan inlet. Differential pressure transducers for measuring the velocity pressure for air flow measurement shall be supplied under Section 23 09 14 and be mounted in the temperature control panel.

2.7 COIL SECTIONS

- A. Coils shall be provided according to section 23 73 12.
- B. Air handling unit coils mounted in casing shall be accessible for removal from either side of unit casing without disturbing adjacent sections.
- C. Entire coil frame, headers and U-bends shall be enclosed within air handling unit casing. Extend coil piping connections, air vent and drain connections to exterior of casing.
- D. Support coils along entire length within casing and pitch coil for proper drainage.
- E. Blank off space between coil frames and air handling unit casing.
- F. Fabricate cooling coil drain pans from type 304 stainless steel. Install a drain pan under each cooling coil. Extend drain pans the entire width of each coil, including the header, and from the upstream face of each coil to a distance $\frac{1}{2}$ of the vertical coil height of the bottom coil or 6", whichever is greater, downstream from the downstream face. Pitch drain pans in two directions towards the outlet. Pipe drain pans individually down to the drain pan below using a minimum 1" type 304 stainless steel piping. The bottom drain pan shall be piped to the exterior of the unit base using a minimum of 1.25" type 304 stainless steel piping.

2.8 HUMIDIFIER SECTIONS

- A. Humidifiers shall be provided according to section 23 84 13.
- B. Fabricate humidifier drain pans from type 304 stainless steel. Install a drain pan under each humidifier. Extend drain pans the entire width of each humidifier and 18" downstream from the downstream face of the humidifier. Pitch drain pans in two directions towards the outlet. Pipe drain pans to the exterior of the unit using a minimum of 1.25" type 304 stainless steel piping.

2.9 FILTER SECTIONS

- A. Filter box section may be furnished by air handling unit manufacturer according to specification requirements of section 23 41 00. Provide static pressure taps that are arranged to prevent damage to the filter elements during replacement. Provide gap between final and prefilters for static pressure probes.

2.10 ACCESS SECTIONS

- A. Provide access sections where shown on drawings.

2.11 SOUND ATTENUATOR SECTIONS

- A. Sound attenuator shall be provided according to section 23 33 00.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all air handling units and accessories as indicated on drawings and/or as scheduled and according to manufacturer's installation instructions.
- B. Mount units at appropriate height above floor to ensure proper condensate trap depth and condensate drainage.
- C. Install air-handling unit to provide for adequate service access. Coordinate with other trades to assure air handling unit does not infringe upon access or service clearances of other equipment.
- D. Lubricate fan bearings. Verify fan isolators have proper deflection.
- E. Upon completion of installation of air handling units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning components, then retest to demonstrate compliance.
- F. Furnish three spare reinforced nylon access door handles.
- G. Installing Contractor shall train the Owner on equipment and accessories as indicated in Section 23 05 00 regarding operations, maintenance, and troubleshooting.

END OF SECTION 23 73 13

SECTION 23 81 26 - SPLIT-SYSTEM DUCTLESS AIR CONDITIONERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for split-system ductless cooling only type systems. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Operation and Maintenance Data
 - 9. Delivery, Storage and Handling
 - 10. Warranty
- C. PART 2 - Products
 - 1. Units up to 3.5 tons
 - 2. Cooling Coil Condensate Piping
 - 3. Refrigerant Piping
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Refrigerant Piping Sizing
 - 3. Refrigerant Piping
 - 4. Refrigerant Piping Accessories
 - 5. Startup

1.2 RELATED WORK

- A. Section 23 05 00 - Common Work Results for HVAC
- B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ARI 210/240 Unitary Air Conditioning and Heat Pump Equipment
- B. ARI 365 Commercial and Industrial Unitary Air Conditioning Condensing Units
- C. ASHRAE 15 Safety Standard for Refrigeration Systems
- D. ASHRAE 90.1 Energy Standard for Buildings Except Low Rise Residential Buildings
- E. NEC National Electrical Code
- F. ASTM B117 Standard Practice for Operating Salt Spray (fog) Apparatus
- G. UL Underwriters Laboratory

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.

- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.
- B. Unit rated performance according to the latest edition of ARI Standard 365 or ARI Standard 210/240, whichever is applicable for the equipment.
- C. Construct units according to ASHRAE 15, UL standards and the NEC. Units shall carry the UL label.
- D. Factory run and test units to see that each control device operates properly. Pressure test, evacuate, charge with holding charge of refrigerant and full oil charge prior to shipping from the factory.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Unit rated performance according to the latest edition of ARI Standard 365 or ARI Standard 210/240, whichever is applicable for the equipment.
- C. Construct units according to ASHRAE 15, UL standards and the NEC. Units shall carry the UL label.
- D. Factory run and test units to see that each control device operates properly. Pressure test, evacuate, charge with holding charge of refrigerant and full oil charge prior to shipping from the factory.

1.8 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturer's instructions for storing, rigging, unloading, and transporting units. Protect units from physical damage. Leave factory-shipping covers in place until installation.
- B. Ship units to jobsite fully assembled.

1.10 WARRANTY

- A. Provide a one year parts and labor warranty on the entire unit beginning upon substantial completion of project.
- B. Provide a five year parts warranty on the compressor(s) beginning upon substantial completion of project.

PART 2 - PRODUCTS

2.1 UNITS UP TO 3.5 TONS

- A. Manufacturers: Carrier, Daikin, Friedrich, Mitsubishi, Samsung, Toshiba, or approved equal.
- B. GENERAL
 - 1. Provide a cooling only unit, as indicated, with an indoor wall mounted fan coil with matched outdoor condensing unit as scheduled.
 - 2. Indoor fan coil units shall be complete with coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, R-410A or R32 refrigerant and integral Temperature sensing. Unit shall be furnished with integral wall mounting bracket and mounting hardware.

3. Outdoor condensing unit shall be factory assembled suitable for ground, rooftop, or wall hung mounting. Units shall consist of a compressor, an air cooled coil, propeller type outdoor fan, metering device(s), and control box. Units shall discharge air horizontally or vertically as shown on the drawings.
- C. INDOOR FAN COIL UNIT (Wall/Ceiling Mounted)
1. Cabinet shall be constructed of a durable material with a galvanized steel sub-chassis. Unit shall be fully insulated for improved thermal and acoustic performance.
 2. Unit cabinet discharge and inlet grilles shall be constructed of high-impact plastic.
 3. Fans shall be direct drive blower type with air intake and discharge on the unit. Automatic, motor driven air sweep shall be provided.
 4. Horizontal and/or vertical discharge louvers shall be adjustable.
 5. Coils shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion and specially coated for enhanced wettability. A drip pan under the coil shall have drain connections for hose attachment, on either the left or right hand side, to remove condensate. Condensate pan shall be corrosion resistant.
 6. Motors shall have permanently lubricated ball bearing with inherent overload protection. Fan motors shall a minimum of 3 speeds.
 7. Unit shall have filter track with factory supplied mildew proof cleanable filters.
 8. Minimum performance shall be 18 SEER for units.
- D. AIR-COOLED CONDENSING UNIT
1. Unit cabinet shall be constructed of galvanized steel, bonderized, and coated with a baked enamel finish on the inside and outside. Unit cabinet shall be capable of withstanding 500 hour salt spray test per Federal Test Standard No. 141 (method 6061). Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fans, and control components. Outdoor compartment shall be isolated and have an acoustic lining.
 2. Outdoor fans shall be direct drive propeller type and shall discharge air horizontally or vertically. Outdoor fan motors shall be totally enclosed, single phase motors with class B insulation and permanently lubricated bearings. Motor shall be protected by internal thermal overload protection and shafts shall have inherent corrosion resistance.
 3. Fan blades shall be statically and dynamically balanced.
 4. Outdoor fan openings shall be equipped with protective grille over fan.
 5. Compressor shall be fully hermetic scroll or a rotary swing type variable speed compressor. Compressor shall be equipped with operating oil charge, and motor. Internal overloads shall protect the compressor from over temperature and over current. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere. Compressor assembly shall be installed on rubber vibration isolators. Compressors shall be provided with crankcase heater.
 6. Outdoor coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed. Air cooled condenser coils shall be leak tested at 573 psig.
 7. Refrigerant circuit components shall include service valves with service gage port connections on compressor suction and discharge lines, each with brass caps, accumulator, and a reversing valve (for heat pump units).
 8. Provide optional wall mounting kit for installation.

9. Condensing unit controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:
 - A time delay control sequence.
 - Outdoor fan failure detection.
 - Compressor motor current and temperature overload protection.
 - Compressor low and high pressure protection.

E. CONTROLS

1. Controls shall consist of a microprocessor based control system which shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 62°F to 84°F. User interface with the unit shall be accomplished through the standard wireless remote control or the optional wired controller.
2. The unit shall have the following functions as a minimum:
 - An automatic restart after power failure at the same operating conditions as at failure.
 - A timer function to provide a minimum 24 hour timer cycle for system Auto Start/Stop.
 - Temperature sensing controls shall sense return air temperature.
 - Automatic air sweep control to provide on or off activation of air sweep louvers.
 - Dehumidification mode shall provide increased latent removal capability by modulating system operation and set point temperature.
 - Fan only operation to provide room air circulation when no cooling or heating is required.
 - Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit.
 - Evaporator fan speed control shall be user selectable: high, medium, low, or microprocessor controlled automatic operation during all operating modes.
 - Automatic heating to cooling changeover. Control shall include dead band to prevent rapid mode cycling between heating and cooling.
 - A liquid level sensor in the condensate reservoir shall stop cooling operation if the liquid level in the reservoir is too high.
3. Provide wired thermostat for wall mounting.

F. ELECTRICAL

1. Unit's electrical requirements shall be 208/230 volt, single phase, and 60 hertz.
2. Division 26 contractor shall provide conduit for both the power and control wiring between indoor unit and outdoor unit.
3. All power and control wiring must be installed per NEC and all local electrical codes.

2.2 COOLING COIL CONDENSATE PIPING

- A. ASTM B88, type L hard temper copper tubing with ASTM B145/ANSI B16.23 cast red bronze or ASTM B75/ANSI B16.29 wrought solder-type drainage fittings.

2.3 REFRIGERANT PIPING

- A. Provide precharged refrigerant lines that can be oriented to connect to the side or back of unit. Both refrigerant lines shall be insulated for heat pump applications.

- B. Provide ASTM B88 type L hard drawn copper tube, cleaned and capped according to ASTM B280, and marked "ACR", with ANSI B16.22 wrought copper or forged brass solder-type fittings.
- C. Precharged tubing line sets may be used on systems 3.5 tons and less in size.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units, piping and accessories according to the manufacturer's written instructions and recommendations. Mount condensing unit(s) on a wall mounting kit as indicated on the drawings.
- B. Maintain adequate service access and airflow clearances for all components as recommended by the manufacturer and as indicated on the drawings.
- C. Charge unit(s) with full oil charge and refrigerant charge based on the entire refrigeration system pipe size and length.
- D. Provide all control wiring in conduit in compliance with Section 23 09 14 and Division 26 00 00 - Electrical.
- E. Coordinate power wiring requirements with Division 26 00 00 contractor.

3.2 REFRIGERANT PIPING SIZING

- A. The unit manufacturer shall verify the final refrigeration pipe sizing process to ensure conformance to specific unit requirements such as maximum lengths, refrigerant velocities, unloading considerations and proper oil return. This contractor shall provide refrigeration piping drawings from the field which details the way the piping will actually be installed.

3.3 REFRIGERANT PIPING

- A. Refrigeration piping to be installed by firms who are experienced in installation of such piping and according to the requirements of the International Mechanical Code, Chapter 11 and the Wisconsin Administrative Code Chapter SPS 345.
- B. All brazing filler metals shall have a melting temperature above 1400 degrees F and contain a minimum of 6% silver.
- C. Tubing to be new and delivered to the job site with the original mill end caps in place. Clean and polish all joints before brazing. Avoid prolonged heating and burning during brazing. Purge all lines with nitrogen during brazing. Provide manual shut-off and check valves as required.
- D. No refrigerant is to be vented directly to the atmosphere except that which may escape through leaks in the system during leak testing. During evacuation procedures, use equipment designed to recover and allow recycling of the refrigerant.
- E. Leak test the system by charging the system to a pressure of 10 psig with refrigerant, with the compressor suction and discharge valves closed and with all other system valves open. Increase pressure to 300 psig with dry nitrogen. Rap all joints with a mallet and check for leaks with an electric leak detector having a certified sensitivity of at least one ounce per year. Seal any leaks that may be found and retest.
- F. After completion of the leak test, evacuate the system with a vacuum pump to an absolute pressure not exceeding 1500 microns while the system ambient temperature is above 60°F. Break the vacuum to 2 psig with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Install a drier of the required size in the liquid line, open the compressor suction and discharge valves, and evacuate to an absolute pressure not exceeding 500 microns. Leave the vacuum pump running for not less than two hours without interruption. Raise the system pressure to 2 psig with refrigerant and remove the vacuum pump.

- G. Charge refrigerant directly from original drums through a combination filter-drier. Each drier may be used for a maximum of three cylinders of refrigerant and then must be replaced with a fresh drier. Charge the system by means of a charging fitting in the liquid line. Weigh the refrigerant drum before charging so that an accurate record can be kept of the weight of refrigerant put in the system. If refrigerant is added to the system through the suction side of the compressor, charge in vapor form only.

3.4 REFRIGERANT PIPING ACCESSORIES

- A. Install accessories according to the manufacturer's written instructions and recommendations.

3.5 STARTUP

- A. Adjust units for maximum operating efficiency, adjust all controls to required final settings and demonstrate that all components are functioning properly. Submit four copies of a written startup report following the initial startup. Include in the report: work done to the system, all readings taken, a statement certifying that the refrigeration system(s) are leak free and a statement certifying that the unit(s) have been placed in proper running condition as recommended by the manufacturer and as intended in the drawings and specifications.

END OF SECTION 23 81 26

SECTION 23 81 49 - WATER-TO-WATER HEAT PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for water-to-water heat pumps (modular scroll chillers and heat recovery chillers). Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Operating and Maintenance Data
 - 9. Delivery, Storage and Handling
 - 10. Warranty
- C. PART 2 - Products
 - 1. Manufacturers
 - 2. Modular Heat Recovery Chiller Package
 - 3. Scroll Compressors
 - 4. Evaporator
 - 5. Condenser
 - 6. Refrigeration Circuit
 - 7. Sound Kit
 - 8. Electrical
 - 9. Waterside Piping (Six-pipe Dedicated Source)
 - 10. Module Controls
 - 11. Supervisor Controls
 - 12. Accessories
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Startup
 - 3. Owner Training

1.2 RELATED WORK

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment
- B. Section 23 05 15 - Piping Specialties
- C. Section 23 05 23 - General-Duty Valves for HVAC Piping
- D. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
- E. Section 23 21 13 - Hydronic Piping
- F. Division 26

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. AHRI 550/590 Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle
- B. AHRI 700-2012 Specification for Fluorocarbon Refrigerants
- C. ANSI/ASHRAE 15 Safety Standard for Refrigeration Systems
- D. ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings
- E. ANSI/ASME SEC 8 Boiler and Pressure Vessel Code
- F. ANSI/NFPA 70 National Electrical Code

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Unit Energy Efficiency Ratio (EER), Integrated Energy Efficiency Ratio (IEER), and Coefficient of Performance (COP) shall meet the minimum applicable requirements of ASHRAE 90.1.
- B. Rate unit performance according to the latest edition of ARI Standard 365 or ARI Standard 210/240, whichever is applicable for the equipment.
- C. Construct units according to ASHRAE 15, UL standards and the NEC. Units shall carry the UL label.
- D. Factory run test units to see that each control device operates properly. Pressure test, evacuate, charge with holding charge of refrigerant and full oil charge prior to shipping from the factory.
- E. Installer shall be factory trained and certified by manufacturer.

1.7 SUBMITTALS

- A. Submit water-source unit shop drawings including the following information: specific manufacturer and model numbers, dimensional and weight data, required clearances, materials of construction, capacities and ratings, refrigerant type and charge, component information, size and location of piping connections, electrical connections, wiring diagrams and information for all specialties and accessories.
- B. Submit manufacturer's installation and start-up instructions, maintenance data, troubleshooting guide, parts lists, controls and accessories.
- C. At substantial completion, submit warranty certificate and copy of start-up report.

1.8 OPERATING AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturer's instructions for storing, rigging, unloading, and transporting units. Protect units from physical damage. Leave factory-shipping covers in place until installation.
- B. Ship units to jobsite fully assembled.

1.10 WARRANTY

- A. Provide a one-year parts and labor warranty.
- B. Provide a 5-year compressor warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Water Furnace, or approved equal.

2.2 MODULAR HEAT RECOVERY CHILLER PACKAGE

- A. Factory-assembled with compressor, compressor motor, compressor motor controller, evaporator, condenser, controls, dryers (on each circuit), interconnecting unit piping and wiring, and indicated accessories. Fabricate chiller mounting base with reinforcement strong enough to resist chiller movement during a seismic event when chiller is anchored to field support structure. Field removable 6-pipe piping rack complete with 3-way modulating water valves, 2-way modulating and manual on/off water valves, factory mounted temperature sensors, and factory mounted water flow switches with quick disconnecting electrical plug for control wiring connections between the compressor section and the piping rack section.
- B. Each Module shall be self-contained. This means a module can be completely removed from a bank of modules without getting into the system. Each module will connect to the header assembly independently, have independent electrical connection, and be capable of running in a temperature control mode with or without a building automation system.
- C. Failure of any module in a bank will not affect the operation of any other module. Any circuit failure on a single module shall not affect the operation of the circuit.
- D. Each module shall be capable of supplying chilled water or hot water.
- E. Source/Geothermal water shall be piped independently of the load (hot/chilled) water piping. Condenser heat exchanger shall be isolated from the evaporator without interconnecting water pipes due to glycol in the source/geothermal water and 100% water in the hot/chilled water. A set of 3-way valves control the load heat exchanger to either provide hot water to hot loop or chilled water to the cold loop. Load/Evaporator HX shall produce hot or chilled water via a refrigerant reversing design.

2.3 SCROLL COMPRESSORS

- A. Hermetically sealed, scroll compressors with factory charged POE or PVE oil and R-410A refrigerant.
- B. Suction gas cooled motors operate at 3500 rpm protected by internal overload device.
- C. Compressors can be operated separately to provide staged capacity for lighter load conditions.
- D. Factory mounted with rubber isolation grommets.
- E. Acoustically insulated sound blankets are factory installed around the compressor to reduce sound emanating from the compressor.
- F. Oil Management: Built in oil management and three stage oil separation system.

2.4 EVAPORATOR

- A. The water to refrigerant heat exchangers shall be single circuit water, copper-brazed 316 stainless steel channel plates, capable of withstanding 650 psig working pressure on the refrigerant side and 360 psig on the water side. Refrigerant circuits are separate with a common water supply. This provides optimal part load efficiency compared to using two single circuit heat exchangers. Heat exchangers are designed to work as an evaporator and condenser.
- B. Heat exchangers are covered with 3/4" closed-cell insulation.

- C. Water line connections attached to the heat exchangers have integrated paddle flow switches for proving flow before and during operation. The water line connections will also have isolation valves to isolate the individual heat exchanger without interrupting system operation for service and maintenance.
- D. Heat exchanger will have a 2.5" flanged connection for direct building connection or to a factory header rack configuration.
- E. Heat exchangers shall be designed, tested, and stamped according to UL 1995.

2.5 CONDENSER

- A. The water to refrigerant heat exchangers shall be dual circuit, copper-brazed 316 stainless steel channel plates, capable of withstanding 650 psig working pressure on the refrigerant side and 360 psig on the water side. Refrigerant circuits are separate with a common water supply. This provides optimal part load efficiency compared to using two single circuit heat exchangers. Heat exchangers are designed to work as an evaporator and condenser.
- B. Heat exchangers are covered with 3/4" closed-cell insulation.
- C. Water line connections attached to the heat exchangers have integrated paddle flow switches for proving flow before and during operation. The water line connections will also have isolation valves to isolate the individual heat exchanger without interrupting system operation for service and maintenance.
- D. Heat exchanger will have a 2.5" flanged connection for direct building connection or to a factory header rack configuration.
- E. Heat exchangers shall be designed, tested, and stamped according to UL 1995.

2.6 REFRIGERATION CIRCUIT

- A. Refrigerant Compatibility: Chiller parts exposed to refrigerants shall be fully compatible with refrigerants, and pressure components shall be rated for refrigerant pressures.
- B. Refrigerant Type: Unit shall utilize refrigerant type R-410A.
- C. Unit shall be provided with factory installed electronic expansion valve (EEV) on each circuit (2/unit in total).
- D. Unit shall have check valve in discharge gas outlet to prevent refrigerant back flow during shutdown.
- E. Unit shall have refrigeration filter drier that is adequately sized for the circuit charge requirements.
- F. Each circuit shall have suction and discharge pressure transducers that monitor the current pressures.
- G. Each circuit shall contain an electric solenoid refrigerant reversing valve for heat pump operation.

2.7 SOUND KIT

- A. Chiller compressor compartment is completely enclosed with 16ga sheet metal and covered with closed cell foam insulation with a thickness of 0.75".

2.8 ELECTRICAL

- A. Factory installed and wired, and functionally tested at factory before shipment.
- B. Dedicated power connection to terminal block in a NEMA 1 control panel per module for complete redundancy
- C. Breaker rotary-type through door disconnect in control panel of each module.
- D. Each compressor should have: Fuse protection, Contactor, thermal overload, along with motor phase and temperature protection.
- E. High pressure cut outs set at 550 PSIG with manual reset.
- F. Low pressure cut outs set at 80 PSIG with manual reset.

2.9 WATERSIDE PIPING (SIX-PIPE DEDICATED SOURCE)

- A. Header assembly shall be independent of the chiller module for installation and service. The header assembly should be isolatable from the module without interrupting the functionality of other modules.
- B. Each module shall use its isolation valves to prevent flow from going through modules that are not currently in operation.
- C. Each module shall be able to be in any mode to equalize runtime regardless of piping connection location, module location, and other module operational modes.
- D. Source and load piping shall not interconnect/mix.
- E. Can have multiple modules in different modes at the same time to provide chilled water and hot water.

2.10 MODULE CONTROLS

- A. The unit shall be controlled using a microprocessor which sequences all functions and modes of operations.
- B. Units shall be capable to communicate through standard DDC protocol BACnet MS/TP.
- C. Inputs from the DDC or from the interface:
 - 1. "Hand/Off/Auto" Selection
 - 2. Plant "Enable"/"Disable" Command
 - 3. Plant Mode Command ("Cooling" or "Heating")
 - 4. Chilled Water Temperature Set Point
 - 5. Hot Water Temperature Set Point
 - 6. Differential Water Pressure Set Points (optional: chilled water/source/net energy water)
 - 7. Chilled Water Temperature Reset (optional)
 - 8. Hot Water Temperature Reset (optional)
 - 9. Load Limiting Status (optional – applies equally to cooling and heating)
 - 10. Remote Plant Shutdown (optional)
 - 11. Differential Water Pressure Set Points (optional: chilled water/source/net energy water).
- D. Outputs to the DDC and points displayed on interface:
 - 1. Entering and leaving water temperatures on each heat exchanger
 - 2. Suction and discharge pressures on each circuit
 - 3. Suction and Discharge saturation temperatures
 - 4. Evaporator and condenser liquid line temperatures on each circuit
 - 5. Superheat and subcooling on each circuit
 - 6. Compressor amperage
 - 7. Compressor runtime
 - 8. Compressor status
 - 9. Isolation valve status
 - 10. Entering Chilled Water Temperature
 - 11. Leaving Chilled Water Temperature
 - 12. Estimated Chilled Water Flow Rate
 - 13. Chilled Water Bypass Valve Position*
 - 14. Estimated Chilled Water Plant Load

15. Entering Hot Water Temperature
16. Leaving Hot Water Temperature
17. Estimated Hot Water Flow Rate
18. Hot Water Bypass Valve Position*
19. Estimated Hot Water Plant Load
20. Entering Source/Net Energy Water Loop Temperature
21. Leaving Source/Net Energy Water Loop Temperature
22. Estimated Source/Net Energy Water Flow Rate
23. Source/Net Energy Water Bypass Valve Position*
24. Estimated Source/Net Energy Water Plant Load
25. Active Module(s)
26. Active Compressor(s)
27. Active System and Unit Module Alarm(s)

*Field installed in bypass header assembly if system configured for water bypass

E. System Control Outputs to the DDC:

1. Alarm Relay/Annunciator (optional)
2. Remote Chilled Water Pump Speed Reference
3. Chilled Water Bypass Valve*
4. Remote Hot Water Pump Speed Reference
5. Hot Water Bypass Valve*
6. Remote Source/Net Energy Water Pump Speed Reference
7. Source/Net Energy Water Bypass Valve*

*Field installed in bypass header assembly if system configured for water bypass

F. Software resetting safeties:

1. Low Saturation alarm
2. High Saturation alarm
3. No flow condenser
4. No flow evaporator
5. No charge alarm
6. Minimum runtime
7. Minimum off time

G. Manual Reset Alarms

1. High pressure
2. Low pressure
3. Thermal overload
4. Motor protect

2.11 SUPERVISOR CONTROLS

- A. The supervisory panel staging logic uses a specialized PID control algorithm that is designed to control stepped capacity systems and will be responsible for staging all the compressors in a chiller back from the required BAS inputs:

1. Enable
 2. Mode
 3. Hot Water set point
 4. Cold Water set point
- B. The Supervisory Control Panel (SCP) is scalable from two to ten dual scroll modular chillers depending on the configuration.
 - C. The supervisory controller can be programmed for communications to virtually any type of BAS. BACnet is standard option for the supervisor's BAS connection. The BAS will connect a single point of communication to the master panel for the modular chiller bank.
 - D. Peripheral devices such as pumps and other chiller plant equipment can be added to the control of the supervisor.
 - E. All staging criteria can be adjusted from the interface for specific system tuning if necessary.

2.12 ACCESSORIES

- A. Strainers: Each header inlet will be supplied a 30 mesh wye type strainer that connects between the chiller bank and building connection. Integrated strainers in each module will not be allowed.
- B. Bypass Headers: The bank of chiller modules will be utilized a pre-engineered bypass and temperature assembly. These bypass assemblies will be supplied by the chiller manufacturer and installed between the chiller outlet connections and the building connection. The bypass assembly will be controlled by the supervisory controller to prevent dead heading of pumps. These temperature sensors shall be used for staging a bank of modular chillers. (A system bypass may still be needed to maintain minimum system or minimum pump flows. These bypasses will be supplied, controlled, and installed by others.)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units, piping and accessories according to the manufacturer's written instructions and recommendations. Mount unit(s) on a poured concrete pad or stand as indicated on the drawings.
- B. Maintain adequate service access for all components as recommended by the manufacturer and
- C. Pipe chiller drains to nearest floor drain.
- D. Provide all control wiring in conduit in compliance with Section 23 09 14 and Division 26 00 00 - Electrical.
- E. Coordinate power wiring requirements with the electrical trade.

3.2 STARTUP

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions. Verify that refrigerant charge is sufficient and chiller has been leak tested. Verify that pumps are installed and functional. Verify that thermometers and gages are installed. Operate chiller for run-in period. Check bearing lubrication and oil levels. For chillers installed indoors, verify that refrigerant pressure relief device is vented outdoors. Verify proper motor rotation. Verify static deflection of vibration isolators, including deflection during chiller startup and shutdown. Verify and record performance of fluid flow and low temperature interlocks for evaporator and condenser. Verify and record performance of chiller protection devices. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assembly, installation, and connection.

3.3 OWNER TRAINING

- A. Contractor to provide factory authorized representative and field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 4 hours.

END OF SECTION 23 81 49

SECTION 23 82 00 - HEATING AND COOLING TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specification for heating terminal equipment using water and/or electricity as the source. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Operation and Maintenance Data
 - 9. Design Criteria
- C. PART 2 - Products
 - 1. Reheat Coils
 - 2. Unit Heaters
 - 3. Cabinet Unit Heaters
 - 4. Convectors
 - 5. Fin Tube Radiation (Wall Fin)
 - 6. Electric Fan Forced Heaters
- D. PART 3 - EXECUTION
 - 1. Installation
 - 2. Reheat Coils
 - 3. Unit Heaters
 - 4. Cabinet Unit Heaters
 - 5. Convectors
 - 6. Fin Tube Radiation (Wall Fin)
 - 7. Electric Fan Forced Heaters

1.2 RELATED WORK

- A. Section 23 05 23 - General-Duty Valves for HVAC Piping
- B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment
- C. Section 23 41 00 - Particulate Air Filtration

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ARI 210 Standard for Unitary Air-Conditioning Equipment
- B. ARI 410 Standard for Forced-Circulation Air-Cooling and Air-Heating Coils

- C. CS 140
- D. NEMA
- E. NEC

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Include dimensions, capacities, materials of construction, ratings, weights, wiring diagrams, and appropriate identification for all equipment in this section. Include color selection chart where applicable.

1.8 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.9 DESIGN CRITERIA

- A. Forced Circulation Coils: Ratings certified according to ARI 410.
- B. Electrical Equipment and heaters shall be UL listed for the service specified.
- C. Electrical components and work must be according to National Electrical Code.

PART 2 - PRODUCTS

2.1 REHEAT COILS

- A. Manufacturers: Carrier, Greenheck, Trane, McQuay, Marlo, York, Precision or approved equal.
- B. Construct coils of copper tubes and aluminum fins in a serpentine arrangement with piping connections on the same end. Provide galvanized steel casing, end supports, top and bottom channels to allowance for expansion of finned tube section. Factory test coils at 200 psig.
- C. Headers may be cast iron with tubes expanded into the header, steel pipe with tubes brazed to the header, or seamless copper with tubes brazed to the header.
- D. Frames to be flanged for a gasketed connection to adjacent ductwork or constructed for slip and drive connection to the ductwork.

2.2 UNIT HEATERS

- A. Manufacturers: Airedale, Modine, McQuay, Trane, Rittling, Sterling, Sigma, Airtherm, or approved equal.
- B. Construct casing of 18 gauge steel with baked enamel finish and heating elements of copper tubing with aluminum fins. Use aluminum fan blades, balanced for quiet operation. Provide safety guard for fan/drive assembly. Test coils units at 200 psig.
- C. Furnish adjustable horizontal and vertical discharge louvers for units with horizontal discharge.
- D. Furnish motors with characteristics as scheduled. Single phase, 120 volt motors to be permanently lubricated and provided with thermal overload protection.

2.3 CABINET UNIT HEATERS

- A. Manufacturers: Airedale, American Air Filter, Sterling, McQuay, Trane, Rittling, Sigma, Airtherm, or approved equal.
- B. Construct vertical unit casings with 16 gauge steel front panels and minimum 18 gauge steel end and side panels. Horizontal units located in concealed spaces or mounted in ceiling to have minimum 18 gauge front, end, and side panels.
- C. Furnish exposed cabinets in a baked enamel finish in one of the manufacturer's standard colors, selected by the Architect.
- D. Furnish ceiling mounted units with a hinged front panel to allow access to all internal components.
- E. Construct heating elements of copper tubes with aluminum fins, tested at 200 psig.
- F. Use centrifugal type fans, statically and dynamically balanced to operate without objectionable noise and vibration.
- G. Motors to be 120 volt, single phase, permanently lubricated, with thermal overload protection and disconnect switch at unit.
- H. Furnish each unit with filter rack and 1" panel filters as specified in Section 23 41 00.

2.4 CONVECTORS

- A. Manufacturers: Airedale, Modine, Sterling, Trane, Rittling, Sigma, Airtherm, or approved equal.
- B. Construct heating elements of copper tubes with aluminum fins expanded into cast iron or brass headers. Support heating elements on adjustable brackets to allow for expansion and pitch. Certify coil ratings according to Commercial Standard CS 140.
- C. Construct enclosures of 18 gauge steel back and end panels, and 16 gauge steel front and top panels. Furnish in a baked enamel finish in one of the manufacturers' standard colors, selected by Architect.

2.5 FIN TUBE RADIATION (WALL FIN)

- A. Manufacturers: Airedale, Modine, Slant/Fin, Sterling, Trane, Vulcan, Rittling, Runtal, Sigma, or approved equal.
- B. Construct heating elements of steel fin on steel tube or aluminum fin on copper tube. Provide wall mounted support cradles which allow expansion of heating element without noise.
- C. Enclosures: Sloped top with die formed grilles. Constructed with removable front panels of 16 gauge steel, 20 gauge steel back panels, and furnished with a baked enamel finish in one of the manufacturer's standard colors, selected by Architect.
- D. Provide dirt gasket for mounting between back panel and wall.
- E. Provide accessories such as inside and outside corners and end caps where required for the complete installation. Where wall-to-wall installations are indicated on plans, provide enclosure extensions or field modification of enclosure to conform to actual room dimensions.
- F. Provide hinged access doors at all valves, traps, and vents.

2.6 ELECTRIC FAN FORCED HEATERS

- A. Manufacturers: Markel, Raywall, Redd-I, Berko, Qmark, Marley, Ouellet or approved equal.
- B. Assembly: UL listed and labeled assembly with terminal box and cover, and controls.
- C. Heating Elements: Helically coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material.
- D. Enclosure: 18 gauge galvanized steel with removable 16 gauge heavy-duty front panel with integral air outlet and inlet grilles.

- E. Control: Provide automatic reset thermal overload protection, disconnect switch, low voltage control transformer, built-in circuit breakers and built-in contactors. Built-in heating thermostat, factory wired, or wall mounted thermostat as indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units according to manufacturer's installation instructions.
- B. Install branch water piping to each unit with a minimum of three elbows to allow for expansion and contraction of the piping system.
- C. Coordinate location of units with other trades to assure correct recess size for recessed units.
- D. After installation, provide protective covers to prevent accumulation of dirt on units during balance of construction.

3.2 REHEAT COILS

- A. Comb bent or crushed fins and clean dust and debris from each coil before enclosing coils in ductwork. Pitch coil casings according to manufacturer's instructions. Install a drain valve on the coil side of the shutoff valves for each reheat coil.
- B. Pipe coils with multiple rows for counter flow arrangement.

3.3 UNIT HEATERS

- A. Suspend units from building structure and as high as possible to maintain headroom beneath units; supporting from piping systems will not be accepted.
- B. Install a drain valve on the coil side of the shutoff valves for each hot water unit heater.

3.4 CABINET UNIT HEATERS

- A. Mount units in locations indicated on the drawings and as detailed. Install a drain valve on the coil side of the shutoff valves for each hot water cabinet heater.

3.5 CONVECTORS

- A. Mount units in locations indicated on the drawings and as detailed. Install a drain valve on the coil side of the shutoff valves for each hot water heater.

3.6 FIN TUBE RADIATION (WALL FIN)

- A. Install dirt guard gasket to mounting strip or caulk along top of mounting strip.
- B. Install a drain valve on the radiation side of the shutoff valves for each separately valved section of radiation.
- C. Install access doors or panels, centered in front of each shut-off valve, balancing valve, steam trap, and temperature control valve located inside radiation enclosure.

3.7 ELECTRIC HEATERS

- A. Install units where indicated on the drawings and details. Where heaters are indicated to be installed in ductwork, provide manufacturers recommended upstream and downstream ductwork to prevent overheating problems.
- B. Electric heaters located in toilet and shower rooms must be installed at least 6 inches above the finished floor.
- C. Install wall mount electric fan forced heaters 12 inches above finished floor unless otherwise noted.
- D. Units will be wired by the Electrical Contractor.

END OF SECTION 23 82 00

SECTION 23 83 16 - RADIANT-HEATING HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for all radiant-heating hydronic piping, including piping, distribution manifold(s) with balancing and flow control valves, pipe-to-manifold compression nut fittings, cold-expansion and compression-sleeve fittings, pipe fasteners as approved by the manufacturer of the piping, and controls for this project. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Reference Standards
 - 5. Federal Bidding Requirements
 - 6. Quality Assurance
 - 7. Submittals
 - 8. Delivery, Storage, and Handling
 - 9. Warranty
- C. PART 2 - Products
 - 1. Manufacturers
 - 2. Piping
 - 3. Fittings
 - 4. Manifolds
- D. PART 3 - EXECUTION
 - 1. Acceptable Installers
 - 2. Examination
 - 3. Preparation
 - 4. Installation
 - 5. Field Quality Control
 - 6. Cleaning
 - 7. Protection

1.2 RELATED WORK

- A. Section 23 05 15 – Piping Specialties
- B. Section 23 05 23 – General Duty Valve for HVAC Piping
- C. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment
- D. Section 23 21 13 – Hydronic Piping
- E. Section 23 25 00 – HVAC Water Treatment
- F. Section 23 52 00 – Heating Boilers

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

- A. ASTM E84 Building Standard Test Method for Surface Burning Characteristics of Materials.
- B. ASTM F876 Standard Specification for Crosslinked Polyethylene (PEX) Tubing
- C. ASTM F877 Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems
- D. ASTM 1807-11ae1 Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing
- E. ASTM F2080 Standard Specification for Cold-Expansion Fittings with Metal Compression-Sleeves for CrossLinked Polyethylene (PEX) Pipe
- F. ASTM F2098-08 Standard Specification for Stainless Steel Clamps for Securing SDR9 Cross-linked Polyethylene (PEX) Tubing to Metal Insert and Plastic Insert Fittings
- G. ASTM F2623 Standard Specification for Polyethylene of Raised Temperature (PE-RT) SDR 9 Tubing
- H. CSA B137.5 Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications
- I. CSA B214 Installation Code for Hydronic Heating Systems
- J. DIN 4726 Plastic Piping Used in Warm Water Floor Heating
- K. IAPMO International Association of Plumbing and Mechanical Officials
- L. ICC-ES PMG 1013
- M. ISO 9001 Quality Management Systems – Requirements
- N. CAN/ULC S102.2 Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials
- O. CAN/ULC S101 Standard Methods of Fire Endurance Tests of Building Construction and Materials
- P. PPI TR-3/2007 Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.
- B. Manufacturer: Must be a company specializing in the Work of this Section with a minimum of 10 years documented experience.
- C. Tubing shall conform and be certified to applicable standards such as ASTM F876, F877, F623, 1807-11ae1 and CSA B137.5, and shall have the PPI TR-3 listing.
- D. Pipes with an oxygen diffusion barrier shall conform to the requirements for oxygen permeability DIN 4726.

1.7 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.

- B. Product Data: Submit manufacturer's Technical Manual, submittal forms, catalog cuts, brochures, specifications, and installation instructions. Submit data in sufficient detail to indicate compliance with the contract documents.
 - 1. Submit manufacturer's instructions for installation.
 - 2. Submit data for equipment, fittings, fasteners and associated items necessary for the installation of the piping and manifolds.
- C. Submit computer-generated radiant heating system design indicating heat flux, pipe sizing, spacing, flow rates and temperatures. Design calculations shall be performed on pipe manufacturer's software or equivalent.
- D. Drawings: Provide plans drawn to scale for all installation areas.
 - 1. Indicate dimensions, descriptions of materials, general construction, component connections, anchorage methods and installation procedures.
 - 2. Indicate design, schematic layout of system, including equipment, critical dimensions and piping/slab penetration details as well as details for protecting exposed PEX piping.
- E. Certification
 - 1. Submit independent certification results for the piping systems from an accredited independent testing laboratory.
 - 2. The design shall be approved by an Architect/Engineer licensed in the jurisdiction where the installation will take place, as being complete and accurate.
 - 3. Fittings shall be third-party certified to applicable referenced standards as part of the manufacturer's PEX piping system, with independent listings from NSF, CSA and ICC, as applicable.
 - 4. Fittings embedded within the thermal mass or encased behind walls or ceilings shall be certified to ASTM F2080.
- F. Maintenance Instructions: Submit product instructions for any maintenance required or recommended by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and equipment in shipping containers with labeling in place.
 - 1. Pipe shall be kept in original shipping boxes until required for installation.
- B. Store piping and equipment in a safe place, dry, enclosed, under cover, in a well-ventilated area.
 - 1. Do not expose pipe to ultraviolet light beyond exposure limits recommended by manufacturer.
 - 2. Protect piping and manifolds from entry of contaminating materials. Install suitable plugs in open pipe ends until installation.
 - 3. Where possible, connect pipes to assembled manifolds to eliminate possibility of contaminants and cross-connections.
 - 4. Piping shall not be dragged across the ground or other surfaces, and shall be stored on a flat surface with no sharp edges.
- C. Protect materials from damage by other trades.
- D. Pipe shall be protected from oil, grease, paint, direct sunlight and other elements as recommended by manufacturer.

1.9 WARRANTY

- A. Provide manufacturer's standard written warranty.
 - 1. To repairing or replacing the defective product in question or providing a refund of the defective product's purchase price.

2. The radiant heating pipe manufacturer shall warrant the piping to be free from defects in material and workmanship for a period of twenty-five (25) years.
3. Cold-expansion compression-sleeve fittings shall be warranted to be free from defects in material and workmanship for a period of twenty-five (25) years.
4. All manifolds, distribution headers, thermostats and actuators shall be warranted to be free from defects in material and workmanship for a period of two (2) years starting at completion of successful pressurized water tests immediately following system installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Roth or approved equal.

2.2 PIPING

- A. All radiant heating pipe shall be one of the following:
 1. High-density crosslinked polyethylene manufactured using the high-pressure peroxide method of crosslinking (PEXa). Pipe shall conform to ASTM F876, ASTM F877 and CSA B137.5.
 2. 5-layer Polyethylene Raised Temperature (PE-RT) consisting of inner and outer layers of PE-RT, two adhesive layers and the EVOH oxygen barrier layer. Tubing shall conform to ASTM F2623.
- B. Pipe shall be rated for continuous operation of 100 psi gauge pressure at 180°F temperature.
- C. Pipe shall have a co-extruded oxygen diffusion barrier capable of limiting oxygen diffusion through the pipe to less than 0.32 mg/(m²/d) @ 104°F water temperature, according to DIN 4726.
- D. Bend Radius
 1. The minimum bend radius for cold bending of the pipe shall be not less than five (5) times the outside diameter.
 2. Bends with a radius less than this shall require the use of a bending template as supplied by the pipe manufacturer, and/or hot air.

2.3 FITTINGS

- A. Fittings shall be third-party certified to applicable standards.
 1. PEX-A: ASTM F877, ASTM F2080 and CSA B137.5 as part of the manufacturer's PEX piping system, with independent listings from NSF, CSA and ICC, as applicable.
 2. PE-RT: ASTM F877 and F2098-08
- B. Compression nut manifold fittings shall be manufactured of brass with a barbed insert and a reusable split compression ring.
- C. Compression-sleeve fittings shall be manufactured of brass and shall be approved by the piping manufacturer to be part of a proven cataloged system.
- D. Fittings embedded within the thermal mass or encased behind walls or ceilings shall be cold-expansion compression-sleeve fittings certified to ASTM F2080. Where required by the manufacturer, fittings shall be protected from external environmental conditions.

2.4 MANIFOLDS

- A. Distribution manifolds shall be manufactured of brass, copper, or stainless steel and be supplied by the piping manufacturer as a proven cataloged part of the manufacturer's system.
- B. Manifolds shall be equipped with integral visual flow gauges, circuit balancing and flow control valves, isolation valves with integral thermometer housings, and air vent/fill ports.

- C. Each circuit valve shall be supplied with a manual actuating handle for filling/purging operation.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS

- A. As a minimum, installation shall be performed by qualified laborers trained by the manufacturer in the procedures of PEX radiant heating systems and appropriately licensed for the jurisdiction where the installation will take place.

3.2 EXAMINATION

- A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work. Do not proceed until unsatisfactory conditions are corrected.
- B. Beginning of installation means acceptance of existing conditions.

3.3 PREPARATION

- A. Coordinate with related trades and manufacturer's recommendations with regard to installation in conjunction with:
 - 1. Reinforcing wire mesh or rebar.
 - 2. Preparation of space for manifold installation.
- B. Prepare the installation site as appropriate:
 - 1. For Concrete Slab-on-Grade: Sub-grade should be compacted, flat and smooth to prevent damage to pipe or insulation. Approved vapor barrier material should be installed. Approved thermal insulation, according to the design, shall be installed. Reinforcing wire mesh, if required by structural design, must be flat and level, with all sharp ends pointing down. Finished grade of the thermal mass must be a minimum of 3/4 in (19 mm) above the top of PEX heating pipes.
- C. Preparation of wall cavity for manifold installation: See drawings to determine the width of the wall cabinet (if required) and required wall opening dimensions. Mount the manifold cabinet allowing space for the screed to fill up the front of the pipe opening. If a cabinet is not used, prepare a suitable cavity for the manifold, with a secure mounting plate that will secure the manifold at least 30 in above floor level. Manifold must be installed in an area that will allow easy access for supply/return piping as well as future access maintenance.

3.4 INSTALLATION

- A. Install according to manufacturer's published installation manual and/or published guidelines and final drawings.
- B. Mount manifolds in the locations previously prepared or in previously installed cabinets, if used. Manifolds shall be mounted as level as possible.
- C. Route piping in an orderly manner, according to layout and spacing shown in final drawings. All installation notes shown on the drawings shall be followed.
- D. At connections and fittings, use a plastic pipe cutter to ensure square and clean cuts, and join pipes immediately or cap ends of pipe to seal from contaminants. Where fittings are installed within the thermal mass, they shall be wrapped in non-adhesive waterproof silicone tape or sealed within a heat-shrink material approved by the manufacturer.
- E. Pipe shall be dispensed using a suitable uncoiling device. Remove twists prior to securing pipe. Pipe shall lie flat on an even plane. Finished grade of a thermal mass shall be a minimum of 3/4 in above the top of PEX heating pipes. Fasten piping at no more than 3 feet intervals, being careful not to twist the pipe. In thin concrete slabs, secure piping every 2 ft. Use only fasteners supplied or approved by the manufacturer of the PEX pipe.
- F. Piping that passes through expansion joints shall be covered in protective polyethylene corrugated sleeving (flexible conduit) extending 15 in on each side of the joint. Sleeving shall be secured on pipe to prevent movement during installation of thermal mass.

- G. Where piping exits the thermal mass, a protective conduit shall be placed around the pipe, with the conduit extending a minimum of 6 in into the floor and exiting by a minimum of 6 in. For penetrations at manifolds, use rigid PVC bend guides secured in place to prevent movement.
- H. At the time of installation of each circuit of pipe, connect the pipe to the correct manifold outlet and record pipe length for balancing. If manifold is not installed, cap the end of the pipe and label the pipe's circuit numbers along with S for supply and R for return. Connect pipes to manifold as soon as possible and record circuit lengths. All circuits shall be labeled to indicate circuit length and serviced area.
- I. The following precautions shall be taken in areas intended for carpet:
 - 1. Notify carpet installer that radiant heating pipes have been installed.
 - 2. Keep pipes 6 in from all wall baseplates.
 - 3. Install metal guards where pipe will pass through wall baseplates and where carpet tack strips will be installed.
- J. The following precautions shall be taken in areas intended for hardwood flooring:
 - 1. Ensure that nailing areas for hardwood flooring, if nailing is required, are clearly marked and known for hardwood installers.
- K. If the radiant heating system substrate material (thermal mass) requires curing and/or has other limitations which can be influenced by the radiant heating system while in operation, then the radiant heating system shall not be put into operation until such time that the substrate material has fully cured or set according to the material requirements of the substrate manufacturer.
- L. The installer shall confirm minimum and maximum exposure temperatures for the substrate material (thermal mass) and shall ensure proper radiant heating operating temperatures.

3.5 FIELD QUALITY CONTROL

- A. Filling, Testing and Balancing: Tests of hydronic heating systems shall comply with authorities having jurisdiction, and, where required, shall be witnessed by the building official.
- B. Pressure gauges used in testing and balancing shall show pressure increments of 1 psig and shall be located at or near the lowest points in the distribution system.
- C. Air Test.
 - 1. Charge the completed, yet unconcealed pipes with air at a minimum of 40 psig.
 - 2. Do not exceed 150 psig.
 - 3. Use liquid gas detector or soap solution to check for leakage at manifold connections.
- D. Water Test.
 - 1. Purge air from pipes.
 - 2. Charge the completed, yet unconcealed pipes with water.
 - 3. Take necessary precautions to prevent water from freezing.
 - 4. Check the system for leakage, especially at all pipe joints.
- E. Perform a preliminary pressure test pressurizing the system to the greater of 1.5 times the maximum operating pressure or 100 psig for 30 minutes.
 - 1. As the piping expands, restore pressure, first at 10 minutes into the test and again at 20 minutes.
 - 2. At the end of the 30-minute preliminary test, pressure shall not fall by more than 8 psig from the maximum, and there shall be no leakage.

- F. After successfully performing the preliminary pressure test, perform the main pressure test immediately.
 - 1. The test pressure shall be restored and continued as the main test for 2 hours.
 - 2. The main test pressure shall not fall more than 3 psig after 2 hours.
 - 3. No leakage shall be detected.
- G. Pressure shall be maintained and monitored during installation of the thermal mass.
 - 1. If any leak is detected during installation of thermal mass, leak shall be found immediately and the area cleared for repair using manufacturer's approved repair coupling.
 - 2. Retest before covering repair.
- H. Complete inspection and furnish test reports supplied by the manufacturer of the system.
- I. All low-voltage equipment shall be tested. The following 3 items should be checked as a minimum:
 - 1. Inputs
 - 2. Outputs
 - 3. Sequence of Operations

3.6 CLEANING

- A. Clean exposed surfaces upon completion of installation using clean, damp cloth. No cleaning agents are allowed.
- B. Comply with manufacturer's recommendations.

3.7 PROTECTION

- A. Protect installation throughout construction process until date of final completion.
- B. Replace components that cannot be repaired.

END OF SECTION 23 83 16

SECTION 23 84 13 - HUMIDIFIERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Scope. This section includes specifications for humidifiers. Included are the following topics:
- B. PART 1 - GENERAL
 - 1. Scope
 - 2. Related Work
 - 3. Reference
 - 4. Federal Bidding Requirements
 - 5. Quality Assurance
 - 6. Submittals
 - 7. Operation and Maintenance Data
- C. PART 2 - Products
 - 1. Manufacturers
 - 2. Steam Blower
 - 3. Dispersion Panel
 - 4. Electrode Evaporative Steam Humidifiers (Electric)
- D. PART 3 - EXECUTION
 - 1. Steam Blower
 - 2. Dispersion Panel
 - 3. Electrode Evaporative Steam Humidifiers (Electric)

1.2 RELATED WORK

- A. Section 23 05 15 - Piping Specialties
- B. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC
- C. Section 23 22 13 - Steam and Condensate Heating Piping
- D. Division 26

1.3 REFERENCE

- A. Applicable provisions of Division 1 govern work under this section.

1.4 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.5 QUALITY ASSURANCE

- A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.6 SUBMITTALS

- A. Refer to Division 1, General Conditions, Submittals.
- B. Include data concerning dimensions, capacities, materials of construction, ratings, weights, wiring diagrams, and appropriate identification.

1.7 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Armstrong, Dri-Steem, Pure Humidifier, Nortec, Sarco, or approved equal.

2.2 STEAM BLOWER

- A. Mounted on top of or remotely from the humidifier shall be a fan-based steam blower that shall draw air from the side and disperse visible steam vapor with a uniform rise, spread and throw out the front.
- B. Steam blower shall have a fastened stainless steel frame assembly housing an electric fan, steam inlet connection and integral dispersion device.
- C. Steam blower shall have a cabinet with exterior that matches the humidifier cabinet. This includes brushed stainless steel cabinet with a painted galvanized steel front door.

2.3 DISPERSION PANEL

- A. Each tube bank shall consist of a horizontal header/separator and designated quantity of vertical dispersion tubes necessary to achieve the required steam capacity and absorption distance.
- B. Header/separator shall span the width of the AHU/duct, be constructed of stainless steel and be fitted with connections for dispersion tubes.
 - 1. The dispersion tubes shall extend the height of the AHU/duct and shall be fitted with two rows of tubelets on the diametric centerline and spaced 1-1/2" (38 mm) apart.
 - 2. Each tubelet shall be made of a thermal-resin.
 - 3. Each tubelet shall extend through the wall of and into the center of the dispersion tube and contain a steam orifice sized for its required steam capacity.
 - 4. For securing the upper ends of the tubes, a 3/4" x 2" stainless steel L-bracket shall be furnished, which the installer shall attach to the duct or housing.
- C. High-efficiency dispersion tubes. Dispersion tubes shall be insulated with a plenum-approved insulating material for in-duct installation and have an R-value not less than 0.5 at a thickness not more than 0.125" (3.2 mm), for minimal increase in dispersion tube diameter.
 - 1. Airstream heat gain shall not exceed the values as scheduled; the values shall be supported by the manufacturer's published data.
 - 2. Insulating material shall meet the following criteria at 0.125" (3.2 mm) thickness:
 - a. Fire/smoke index shall be 0/0 per UL 723, NFPA 255, and ASTM E84.
 - b. Stable up to 300°F continuous to prevent material degradation, hardening, or crumbling at high temperatures.
 - c. Closed-cell construction does not absorb water or support microbial growth.
 - d. Non-toxic and pure as documented in manufacturer's data.
 - e. Will not degrade when exposed to UVC light.
 - f. Continuous, seam-welded, and held in place without bands or clamps.

2.4 ELECTRODE EVAPORATIVE STEAM HUMIDIFIERS (ELECTRIC)

- A. Manufacturers: Carnes, Armstrong, Dri-Steem, Nortec, or approved equal.
- B. Water requirements: The humidifier shall be capable of generating steam from potable un-softened or softened water. Water conductivity operating range shall be 125 to 1250 $\mu\text{S}/\text{cm}$.
- C. Humidifier enclosure shall be constructed with 18-gauge painted galvanized steel cabinet and 22-gauge painted galvanized steel doors. Enclosure shall have separate compartments: one or two for the steam cylinder(s), and one for electrical components. Enclosure shall be designed and secured to prevent accidental contact with electrical components. The front exterior of the cabinet shall contain the controller's touch keypad. The humidifier enclosure shall have pre-punched keyhole-style mounting holes for ease of wall mounting and leveling.
- D. Steam cylinder and electrical compartments shall have removable doors with door interlock safety switch to interrupt unit operation when doors are open or removed. Door interlock switch can be overridden to allow for troubleshooting. Removable doors shall allow full front and right-side access for installation and service.
- E. Steam outlet(s) on top of cylinder shall be configured to connect to a dispersion tube assembly in a duct via hose or pipe.
- F. Plastic disposable steam cylinder shall have welded seams to ensure that cylinder is watertight. Provide full output for entire cylinder life. Have integral high water sensor probe to prevent overfilling.
- G. Steam cylinder compartment of humidifier cabinet shall have reusable, spring loaded brass electrode plugs to ensure safe, secure connection of primary voltage leads to the steam cylinder for life of unit.
- H. Drain: An electric drain valve shall be cabinet-mounted to allow cylinder to automatically drain periodically and at the end of a humidification season. The cylinder shall automatically and completely drain if it doesn't receive a humidity demand signal for a user-programmable number of hours (default is 72 hours), to eliminate potential contaminant buildup in the cylinder, and to extend cylinder life during long periods of inactivity. After draining at the end of a humidification season, the unit will automatically reset and start normal operation when it receives a humidity demand signal. Integral drain cup shall prevent water leakage.
- I. Controls
 - 1. Fully modulating (20% to 100%) control of humidifier outputs.
 - 2. User-selectable time-proportioned (TP) modulation control below 20% (humidifier shall cycle a single output on and off corresponding to an input demand signal).
 - 3. Microprocessor controller with the following features or functions:
 - PID control capability with field-adjustable settings.
 - USB port on the control board for firmware updates, data backups, and data restoration.
 - Real-time clock to allow time-stamped alarm/message tracking, and scheduled events.
 - Factory commissioning of humidifier and control board, including system configuration as ordered.
 - Keypad/display operable within a temperature range of 32 to 158°F, and that provides backlighting for viewing in low light.
 - Alarms, unit configuration, and usage timer values shall remain in nonvolatile memory indefinitely during a power outage.

- The capability to monitor, control, and/or adjust the following parameters:
 - o Relative humidity (RH) set point, actual conditions in the space (from humidity transmitter), RH offset.
 - o Dew point set point, actual conditions in the space (from dew point transmitter).
 - o Relative humidity (RH) duct high limit set point (switch) and actual conditions.
 - o Relative humidity (RH) duct high limit set point, actual conditions (from transmitter), high limit span, and high limit offset.
 - o Total system demand in % of humidifier capacity.
 - o Total system output in lbs/hour.
 - o End-of-season drain status and hours humidifier is idle before end of season draining occurs.
 - o System alarms and system messages, current and previous.
 - o Programmable outputs for remote signaling of alarms and/or messages, device activation (such as a fan), or for signaling tank heating and/or steam production.
 - o System diagnostics that include: Test outputs function to verify component operation, test humidifier function, by simulating demand to validate performance, and data collection of RH, air temperature, water use, energy use, alarms, and service messages for viewing from the keypad/display.
 - o Service notification scheduling.
 - o Password-protected system parameters.
 - o Keypad/display displays in English, and numerical units displayed in inch-pound.
- 4. Water level control for potable un-softened or softened water:
 - Water level control for potable un-softened or softened water.
 - Humidifier system shall provide for automatic refill, high water cutoff, and automatic drain-down of humidifier. System shall include:
 - o Cabinet-mounted solenoid-operated fill valve.
 - o User-selectable integral drain water tempering.
 - o Controller shall optimize water conductivity, minimize energy waste, and maximize cylinder life.
 - o Humidifier shall automatically drain if there is no call for a user-programmable number of hours.
- 5. Interoperability using BACnet.
- 6. Humidistat, modulating, room: Electric humidistat control shall be a modulating style, room mounted with a control range of 20% to 80% RH. Compatible with 21 VDC. Output signals shall be 0 to 10 VDC. Operating temperature range 32 to 122°F.
- 7. Humidistat, modulating, duct: Electric humidistat control shall be a modulating style, duct mounted with a control range of 15% to 55% RH. Compatible with 21 VDC. Output signals shall be 0 to 10 VDC. Operating temperature range of humidistat 20 to 120°F. Includes an outdoor temperature reset sensor that will lower the indoor RH set point thus preventing window condensation. Operating temperature range of sensor -40 to 185°F.

8. Modulating high limit control: The modulating high limit control system shall include a modulating electronic humidity transmitter (duct-mounted downstream from the humidifier). It shall transmit to the microprocessor controller to modulate humidifier output and maintain the highest desired space humidity possible, at all airflow volumes, without saturation of the airstream.
9. Airflow proving switch, sail type: Airflow proving switch shall be a sail operated electric switch for field installation. Switch makes @ 250 fpm (1.3 m/s), breaks @ 75 fpm (0.4 m/s). Maximum operating temperature for sail: 170°F. Maximum operating temperature for switch: 125°F.
10. User-settable demand signal from humidistat or building management system (BMS), 0–100% modulation: 0–15 VDC or 4–20 mA.

PART 3 - EXECUTION

3.1 STEAM BLOWER

- A. Mount units on top of or remotely from humidifier per manufacturer's instructions and as indicated on the drawings. Provide additional reinforcing or support required for the humidifier body. Install piping specialties and controls as detailed and according to manufacturer's instructions.
- B. Install condensate piping and specialties as detailed and according to manufacturer's instructions.

3.2 DISPERSION PANELS

- A. Mount units in air handling units as indicated on the drawings. Provide additional reinforcing or support required for the humidifier body and/or distribution manifold(s). Install piping specialties and controls as detailed and according to manufacturer's instructions.
- B. Use steam and condensate pipe size indicated on drawings or recommended by the manufacturer, whichever is larger. Ream pipe and blow out before making final connection to humidifier.
- C. Mount units in air handling units with sufficient elevation to drain condensate by non-pressurized gravity condensate lines. Install condensate piping and specialties as detailed and according to manufacturer's instructions.

3.3 ELECTRODE EVAPORATIVE STEAM HUMIDIFIERS (ELECTRIC)

- A. Mount manifold(s) in air handling units or ductwork as indicated on the drawings with proper pitch for condensate drainage. Mount steam generating cylinder assembly and control panel on wall or angle iron stand where indicated. Provide reinforcing or support required for the humidifier body and/or distribution manifold(s) as required. Install piping specialties and controls as detailed and according to manufacturer's instructions. Coordinate final connection point with the Plumbing Contractor. Isolation valve by Plumbing contractor. Install drain line to nearest drain location or as indicated on the drawings.

END OF SECTION 23 84 13

END OF DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

DIVISION 26 – ELECTRICAL

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26 43 05	Surge Suppression
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END OF INDEX	

SECTION 26 01 0 – BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE OF PROJECT

- A. This project consists of a new weigh station and state patrol office building with a rough area of 31,000 sq. ft. and shall include all material to provide for the completion of all work associated with the following, but not be limited to the following:
 1. Temporary services.
 2. Site utility work.
 3. Low voltage conduit and wire.
 4. Panelboards.

5. Surge protection.
6. Starters and disconnects.
7. Engine generator and transfer switch.
8. Uninterruptible power unit(s).
9. Wiring Devices.
10. Interior lighting.
11. Voice and data wiring.
12. Television system.
13. Access control.
14. Video surveillance.
15. Fire alarm and detection system.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

1.3 REQUIREMENTS OF REGULATORY AGENCIES AND STANDARDS

- A. Equipment, fixtures, material and installation shall conform to the requirements of the local Building Department, the serving utility companies, the National Electrical Code, National Electrical Safety Code, Life Safety Code, Occupational Safety and Health Act, and applicable national, state, and local codes, ordinances, and regulations.
- B. All equipment shall be equal to, or exceed, the minimum requirements of NEMA, IEEE, and UL.
- C. Should any change in Drawings or Specifications be required to comply with governmental regulations, the contractor shall notify Architect/Engineer prior to execution of the Work. The work shall be carried out according to the requirements of such code according to the instruction of the Architect/Engineer and at no additional cost to the Owner.
- D. The provisions of Standards, Codes, Laws, Ordinances, etc., shall be considered minimum requirements. In case of conflict between their published requirements, the Owner's Representative shall determine which is to be followed and his decision shall be binding. Specific requirements of this specification or the drawings, which exceed the published requirements, shall take precedence over them.

1.4 FEDERAL BIDDING REQUIREMENTS

- C. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- D. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.5 QUALITY ASSURANCE

- A. Work under this Division shall be supervised by a person who holds a certification issued by the Wisconsin Department of Safety and Professional Services as a certified electrical contractor, certified electrical contractor-restricted or certified master electrician.
- B. Work under this Division shall be executed by a person who holds a certification issued by the Wisconsin Department of Safety and Professional Services as a certified electrical contractor, certified electrical contractor-restricted, certified master electrician, certified journeyman electrician or certified beginning electrician.

1.6 FEES

- A. All local fees, permits, and services of inspection authorities shall be obtained and paid for by the contractor. The contractor shall cooperate fully with local utilities with respect to their services. The owner is responsible for any costs to be incurred relative to power service (primary and/or secondary) and telephone service provided by the utilities.

1.7 SCOPE OF WORK

- A. Electrical Installations: This division of the specifications covers the electrical systems of the project. It includes work performed by the electrical trades as well as trades not normally considered as electrical trades.
- B. Provide all incidentals, equipment, appliances, services, hoisting, scaffolding, supports, tools, supervision, labor consumable items, fees, licenses, etc., necessary to provide complete systems. Perform start-up and checkout on each item and system to provide fully operable systems.
- C. Examine and compare the Electrical Drawings with these specifications, and report any discrepancies between them to the Architect/Engineer and obtain from him written instructions for changes necessary in the work. At time of bid the most stringent requirements must be included in the bid.
- D. Examine and compare the Electrical Drawings and Specifications with the Drawings and Specifications of other trades, and report any discrepancies between them to the Architect/Engineer and obtain from him written instructions for changes necessary in the work. At time of bid, the most stringent requirements must be included in said bid.
- E. Install and coordinate the electrical work in cooperation with other trades installing interrelated work. Before installation, make proper provisions to avoid interferences in a manner approved by the Architect/Engineer. All changes required in the work of the contractor, caused by his neglect to do so, shall be made by him at his own expense.
- F. It is the intent of the Drawings and Specifications to provide a complete workable system ready for the Owner's operation. Any item not specifically shown on the Drawings or called for in the Specifications, but normally required to conform with the intent, are to be considered a part of the Contract.
- G. All materials furnished by the contractor shall be new and unused (temporary lighting and power products are excluded) and free from defects. All materials used shall bear the Underwriter's Laboratory, Inc. label provided a standard has been established for the material in question.
- H. Except for conduit, conduit fittings, outlet boxes, wire and cable, all items of equipment or material shall be the product of one manufacturer throughout the entire project. Multiple manufacturers will not be permitted.

1.8 DEFINITIONS

- A. "PROVIDE" means to furnish, install, purchase, transport, place, erect, connect, wire, test, and turn over to Owner, complete and ready for regular operation, the particular Work referred to.
- B. "INSTALL" means to set in place, join, unite, fasten, link, attach, wire, set up, or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation, the particular Work referred to.
- C. "FURNISH" means to purchase, supply, and deliver to job site, all materials, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the particular Work referred to.
- D. "WIRE", "WIRING" means the inclusion of all raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such Work.
- E. "CONDUIT" means the inclusion of all fittings, hangers, supports, sleeves, etc.
- F. "AS DIRECTED" means as directed by the Architect/Engineer, or his representative.
- G. "CONCEALED" means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed above hung ceilings.

1.9 COORDINATION OF THE WORK

- A. Certain materials will be provided by other trades. Examine the Contract Documents to ascertain these requirements.
- B. Carefully check space requirements with other trades and the physical confines of the area to ensure that all material can be installed in the spaces allotted thereto including finished suspended ceilings and the spaces within the existing building. Make modifications thereto as required and approved.
- C. Transmit to other trades all information required for work to be provided under their respective Sections in ample time for installation.
- D. Wherever work interconnects with work of other trades, coordinate with other trades to ensure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.
- E. Coordinate, project and schedule work with other trades according to the construction sequence.
- F. The Drawings show only the general run of raceways and approximate location of outlets. Any significant changes in location of outlets, cabinets, etc., necessary in order to meet field conditions shall be brought to the immediate attention of the Architect/Engineer and receive his approval before such alterations are made. All such modifications shall be made without additional cost to the Owner.
- G. Obtain from the Architect/Engineer in the field the location of such outlets or equipment not definitely located on the Drawings.
- H. Circuit "tags" are used to show the circuit number and the panel designation for wiring devices and luminaires. Equipment circuits are indicated on equipment connection schedule. Show the actual circuits numbers on the finished record drawings and on panel directory card. Where circuiting is not indicated, Electrical Subcontractor must provide required circuiting according to the loading indicated on the drawings and/or as directed.
- I. Adjust location of conduits, panels, equipment, pull boxes, fixtures, etc. to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each raceway prior to fabrication.
 - 1. Right-of-Way
 - a. Lines that pitch have the right-of-way over those that do not pitch. For example: steam, condensate, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.
 - b. Make offsets, transitions and changes in direction in raceways as required to maintain proper headroom in pitch of sloping lines whether or not indicated on the Drawings.
- J. Wherever the work is of sufficient complexity, prepare additional Detail Drawings to scale similar to that of the bidding Drawings of the same size as the Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field.
- K. Coordinate with the local Electric Utility Company and the local Telephone Company as to their requirements for service connections and provide all necessary materials, labor and testing.
- L. Coordinate with contractors for work under other Divisions of this specification for all work necessary to accomplish this contractor's work.

1.10 PROGRESS OF WORK

- A. The contractor shall order the progress of his work to conform to the progress of the work of other trades and shall complete the entire installation as soon as the conditions of the building will permit. Any cost resulting from the defective or ill-timed work performed under this section shall be borne by the contractor.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Ship and store all products and materials in a manner that will protect them from damage, weather and entry of debris. If items are damaged, do not install, but take immediate steps to obtain replacement or repair. Any such repairs shall be subject to review and acceptance of the manufacturer and Architect/Engineer.
- B. Deliver materials in manufacturer's unopened container fully identified with manufacturer's name, trade name, type, class, grade, size and color.
- C. Store materials suitably sheltered from the elements, but readily accessibly for inspection by the Architect/Engineer until installed. Store all items subject to moisture damage in dry, heated spaces.

1.12 EQUIPMENT ACCESSORIES

- A. Provide supports, hangers and auxiliary structural members required for support of the work.
- B. Furnish and set all sleeves for passage of raceways through structural, masonry and concrete walls of floors and elsewhere as will be required for the proper protection of each raceway passing through building surfaces.
- C. Wall mounted equipment may be directly secured to wall by means of steel bolts. Maintain at least 1" air space between equipment and supporting wall. Groups or arrays of equipment may be mounted on adequately sized steel angles, channels, or bars. Prefabricated steel channels providing a high degree of mounting flexibility, such as those manufactured by Kindorf, Glob-Strutt and Unistrut, may be used for mounting arrays of equipment.

1.13 OPERATIONS AND MAINTENANCE MANUALS

- A. General: Provide operations and maintenance (O&M) manuals according to the Contract Documents.
 - 1. Provide two (2) copies of each manual.
 - 2. Manuals shall be 8-1/2 inches X 11 inches in hard cover 3-ring loose-leaf binders.
 - 3. Manuals shall be complete and in Owner's hands prior to turning building over to Owner and at least 10 days prior to instruction to operating personnel.
- B. Provide manufacturer's literature as regularly published by the respective manufacturers for proper preventative and comprehensive maintenance.
- C. Provide O&M manuals including but not limited to the following:
 - 1. Alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
 - 2. Operating instructions for complete system including:
 - a. Normal starting, operating, and shut-down.
 - b. Emergency procedures for fire or failure of major equipment.
 - c. Summer and winter special procedures, if any.
 - d. Day and night special procedures, if any.

3. Maintenance instruction including:
 - a. Proper lubricants and lubricating instructions for each piece of equipment, and date when lubricated.
 - b. Necessary cleaning, replacement and/or adjustment schedule.
 4. Manufacturer's data for each piece of equipment including:
 - a. Installation instructions.
 - b. Drawings and specifications.
 - c. Parts list, including recommended items to be stocked.
 - d. Complete wiring diagrams.
 - e. Marked or changed prints locating all concealed parts and all variations from the original system design.
 - f. Test and inspection certificates.
- D. Refer to individual specification sections for additional O&M requirements.

1.14 RECORD DOCUMENTS

- A. Prepare record ("as-built") documents according to the requirements in Division 1. In addition to the requirements specified in Division 1, indicate installed conditions for:
1. Major raceway systems, size, and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 3. Approved substitutions, contract modifications, and actual equipment and materials installed.

1.15 GUARANTEE

- A. Guarantee all material and workmanship for a period of one (1) year from date of final acceptance by the Owner, except that where guarantees or warranties for longer terms are specified elsewhere, such longer term to apply. Within 24 hours after notification, correct any deficiencies that occur during the guarantee period at no additional cost to the Owner, all to the satisfaction of the Owner and Architect/Engineer. Obtain similar guarantees from subcontractors, manufacturers, suppliers and subtrade specialists.
- B. See Division 1 – Closeout Procedures, for additional warranty requirements.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Applicable equipment and materials shall be listed by Underwriters' Laboratories and Manufactured according to ASME, NEMA, ANSI or IEEE standards, and as approved by local authorities having jurisdiction as mentioned in Division 1.
- B. If products and materials are specified or indicated on the Drawings for a specific item or system, use those products or materials. If products and materials are not listed in either of the above, use first class products and materials, subject to approval of Shop Drawings where Shop Drawings are required or as approved in writing where Shop Drawings are not required.
- C. All equipment capacities, etc. are listed for job site operating conditions. All equipment sensitive to altitudes or ambient temperatures to be derated and method of derating shown on Shop Drawings. Where operating conditions shown differ from the laboratory test conditions, the equipment to be derated and the method of derating shown on Shop Drawings.

2.2 SUBSTITUTION OF MATERIALS OR EQUIPMENT

- A. All requests for substitution of materials or equipment shall be made in writing. The request for prior approval must be in the engineer's office not less than 10 days prior to the bid date. Samples of proposed substitute materials or equipment shall be submitted to the engineer for review whenever they are requested. Bids shall be based only upon the specified materials and equipment, or substitutes that have received written acceptance from the engineer prior to the bid.
- B. Wherever the words "for approval" or "approved" are used in regard to manufactured specialties, or wherever it is desired to substitute a different make or type of apparatus for that specified, submit all information pertinent to the adequacy and adaptability of the proposed apparatus, and secure Architect/engineer's acceptance before apparatus is ordered.
- C. Wherever quantities or a definite make and size of apparatus are specified, the make and size of apparatus which is proposed must conform substantially (in regard to the operating results) to that specified or implied. Same shall apply to important dimensions relating to operation of apparatus in coordination with the rest of the system, or to properly fitting it into available space conditions. Any substitution of equipment or apparatus shall include all necessary revisions, as required to complete the installation.
- D. Acceptance of substitutions, for equipment specified herein, will not be given merely upon submission of manufacturer's names and will be given only after receipt of complete and satisfactory performance data covering the complete range of operating conditions in tabular and graphical form. Furnish complete and satisfactory information relative to equipment dimensions, weight, etc. Acceptance of all equipment specified or shown on the Drawings, or substitutions submitted for that specified or shown on the Drawings, will be granted if such equipment, in the opinion of the Architect/Engineer, conforms to the performance requirements, space conditions, weight requirements and quality requirements. Any additional construction and design costs incurred as a result of any accepted substitution shall be borne by the contractor. The opinion and judgment of the Architect/Engineer shall be final, conclusive, and binding.

2.3 SUBMITTALS

- A. Submit through General or Prime Contractor. Refer to Division 1 – Section 'Submittals'.
- B. Prepare and submit one (1) electronic copy of Shop Drawings for materials, systems, and equipment as listed herein, including locations and sizes of all openings in floor decks, walls, and floors.
- C. The Work described in any Shop Drawing submission shall be carefully checked for all clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions, and proper coordination with all trades on the job. Each submitted Shop Drawing shall include a certification that all related job conditions have been checked and that no conflict exists.
- D. All drawings shall be submitted sufficiently in advance of field requirements to allow ample time for checking and resubmitting as may be required. All submittals shall be complete and contain all required and detailed information.
- E. Acceptance of any submitted data or Shop Drawings for material, equipment apparatus, devices, arrangements, and layout shall not relieve contractor from responsibility of furnishing same of proper dimensions and weight, capacities, sizes, quantity, quality and installation details, to efficiently perform the requirements and intent of the Contract. Such acceptance shall not relieve contractor from responsibility for errors, omissions, or inadequacies of any sort on submitted data or Shop Drawings.
- F. Each Shop Drawing shall contain the following information.
 - 1. Provide general information on each copy of the submittal.
 - a. Project title.
 - b. Reference to the applicable drawing and specification article.
 - c. Identify each device per the schedules and drawings.

- d. Contractor and supplier identification, addresses and telephone numbers.
 - e. Submittal Date.
 - f. Tab each submittal with its specification section. Do not supply a complete submittal without breaking out each specification section.
 - 2. Certification that the contractor has reviewed the submittal.
 - 3. Refer to individual specification sections for additional information requirements.
- G. Shop Drawing submittals shall be provided for each specific material, system, or equipment as identified herein.
 - 1. As a minimum, make submittals on the following items:
 - a. Raceways, conduit and wire
 - b. Wiring devices and plates
 - c. Panelboards
 - d. Fuses
 - e. Disconnect switches
 - f. Motor controllers, starters, and contactors
 - g. Lighting fixtures, lamps
 - h. Special systems - fire alarm, security, CCTV, intercom, etc.
 - 2. Refer to individual specification sections for additional submittal requirements.

END OF SECTION 23 01 00

SECTION 26 01 10 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Requirements specified in Division 26 Section "Basic Electrical Requirements" apply to this Section.
- C. This Section includes limited scope general construction materials and methods for application with electrical installations as follows:
 - 1. Joint sealers for sealing around electrical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
 - 2. Cutting, patching, and repairing.
 - 3. Excavation, trenching, and backfill.
 - 4. Waterproofing.
 - 5. Supports.
 - 6. Fastenings.
 - 7. Testing equipment and materials.
 - 8. Cleaning up.

1.2 DEFINITIONS

- A. The following definitions apply to excavation operations:
 - 1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
 - 2. Subbase: As used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
 - 3. Subgrade: As used in this Section refers to the compacted soil immediately below the slab or pavement system.
 - 4. Unauthorized excavation: Consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the engineer.

1.3 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle joint sealer materials in compliance with the manufacturers' recommendations to prevent their deterioration and damage.

PART 2 PRODUCTS

2.1 JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the engineer from manufacturer's standard colors.
- C. Elastomeric Joint Sealers: Provide the following types:
 - 1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. One-Part, Nonacid-Curing, Silicone Sealant
 - b. "Chem-Calk N-Cure 2000", Bostic Construction Products Division.
 - c. "Dow Corning 790", Dow Corning Corporation.
 - d. "Silglaze N SCS 2501", General Electric Company.
 - e. "Silpruf SCS 2000", General Electric Company.
 - f. "864", Pecora Corporation.
 - g. "Rhodorsil 5C", Rhone-Poulenc, Inc.
 - h. "Spectrum 1", Tremco, Inc.
 - i. "Spectrum 2", Tremco, Inc.
- D. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies according to ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Dow Corning Fire Stop Foam", Dow Corning Corp.
 - b. "Pensil 851", General Electric Co.

2.2 INSTALLATION

- A. Examine substrates, area, and condition, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of joint sealers and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Preparation for Joint Sealers.
 - 1. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
 - 2. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.
- C. Application of Joint Sealers
 - 1. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

- a. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
 - b. Comply with recommendations of ASTM C 790 for use of acrylic emulsion joint sealants.
- 2. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide fire-stops with fire- resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Follow manufacturer's instructions for installing, connecting, and adjusting all equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Provide all special supports, connections, wiring, accessories, etc.
- B. Use mechanics skilled in their trade for all work.
- C. Rough-in:
 - 1. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
 - 2. Refer to equipment specifications in Divisions 2 through 26 for rough-in requirements.
- D. Electrical Installations: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate electrical systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 - 5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 7. Coordinate connection of electrical systems with exterior underground utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
 - 8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect/Engineer.
 - 9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

10. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Install access panel or doors where units are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "ACCESS DOORS".
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.2 CUTTING, PATCHING, AND REPAIRING

- A. The work shall be carefully laid out in advance. Where cutting, channeling, chasing or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support or anchorage of raceway, outlets or other equipment, the work shall be carefully done. Any damage to the building, piping, equipment or defaced finish plaster, woodwork, metalwork, etc. shall be repaired by skilled mechanics of the trades involved at no additional cost to the Owner.
- B. Where conduits, mounting channels, outlet, junction, or pull boxes are mounted on a painted surface, or a surface to be painted, they shall be painted to match the surface. Whenever support channels are cut, the bare metal shall be cold galvanized.
- C. Perform cutting and patching according to Division 01 Section "CUTTING AND PATCHING". In addition to the requirements specified in Division 01, the following requirements apply:
 1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - a. Uncover work to provide for installation of ill-timed work.
 - b. Remove and replace defective work.
 - c. Remove and replace work not conforming to requirements of the Contract Documents.
 2. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
 3. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
 4. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
 5. Patch finished surfaces and building components using new materials specified for the original installation and experienced installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

3.3 EXCAVATION, TRENCHING, AND BACKFILL

- A. Provide excavation for the Work. Excavate all material encountered, to the depths indicated on the drawings or required. Remove from the site, excavated materials not required or suitable for backfill. Provide grading, as may be necessary, to prevent surface water from flowing into trenches or other excavations. Remove any water accumulating therein. Provide sheeting and shoring as may be necessary for the protection of the Work and for the safety of personnel.
- B. Provide trenches of widths necessary for the proper execution of the Work. Grade bottom of the trenches accurately to provide uniform bearing and support the Work on undisturbed soil at every point along its entire length. Except where rock is encountered, do not excavate below the depths indicated. Where rock excavations are required. Excavate rock to a minimum overdepth of four (4") inches below the trench depths indicated on the Drawings or required. Backfill overdepths in the rock excavation and unauthorized overdepths with loose granular, moist earth, thoroughly machine tamped, to a compaction level of at least 95 percent to standard protector density or 75 percent

relative density or as specified by the Architect. Whenever unstable soil that is incapable of properly supporting the Work, as determined by Architect/Engineer, is encountered in the bottom of the trench, remove soil to a depth required and backfill the trench to the proper grade with coarse sand, fine gravel, or other suitable material.

- C. Excavate trenches for utilities to a depth that will provide the following minimum depths of cover from existing grade or from indicated finished grade, whichever is lower, unless otherwise specifically shown.
 - 1. Primary electric service: four (4) feet (minimum)
 - 2. Secondary electric service: two (2) feet (minimum)
 - 3. Telephone service: two (2) feet (minimum)
- D. Trenches shall not be placed within ten (10) feet of foundation or soil surfaces which must resist horizontal forces.
- E. Do not backfill trenches until all required tests have been preformed and the installation observed by the engineer. Comply with the requirements of other sections of these specifications. Backfill shall consist of non-expansive soil with limited porosity. Deposit in six (6") inch layers and thoroughly and carefully tamp until the Work has a cover of not less than one (1) foot. Backfill and tamp remainder of trench at twelve (12") inch intervals until complete. Uniformly grade the finished surface. Backfill and tamp with compaction at least equal to the surrounding area.

3.4 WATERPROOFING

- A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect/Engineer and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.
- B. If contractor penetrates any walls or surfaces after they have been waterproofed, he shall restore the waterproof integrity of that surface as directed by the Architect/Engineer at his own expense.

3.5 SUPPORTS

- A. Support work according to the best industry practice and the following.
- B. Include supporting frames or racks extending from building structure for work indicated as being supported from walls where the walls are incapable of supporting the weight. In particular, provide such frames or racks in electric closets.
- C. Include supporting frames or racks for equipment, intended for vertical surface mounting, which is required in a free standing position.
- D. Supporting frames or racks shall be of standard angle, standard channel or specialty support system steel members. They shall be rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.
- E. Nothing, (including outlet, pull and junction boxes and fittings) shall depend on electric conduits, raceways, or cables for support, except that threaded hub type fittings having a gross volume not in excess of 100 cubic inches may be supported from heavy wall conduit, where the conduit is securely supported from the structure within five inches of the fitting on two opposite sides.
- F. Nothing shall rest on, or depend for support on, suspended ceilings media (tiles, lath, plaster, as well as splines, runners, bars and the like in the plane of the ceiling).
- G. Provide required supports and hangers for conduit, equipment, etc., so that loading will not exceed allowable loadings of structure.

3.6 FASTENINGS

- A. Fasten electric work to building structure according to the best industry practice and the following.
- B. Floor or pad mounted equipment shall not be held in place solely by its own dead weight. Include anchor fastening in all cases.
- C. For items which are shown as being ceiling mounted at locations where fastening to the building construction element above is not possible, provide suitable auxiliary channel or angle iron bridging, tying to the building structural elements.

3.7 TESTING EQUIPMENT AND MATERIALS

- A. The contractor shall provide all testing instruments, equipment and all materials, connections, labor, etc., required to perform tests.
- B. Test all circuits, fixtures, equipment, and systems for proper operation and freedom from grounds, shorts and open circuits before acceptance is requested.
- C. Measure voltage at panelboards and outlets after the building is fully occupied. Make final transformer tap adjustments based on these measurements.
- D. Perform all tests required by local authorities, such as tests of life safety systems, in addition to tests specified herein.
- E. Perform tests required by other specification sections.

3.8 CLEANING UP

- A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of his work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean.
- B. Contractor shall clean up all fixtures and equipment at the completion of the project.
- C. All panelboards, wireways, trench ducts, cabinets and enclosures shall be thoroughly vacuumed clean prior to energizing equipment and at the completion of the project. Equipment shall be opened for observation by the Architect/Engineer as required.

END OF SECTION 26 01 10

SECTION 26 01 15 - TEMPORARY SERVICE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The Electrical Contractor shall arrange with local utility for temporary power for construction areas.
- B. Temporary lighting and circuits shall conform to all aspects of 2017 National Electrical Code Provisions. Among other provisions, code prohibits use of Romex, UF, or open wiring and requires cord connections for all work.
- C. Temporary service is required for construction areas.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 INSTALLATION

- A. The service size shall be 200 amp, 120/208 volt, 3 phase. Provide 100 amp panel in area of each addition.
- B. The Electrical Contractor shall provide, at no cost to other contractors, all lamps, wiring switches, sockets and similar equipment required for temporary system until substantial completion. Temporary system shall be installed and maintained according to requirements of the safety code of the Industrial Commission and such as to prevent injury or damage to persons, equipment or construction. All facilities exposed to moisture or weather shall be weatherproof type, and electrical equipment enclosures shall be locked to prevent access.
- C. According to the latest issue of the National Electrical Code, all temporary electrical circuits for construction purposes shall be equipped with combination ground fault interrupter and circuit breaker meeting the requirements of UL for Class A, Group 1 devices. The ground fault interrupter portion shall be solid state type, insulated and isolated from the breaker mechanism. A test button shall be provided for checking the device. The breaker mechanism shall provide overload and short circuit protection and shall be operated by a toggle switch with overcenter switching mechanism so that contact cannot be held closed.
- D. The Electrical Contractor shall provide at least one 120 volt, single phase outlet for lighting and one grounded duplex outlet for small power tools for each 1,000 sq. ft. of floor space. Circuits shall be 20 ampere, single pole, No. 12 wire. Circuit length shall not exceed 200 feet. Not less than 15 foot candles illumination shall be provided. Lighting shall be provided to maintain 15 foot candles minimum light levels.
- E. Subcontractors and other contractors shall be allowed to use the service provided for general lighting and fractional horsepower tools at no cost. Each contractor shall furnish his own extension cords and lamps other than those furnished for general lighting.
- F. Contractors requiring voltage other than basic temporary system specified, three phase power, or a special single phase run, for operation of construction equipment or testing shall make their own arrangements with the Owner for cost of energy used and with Electrical Contractor for cost of service extension, installation and removal when no longer required.
- G. Each contractor shall provide and pay for installation of temporary service for lighting, heating or cooling of their temporary offices. They shall make arrangements with the Electrical Contractor for the cost of installation and removal when no longer required.

- H. Heating and Ventilating Contractor shall expedite the work under his contract in such a manner that the permanent power wiring system and panels will be installed and connected to permanent heating and ventilating equipment in time to operate and test this equipment when the building has been closed sufficiently to permit the use of portions of the heating and ventilating system for temporary heating during construction. Permanent wiring and connections may be used at permanent equipment; however, the use of the permanent system during construction shall in no way waive any part of the guarantee period.
- I. After substantial completion of the permanent electrical system and building wiring by the Electrical Contractor, permanent receptacles may be used during finishing work. Permanent wiring for lighting fixtures, switches and receptacles shall be installed only after all masonry and plastering has been completed, but this wiring shall not be used for motors larger than fractional HP or for welding equipment. Circuits for larger motors and welding equipment may be provided with special circuits to mains of electrical panels at the expense of contractors requiring them, provided that special permission is obtained from the Architect/Engineer and the installation is made by the Electrical Contractor.
- J. Upon completion of the project, the Electrical Contractor shall remove the temporary electrical systems.

END OF SECTION 26 01 15

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wire and cable for 600 volts and less.
- B. Wiring connectors and connections.

1.2 RELATED REQUIREMENTS

- A. Division 31 - Earthwork.
- B. Section 26 05 53 - Identification for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2015.
- B. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2017.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; 2017.

1.4 SUBMITTALS

- A. See Division 01 - Submittal Procedures.
- B. Test Reports: Indicate procedures and values obtained.
- C. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency.
- E. Project Record Documents: Record actual locations of components and circuits.

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience and with service facilities within 100 miles (160 km) of Project.
- C. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 WIRING REQUIREMENTS

- A. Concealed Dry Interior Locations: Use only building wire in raceway, building wire with Type THHN, THWN, XHHW insulation in raceway, armored cable, or metal clad cable. See permitted use in 3.03 Installation for AC and MC cable.
- B. Exposed Dry Interior Locations: Use only building wire in raceway, building wire with Type THHN, THWN, XHHW insulation in raceway, armored cable, or metal clad cable. See permitted use in 3.03 Installation for AC and MC cable.

- C. Above Accessible Ceilings: Use only building wire in raceway, building wire with Type THHN, THWN, or XHHW insulation in raceway, armored cable, or metal clad cable. See permitted use in 3.03 Installation for AC and MC cable.
- D. Wet or Damp Interior Locations: Use only building wire with Type THWN or XHHW insulation in raceway.
- E. Exterior Locations: Use only building wire with Type THWN or XHHW insulation in raceway, direct burial cable, service-entrance cable.
- F. Underground Installations: Use only building wire with Type THWN or XHHW insulation in raceway.
- G. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- H. Use stranded conductors for control circuits.
- I. Use conductor not smaller than 12 AWG for power and lighting circuits.
- J. Use conductor not smaller than 16 AWG for control circuits.
- K. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (25 m).
- L. Conductor sizes are based on copper.

2.2 WIRE MANUFACTURERS

- A. Cerro Wire Inc.
- B. Industrial Wire & Cable, Inc.
- C. Southwire Company.
- D. Encore.
- E. Substitutions: See Division 01 - Product Requirements.

2.3 BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Conductor: Copper.
 - 1. For Sizes Smaller Than 4 AWG: Copper.
 - 2. For Sizes 4 AWG and Larger: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: NFPA 70, Type THW, THHN, THWN, XHHW.
- E. Insulation: Thermoplastic material rated 60 degrees C.

2.4 ARMORED CABLE (See Permitted Use in 3.03 Installation)

- A. Description: NFPA 70, Type AC.
- B. Conductor: Copper.
 - 1. For Sizes Smaller Than 4 AWG: Copper.
 - 2. For Sizes 4 AWG Through 1 AWG: Copper.
- C. Insulation Voltage Rating: 300 volts.
- D. Insulation Temperature Rating: 60 degrees C.
- E. Insulation Material: Thermoplastic.
- F. Conductor Assembly Covering: Lead.

2.5 METAL CLAD CABLE (See Permitted Use in 3.03 Installation)

- A. Description: NFPA 70, Type MC.

- B. Conductor: Copper.
 - 1. For Sizes Smaller Than 4 AWG: Copper.
 - 2. For Sizes 4 AWG and Larger: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 60 degrees C.
- E. Insulation Material: Thermoplastic.
- F. Armor Material: Steel.
- G. Armor Design: Interlocked metal tape.
- H. Jacket: PVC; use in locations indicated.

2.6 WIRING CONNECTORS

- A. Split Bolt Connectors:
 - 1. Not acceptable.
- B. Solderless Pressure Connectors:
 - 1. High copper alloy terminal. May be used only for cable termination to equipment pads or terminals.
 - 2. Substitutions: See Division 01 - Product Requirements.
- C. Spring Wire Connectors:
 - 1. Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
 - 2. Substitutions: See Division 01 - Product Requirements.
- D. Compression Connectors:
 - 1. Long barrel; seamless, tin-plated electrolytic copper tubing; internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps.
 - 2. Substitutions: See Division 01 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that mechanical work likely to damage wire and cable has been completed.
- C. Verify that raceway installation is complete and supported.
- D. Verify that field measurements are as indicated.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION

- A. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.
 - 1.
- B. Route wire and cable as required to meet project conditions.
 - 1. Wire and cable routing indicated is approximate unless dimensioned.
 - 2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
 - 3. Include wire and cable of lengths required to install connected devices within 10 feet of location shown.

- C. Use wiring methods indicated.
- D. Pull all conductors into raceway at same time.
- E. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- F. Protect exposed cable from damage.
- G. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
- H. Use suitable cable fittings and connectors.
- I. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- J. Clean conductor surfaces before installing lugs and connectors.
- K. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- L. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
- M. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- N. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
- O. AC and MC cable permitted uses:
 - 1. Flexible connections less than 4'.
 - 2. Light fixture connections above suspended ceiling. Length shall be 6' or less. Not approved for fixture to fixture wiring.
 - 3. Conductor to last device on branch circuits installed in walls.
 - 4. Control and signal circuits.

3.4 FIELD QUALITY CONTROL

- A. Perform field inspection and testing according to Division 01.
- B. Inspect and test according to NETA STD ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

END OF SECTION 26 05 19

SECTION 26 05 23 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Furnishing and installing cabling for remote-control, signaling and power-limited circuits.

1.2 RELATED REQUIREMENTS

- A. Applicable provisions of Division 1 govern work under this Section.
- B. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- C. Section 26 05 53 – Identification for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. NFPA 70 National Electrical Code 2017.

1.4 SUBMITTALS

- A. Submit product data: Provide for each cable assembly type.
- B. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency.

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
- C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 PRODUCTS

2.1 GENERAL

- A. All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.
- B. All conductors shall be copper.
- C. Insulation shall have a 600 volt rating.
- D. All conductors shall be suitable for the application intended. Conductors #12 and smaller may be solid or stranded with the following requirements or exceptions:
 - 1. All conductors terminated with crimp type devices shall be stranded.
 - 2. Stranded conductors shall be terminated with an approved ETL Listed type terminations or methods: e.g. stranded conductors shall not be wrapped around a terminal screw but shall be terminated with a crimp type device or in an approved back wired method.

2.2 REMOTE CONTROL AND SIGNALING CABLE

- A. Refer to Section 28 31 00 for requirements for cable to be used on fire alarm systems.
- B. Refer to Section 27 10 00 for requirements for cable to be used on communication systems.
- C. All other systems cabling shall meet the requirements of NEC Article 725 and the following:
 - 1. Cable for Class 1 Remote-Control, Signaling and Power-Limited Circuits: 600 volt insulation, individual conductors twisted together, shielded, and covered with an overall PVC jacket. Cable shall be Listed, temperature rated, and suitable Type (general purpose, riser or plenum) for the application as required in the National Electrical Code.
 - 2. Cable for Class 2 or Class 3 Remote-Control, Signaling and Power-Limited Circuits shall be Listed, temperature rated, and suitable Type (general purpose, riser or plenum) for the application as required in the National Electrical Code.

2.3 WIRING CONNECTORS

- A. Split Bolt Connectors: Not acceptable.
- B. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
- C. All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations.

PART 3 EXECUTION

3.1 GENERAL WIRING METHODS

- A. Control-voltage cables shall be installed in conduit. However, they may be installed free-air (without conduit) above accessible ceilings if the cable meets NEC requirements for the application, unless specified to be in conduit in other sections of the specifications. See requirements for free-air cable installation below.
- B. Control cables for controlling HVAC and lighting equipment connected to emergency power shall be routed in raceway.
- C. Do not use wire smaller than 14 AWG for control wiring greater than 60 volts, or 18 AWG for voltages less than 60 volts, all sizes subject to NEC 725 requirements.
- D. Splice only in junction boxes.
- E. Identify wire per section 26 05 53.
- F. Neatly train and lace wiring inside boxes, and equipment.

3.2 WIRING INSTALLATION

- A. Pull all conductors into a raceway at the same time. Use Listed wire pulling lubricant for pulling conditions when necessary.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

3.3 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice only in accessible junction boxes (except splices to low voltage occupancy sensor power packs and terminations to temperature control devices).
- B. All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.
- C. Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller.
- D. Thoroughly clean wires before installing lugs and connectors.
- E. At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

END OF SECTION 26 05 23

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding and bonding components.
- B. Provide all components necessary to complete the grounding system(s) consisting of:
 - 1. Metal underground water pipe.
 - 2. Metal frame of the building.
 - 3. Concrete-encased electrode.
 - 4. Metal underground gas piping system.
 - 5. Rod electrodes.

1.2 RELATED REQUIREMENTS

- A. Section 33 79 00 - Site Grounding.
- B. Division 01 - Concrete Reinforcing.
- C. Division 01 - Cast-in-Place Concrete.

1.3 REFERENCE STANDARDS

- A. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2017.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association; 2017.

1.4 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms.
- B. Communications Busbar(s): 5 ohms.

1.5 SUBMITTALS

- A. See Division 01 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide for grounding electrodes and connections.
- C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Project Record Documents: Record actual locations of components and grounding electrodes.
- F. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.6 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience with service facilities within 100 miles of Project.

- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Cooper Power Systems.
- B. Framatome Connectors International.
- C. CadWeld.
- D. Substitutions: See Division 01 - Product Requirements.

2.2 ELECTRODES

- A. Manufacturers:
 - 1. Cooper Power Systems.
 - 2. Framatome Connectors International.
 - 3. Lightning Master Corporation.
 - 4. Substitutions: See Division 01 - Product Requirements.
- B. Rod Electrodes: Copper.
 - 1. Diameter: 3/4 inch.
 - 2. Length: 8 feet.
 - 3. Substitutions: See Division 01 - Product Requirements.
- C. Foundation Electrodes: 2/0 AWG.

2.3 CONDUCTORS

- A. Material: Stranded copper (aluminum not permitted).
- B. Grounding Electrode Conductor: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger.
- C. Foundation Electrodes: As required by code.
- D. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both are used at the same facility.
- E. Conductors for Telecommunications shall be as follows:
 - 1. Telecommunications Bonding Conductor (TMGB to Service Ground): No. 3/0 minimum or as shown on drawings.
 - 2. Telecommunications Bonding Backbone (TBB; TMGB to TGB): No. 3/0 minimum or as shown on drawings.
 - 3. Telecommunications Grounding Equalizer (GE): No. 3/0 minimum or as shown on drawings.
 - 4. Bonding Conductors shall be insulated with a Green Jacket or jacket marked with Green Tape or labeled per NEC Guidelines

2.4 BUS/BUSBAR

- A. Material: Copper (aluminum not permitted).
- B. Size:
 - 1. All Power systems: 1/4" X 2", length as needed (24" minimum).
 - 2. Telecommunications Main Ground Busbar (TMGB): 1/4" x 4" x 20" long (minimum).
 - 3. Telecommunications Grounding Busbar (TGB): 1/4" x 2" x 12" long (minimum).

- C. Busbars for Telecommunications shall:
 - 1. Be pre-drilled to accommodate two-hole lugs.
 - 2. 3/8" stud hole size; hole spacing per ANSI J-STD-607-A.
 - 3. Incorporate insulators and stand-off brackets that electrically isolate busbar from mounting surface.
- D. Provide main ground busbar located adjacent to main electrical service equipment to terminate all ground conductors.

2.5 CONNECTORS AND ACCESSORIES

- A. Mechanical Connectors: Bronze.
 - 1. Substitutions: See Division 01 - Product Requirements.
- B. Exothermic Connections:
 - 1. Product: CadWeld
 - 2. Substitutions: See Division 01 - Product Requirements.
- C. Wire: Stranded copper.
- D. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.
- E. Grounding Well:
 - 1. Well Pipe: 8 inch by 24 inch long clay tile pipe with belled end.
 - 2. Well Cover: Cast iron with legend "GROUND" embossed on cover.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions prior to beginning work.
- B. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

- A. Install rod electrodes as required to achieve specified resistance to ground.
- B. Provide grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.
- C. Install 4 AWG bare copper wire in foundation footing.
- D. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel together.
- E. Provide bonding to meet requirements described in Quality Assurance.
- F. Bond together metal siding not attached to grounded structure; bond to ground.
- G. Install ground grid under access floors where indicated. Construct grid of 2 AWG bare copper wire installed on 24 inch centers both ways. Bond each access floor pedestal to grid.
- H. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Use 2 AWG bare copper conductor.
- I. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- J. Interface with site grounding system installed under Section 33 79 00.

3.3 COMMUNICATION SYSTEM GROUNDING

- A. Grounding and Bonding System for Communications shall be an isolated grounding system with a single ground point. That ground point is to be the common grounding electrode system at the building electrical service entrance (main ground bar located in electrical room).
- B. The system shall be compliant with ANSI J-STD-607-B with the exception that the ground cable shall not be bonded to building steel except at the electrical service entrance.
- C. Provide Grounding Busbar for Telecommunications at each Telecommunications Room, the Main Equipment Room and at the electrical service entrance per project drawings. Coordinate Busbar location(s) and conductor routing per drawings with Division 27 contractor.
- D. Provide Telecommunications Bonding Conductor from Telecommunications Main Grounding Busbar (TMGB) at the Communications Entrance Facility to building common grounding electrode system. Attach grounding conductor to building steel as allowed only at the main electrical service entrance.
- E. Provide Telecommunications Bonding Backbone (TBB) conductor from the TMGB to Telecommunications Grounding Busbar (TGB) at each Telecommunication Room, Telecommunications Equipment Room and Telecommunications Enclosure.
 - 1. The TBB shall be connected through Telecommunications Main Ground Busbar direct to the Telecommunications Ground Busbar (TGB).
 - 2. The TGBs may be bonded to the TBB via tap off of the TBB. Use the same conductor size for the tap as the main TBB.
 - 3. Provide 10 foot of slack in the TBB conductor at each TGB location.
 - 4. Do not bond the TBB or TGB to the building steel at the TGB location(s); bond only at the building common grounding electrode system.
- F. Provide Grounding Equalizer(s) (GE) per project drawings. Connect GE conductor directly to TGBs being interconnected.

3.4 FIELD QUALITY CONTROL

- A. Owner will provide field inspection according to Division 01.
- B. Provide field inspection according to Division 01.
- C. Inspect and test according to NETA STD ATS except Section 4.
- D. Perform inspections and tests listed in NETA STD ATS, Section 7.13.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Conduit and equipment supports.
- B. Anchors and fasteners.

1.2 REFERENCE STANDARDS

- A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2015.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association; 2017.

1.3 SUBMITTALS

- A. See Division 01 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
- B. Supports: Fabricated of structural steel or formed steel members; galvanized.
- C. Anchors and Fasteners:
 - 1. Do not use powder-actuated anchors, spring clips, or beam clamps.
 - 2. Obtain permission from Architect before using powder-actuated anchors.
 - 3. Concrete Structural Elements: Use precast inserts, expansion anchors, powder-actuated anchors, or preset inserts.
 - 4. Steel Structural Elements: Use beam clamps, steel spring clips, steel ramset fasteners, or welded fasteners.
 - 5. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
 - 6. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.

7. Solid Masonry Walls: Use expansion anchors or preset inserts.
8. Sheet Metal: Use sheet metal screws.
9. Wood Elements: Use wood screws.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
 1. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
 2. Do not drill or cut structural members.
 3. Obtain permission from Architect before drilling or cutting structural members.
- B. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- C. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- D. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1 inch off wall.
- E. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION 23 05 29

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section describes the products and execution requirements relating to furnishing and installing raceways and boxes and related systems as part of a raceway system for electrical, communications, and other low-voltage systems for the project.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- C. Section 26 27 02 – Equipment Wiring Systems.
- D. Section 26 27 26 – Wiring Devices.
- E. Section 27 10 00 - Structured Cabling.
- F. Section 28 31 00 – Fire Detection and Alarm.

1.3 REFERENCE STANDARDS

- A. NFPA 70 – National Electrical Code; National Fire Protection Association, 2017.
- B. ANSI/TIA-569-C-Telecommunications Pathways and Spaces.
- C. ANSI/SCTE 77-2017 – Specifications for Underground Enclosure Integrity.

1.4 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.5 SUBMITTALS

- A. Surface Raceway System - submit product data and catalog sheets for all components.
- B. Boxes - provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.
- C. Conduits in Concrete Slabs Above Grade - provide proposed conduit routing and sizing to Structural Engineer prior to approval of installation to verify structural integrity and fire rating of concrete slab.
- D. Mockups -- Provide on request, mockups for Floor Box and Poke-through Assemblies to demonstrate configuration, capacity and aesthetics and to set quality standards for fabrication and installation. Coordinate with Division 26 and Division 27 requirements as applicable to include all power and communications devices.

PART 2 PRODUCTS

2.1 GENERAL

- A. All steel fittings and conduit bodies shall be galvanized.
- B. All conduit transitional fittings shall be listed for installed application.
- C. No cast metal or split-gland type fittings permitted.
- D. All conduit covers must be fastened to the conduit body with screws and be of the same manufacture.
- E. Mogul-type condulets 2 inch (50 mm) and larger, shall be permitted.

- F. C-condulets shall not be used in lieu of pull boxes.
 - G. All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.
- 2.2 RIGID METAL CONDUIT (RMC) AND FITTINGS
- A. Conduit: Heavy wall threaded, galvanized steel.
 - B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.
 - C. Expansion Fittings/Expansion Joints: Expansion Fittings shall be Internal Grounding type and shall not rely on external bonding jumpers to maintain grounding continuity between raceway components.
- 2.3 PVC COATED RIGID METAL CONDUIT
- A. PVC Externally Coated Conduit: Rigid heavy wall, schedule 40, steel conduit with external 40 mil (0.1 mm) PVC coating. Conduit must be hot dipped galvanized inside and out including threads. The PVC coating bond to the galvanized steel conduit shall be stronger than the tensile strength of the coating itself.
 - B. Fittings and Conduit Bodies: Threaded type, material to match conduit. PVC coated fittings and couplings shall have specially formed sleeves to tightly seal to conduit PVC coating. The sleeves shall extend beyond the fitting or coupling a distance equal to the pipe outside steel diameter or two inches (50 mm) whichever is greater.
- 2.4 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS
- A. Conduit: Galvanized Steel, threaded.
 - B. Fittings and Conduit Bodies: Use all Steel threaded fittings and conduit bodies.
 - C. Expansion Fittings/Expansion Joints: Expansion Fittings shall be Internal Grounding type and shall not rely on external bonding jumpers to maintain grounding continuity between raceway components.
- 2.5 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS
- A. Conduit: Steel, Unthreaded thin wall galvanized tubing.
 - B. Fittings: All steel, compression or set screw type. No push-on or indenter types permitted.
 - C. Transitional fitting: 1/2-1": All steel and malleable iron; 1 1/4" and above: All steel, Malleable iron and Die cast where not subjected to physical damage and with project specific DFDM electrical inspector approval.
 - D. Conduit Bodies: All steel conduit bodies.
- 2.6 FLEXIBLE METAL CONDUIT (FMC) AND FITTINGS
- A. Conduit: steel, galvanized, spiral strip.
 - B. Fittings and Conduit Bodies: All steel, galvanized or malleable iron (except as allowed in specification 26 51 13).
- 2.7 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC) AND FITTINGS
- A. Conduit: flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-resistant jacket.
 - B. Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic cover/insert on the end of the conduit inside the connector housing to seal the cut conduit end.
- 2.8 RIGID POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS
- A. Conduit: Rigid non-metallic conduit, Schedule 40 PVC minimum, Listed, sunlight resistant, rated for 90°C conductors. Schedule 80 for locations exposed to physical damage or as required.
 - B. Fittings and Conduit Bodies: NEMA TC 2, Listed.

2.9 CONDUIT SUPPORTS

- A. See specification Section 26 05 29.

2.10 SURFACE METAL RACEWAY

- A. Description: Sheet metal channel with fitted cover, suitable for use as surface metal raceway.
- B. Size: As shown on Drawing.
- C. Finish: Ivory enamel.
- D. Fittings: Couplings, elbows, and connectors designed for use with raceway system.
- E. Boxes and Extension Rings: Designed for use with raceway systems.

2.11 CONDUIT WATER SEALANT

- A. Description: Conduit sealant used to prevent water from entering buildings via conduits.
- B. Sealant shall seal conduits against water and gas intrusion, such as Polywater® FST™ 250 Foam Duct Sealant, Raychem RDSS Rayplate Duct Sealing System, or approved alternate. Sealant shall be re-enterable, shall be compatible with the conduit and conductor types being used, and shall comply with NEC 225.27, 230.8, and 300.5(G).
- C. Manufacturer names and catalog numbers are used to develop quality and performance requirements only. Products manufactured by others may be acceptable provided they meet or exceed the specifications.

2.12 PULL AND JUNCTION BOXES

- A. Interior Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot-welded joints and corners.
- B. Interior Sheet Metal Boxes larger than 12 inches (300 mm) in any dimension shall have a hinged cover or a chain installed between box and cover. Boxes 9 square-feet or larger shall have hinged covers and a single cover shall not exceed 10 square-feet.
- C. Interior Sheet Metal Boxes connected to an exterior underground raceway, shall have a drain fitting located in the bottom.
- D. Exterior Boxes and Wet Location Installations: Type 4 and Type 6, flat flanged, surface mounted junction box, UL listed as rain-tight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
- E. Box extensions and adjacent boxes within 48 inches of each other are not allowed for the purpose of creating more wire capacity.
- F. Junction boxes 6 inch-by-6 inch or larger size shall be without stamped knock-outs.
- G. Wireways shall not be used in lieu of junction boxes.

2.13 IN GRADE HANDHOLES AND BOXES

- A. Handholes and Boxes: Polymer- Concrete.
- B. Handhole and Box Covers: Polymer- Concrete.
- C. Handhole and box bottoms: Integral Closed.
- D. Handholes and boxes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
- E. Handhole and cover Assembly Load Rating: ANSI/SCTE Tier 8 or better.
- F. Covers: Weatherproof, secured by tamper-resistant locking devices with non-skid finish.
- G. Cover Label: ELECTRIC or COMMUNICATIONS.
- H. Units shall be designed – typically with a flared wall and footed base – to prevent frost heaving.

2.14 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.
- B. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture studs where required.
- C. Concrete Ceiling Boxes: Concrete type.
- D. Cast Boxes: Cast ferroalloy or aluminum, deep type, gasketed cover, threaded hubs.

2.15 FLOOR BOXES

- A. Floor Boxes for Installation in Cast In Place Concrete Floors: As indicated on drawings. Provide boxes with sufficient capacity to house the devices indicated on the plans.
- B. Type: Flush or Concealed service as indicated on drawings.
- C. Floor Box Cover: Solid Brass with Brushed Finish. Floor plates shall meet and exceed UL scrub water exclusion requirements for concrete, tile, carpet, and wood covered floors.
- D. Device Plate: Stainless steel or as available from manufacturer.
- E. Configuration: As indicated on drawings.

2.16 BOXES FOR FIRE ALARM AUDIO-VISUAL NOTIFICATION APPLIANCES

- A. Recessed boxes for Fire Alarm audio, visual, and audio-visual notification appliances shall be galvanized steel sheet metal with stamped knockouts. Boxes shall be painted red.
- B. For surface mounting, use manufacturer supplied back boxes and trim plates, painted red or off white to match device color, and shall contain no visible conduit knock-outs. Mark each device with its circuit number.

PART 3 EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. EMT is permitted to be used in sizes 4 inch (100 mm) and smaller for power and low-voltage systems. See CONDUIT INSTALLATION SCHEDULE below for other limitations for EMT and other types of conduit.
- B. Size power conductor raceways for conductor type installed. Conduit size shall be 1/2 inch (16 mm) minimum except all homerun conduits shall be 3/4 inch (21 mm), or as specified elsewhere. Caution: Per the NEC, the allowable conductor ampacity is reduced when more than three current-carrying conductors are installed in a raceway. Contractor must take the NEC ampacity adjustment factors into account when sizing the raceway and wiring system.
- C. Size communications and other low-voltage systems raceways as follows:
 - 1. Communications, including Equipment Outlet Box: 1-1/4" Conduit used for single device locations (e.g. Wireless Access Point, Video Surveillance Camera, and Wall mounted telephone) may be 3/4 inch minimum.
 - 2. Control, security, signal, and other low-voltage applications (not including AV): 3/4 inch minimum.
 - 3. Fire Alarm: 1/2 inch minimum.
 - 4. Floor Box and Poke-Through Assemblies:
 - a. Power: 3/4 inch minimum or as indicated on drawings.
 - b. Low-voltage: 1 inch minimum or as indicated on drawings.
- D. Provide one raceway from each communications outlet box to cable tray.
- E. Arrange conduit to maintain 6'-8" clear headroom and present a neat appearance.
- F. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.

- G. Maintain minimum 6 inch (150 mm) clearance between conduit and piping. Maintain 12 inch (300 mm) clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
- H. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized pipe straps, conduit racks (lay in adjustable hangers), clevis hangers, or bolted split stamped galvanized hangers.
- I. Group conduit in parallel runs where practical and use conduit rack (lay in adjustable hangers) constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- J. Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used for temporary conduit support during construction.
- K. Support and fasten metal conduit at a maximum of 8 feet (2.4 m) on center.
- L. Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes, other conduits, etc., unless so approved or detailed.
- M. Conceal all conduits except where noted on the drawings or approved by the Architect/Engineer. Contractor shall verify with Architect/Engineer all surface conduit installations except in mechanical rooms.
- N. Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast steel conduit bodies.
- O. For indoor and exposed exterior conduits, no continuous conduit run shall exceed 100 feet (30 meters) without a junction box.
- P. For exterior below grade conduits, no continuous conduit run shall exceed 250 feet (75 meters) without hand hole, manhole or pull box.
- Q. All conduits installed in exposed areas shall be installed with a box offset before entering box.

3.2 CONDUIT INSTALLATION

- A. All conduit shall be run overhead unless indicated on the plans.
- B. All raceways shall be routed concealed in finished areas unless authorized by the Architect and Engineer.
- C. Cut conduit square; de-burr cut ends.
- D. Conduit shall not be fastened to the corrugated metal roof deck nor drywall or suspended ceiling grids.
- E. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- F. Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening conduit to sheet metal boxes in damp or wet locations.
- G. Threads cut in the field, and factory threads of conduit and nipples not coated with corrosion protection, shall be coated with an approved electrically conductive compound per NEC 300.6.
- H. Terminate all conduit (except for terminations into conduit bodies) using conduit hubs, or connectors with one locknut, or utilize double locknuts (one each side of box wall).
- I. Provide bushings for the ends of all conduit not terminated in box walls. Refer to Section 26 05 26 – Grounding and Bonding for Electrical Systems for grounding bushing requirements.
- J. Provide insulated bushings where raceways contain 4 AWG or larger conductors.
- K. Communication and Low Voltage systems conduits shall terminate in horizontal plane.
- L. Use pendants supported from swivel hangers in exposed ceiling/ structure locations where necessary to mount boxes supporting luminaires and wiring devices. Installation method shall comply with NEC 314.23 (H).

- M. Install no more than the equivalent of the following for building:
1. Three 90 degree bends between boxes for electrical systems.
 2. Two 90 degree bends between boxes for communications and other low voltage systems. Note: Offsets shall be considered 90 degrees.
 3. No single bend may exceed 90 degrees.
- N. Use hydraulic one shot conduit bender or factory elbows for bends in conduit larger than 2 inch (50 mm) size unless sweep elbows are required.
- O. Bend conduit according to manufacturer's recommendations. Torches or open flame shall not be used to aid in bending of PVC conduit.
- P. Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and moisture.
- Q. Provide 1/8 inch (3 mm) nylon pull string in empty conduit, except sleeves and nipples.
- R. Install listed expansion deflection fitting or other approved means shall be used where a raceway crosses a structural joint for expansion, contraction or deflection, used in buildings, bridges, parking garages or other structures.
- S. Install expansion joints where direct-buried conduit is subject to Earth Movement by settlement or frost per NEC 300.5(J), especially where conduit exits the ground exposed and enters a box, cabinet, or enclosure attached to a building or structure.
- T. Install expansion fitting in exterior PVC conduit runs per NEC table 352.44 utilizing a minimum temperature change of 120 degree F.
- U. Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with drain fittings at conduit low points.
- V. Where conduit passes between areas of differing temperatures such as into or out of cool rooms, freezers, unheated and heated spaces, buildings, etc., provide conduit or box with duct seal or other means to prevent the passage of moisture and water vapor through the conduit.
- W. Route conduit through roof openings for piping and ductwork where possible.
- X. Where communication cabling is to be installed in conduit to the wiring hub (e.g. Telecom Room), multiple conduits may be consolidated into fewer, larger conduits. Capacity of shared conduits shall equal the capacity of the individual conduits unless otherwise noted.
- Y. Use NRTL listed metallic grounding clamps when terminating conduit to cable tray.
- Z. Ground and bond conduit under provisions of Section 26 05 26.
- AA. Conduit is not permitted in any slab topping of two inches (50 mm) or less.
- AB. Conduits in Concrete Slab Above Grade: Provide proposed conduit routing and sizing to Structural Engineer for approval prior to installation to verify structural integrity and fire rating of concrete slab.
- AC. Maximum Size Conduit in Concrete Slabs Above Grade: 1 inch (25 mm). Do not route conduits to cross each other in slabs above grade. Minimum conduit spacing shall be 6 inches on center.
- AD. PVC conduit in concrete pole bases shall transition to galvanized rigid metal conduit 12 inches before it enters a concrete pole base. Inside the pole base, the elbow shall be galvanized rigid metal conduit. From the elbow, the conduit shall transition back to PVC as it continues up and out the top of the concrete pole base.
- AE. PVC conduit shall transition to galvanized rigid metal conduit before it enters a foundation wall or up through a concrete floor.

- AF. PVC conduit shall be allowed without need of transition to galvanized rigid metal conduit up through concrete floor and concrete equipment pads for pad mounted transformers and switchgear. Provide a PVC connector and bushing, or bell-ends, on each conduit entry. Coordinate conduit installation with submittals and shop drawings for transformers and switchgear.
- AG. PVC conduits installed in exposed parking ramps shall have expansion fittings installed per NEC table 352.44, utilizing a minimum temperature change of 110 degrees F. Each conduit run shall be provided with a minimum of one expansion fitting. Proper PVC clamps shall be utilized to allow for conduit movement.
- AH. Identify conduit under provisions of Section 26 05 53.
- AI. All conduit installed underground (exterior to building) shall be buried a minimum of 24 inches below finished grade, whether or not the conduit is concrete encased. Install warning tape 12" below finish grade over all buried conduits. Underground warning tape shall be detectable, 2" wide minimum, 5 mil thickness, containing a foil core. Tape color shall be red and labeled with the words "CAUTION-BURIED ELECTRIC LINE BELOW" as manufactured by Presco or similar.
- AJ. Conduits penetrating underground foundation walls: Individual conduits or each conduit as part of a ductbank penetrating underground foundation walls (excluding manholes) shall be sealed against water intrusion into the building.
- AK. Clean PVC conduit with solvent, and dry before application of glue. The temperature rating of glue/cement shall match weather conditions. Apply full even coat of cement/glue to entire area that will be inserted into fitting. The entire installation shall meet manufacturer's recommendations.

3.3 CONDUIT INSTALLATION SCHEDULE

- A. Conduit other than that specified below for specific applications shall not be used.
- Underground Installations That Penetrate Foundation Walls: Rigid metal conduit within five feet (1.5 m) of the foundation wall. Conduit may transition to PVC conduit five feet (1.5 m) from the foundation walls.
 - Underground Installations That Do Not Penetrate Foundation Walls: Rigid metal conduit or PVC conduit.
 - Underground Installations Emerging from Grade: Buried conduit emerging from grade shall be Rigid metal conduit extending from the minimum cover distance of 24 inches below grade to the conduit termination point above grade.
 - Underground Installations Under Concrete Slab: Rigid metal conduit or Schedule 40 PVC conduit.
 - Underground Installations Emerging through Concrete Slab: Rigid metal conduit.
 - Concealed in Poured Concrete Walls: Rigid Metal Conduit or PVC conduit.
 - Concealed in Concrete Block Walls: Electrical metallic tubing or PVC conduit.
 - Within Concrete Slab: Rigid Metal conduit or PVC conduit.
 - Emerging from Within Concrete Slab: Rigid Metal conduit.
 - Exposed Outdoor Locations: Rigid Metal conduit, Intermediate Metal conduit.
 - Exposed within Parking Structures: Rigid Metal conduit, Intermediate Metal conduit, PVC conduit.
 - Wet Interior Locations: Exposed: Rigid metal conduit.
 - Concealed Dry Interior Locations: Rigid metal conduit, Intermediate metal conduit, Electrical metallic tubing, PVC conduit (Ground conductor).
 - Interior Building Grounding Electrode Conductor: Schedule 80 PVC.
 - Exposed Dry Interior Locations: Rigid metal conduit, Intermediate metal conduit, Electrical metallic tubing.

- Motor and equipment connections: Liquidtight flexible metal conduit (LFMC) in all locations except in Mechanical equipment plenum spaces where Flexible Metal Conduit (FMC) shall be utilized. Minimum length shall be one foot (300 mm); maximum length shall be three feet (900 mm). Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
- Exposed Dry Interior Locations for HVAC control devices with Conduit Connections: Electrical metallic tubing, Flexible Metal Conduit (FMC). For FMC installations, Minimum length shall be one foot (300 mm), Maximum length shall be three feet (900 mm). Minimum size FMC of 3/8".
- Exposed Dry Interior Locations for HVAC control devices without Conduit Connections: Where HVAC equipment control panels or devices do not provide for the direct connection of conduits, exposed Class 2 wiring may be extended to complete the final connections in dry locations, provided it does not exceed 18 inches in length.
- Light fixtures: Refer to specification section 26 51 13.
- Plenum Spaces: Installation shall comply with requirements of NEC 300.22.

3.4 PVC COATED RIGID METAL CONDUIT INSTALLATION

- A. Installers of PVC Coated Rigid Metal Conduit shall be factory trained and certified in the proper installation methods for this type of conduit. Proof of such certification shall be kept on the project site at all times and shall be produced upon request.

3.5 SURFACE METAL RACEWAY AND MULTI-OUTLET ASSEMBLY INSTALLATION

- A. Use flat head screws to fasten channel to surfaces every twenty-four (24) inches. Mount plumb and level.
- B. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- C. Maintain grounding continuity between raceway components to provide a continuous grounding path under provisions of Section 26 05 26.
- D. Fastener Option: Use clips and straps suitable for the purpose.

3.6 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough in.
- C. No outlet, junction, or pull boxes shall be located where it will be obstructed by other equipment, piping, lockers, benches, counters, etc.
- D. Conduit and boxes shall not be fastened to the metal roof deck. If conduit and boxes are required to be located and installed on roof decks, the conduit and boxes are required to be spaced minimum 1-5/8 inch off the lowest part of the metal roof decking material, per NEC 300.4 (E).
- E. It shall be the contractor's responsibility to study drawings pertaining to other trades, to discuss location of outlets with workmen installing other piping and equipment and to fit all electrical outlets to job conditions.
- F. In case of any question or argument over the location of an outlet, the contractor shall refer the matter to the Architect/Engineer and install outlet as instructed by the Architect/Engineer.
- G. The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the contractor for moving outlets which were improperly located.
- H. Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 18 inch (450 mm) by 24 inch (600 mm) access doors. Boxes must be installed within 12" from edge of the access door.

- I. Locate and install to maintain headroom and to present a neat appearance.
- J. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.
- K. Boxes installed in the building envelop shall be sealed with caulking materials or closed with gasketing systems compatible with the construction materials and locations per IEC 502.4.3.

3.7 PULL AND JUNCTION BOX INSTALLATION

- A. Pull boxes and junction boxes shall be minimum 4 inches square (100 mm) by 2 1/8 inches (54 mm) deep for use with 1 inch (25 mm) conduit and smaller. On conduit systems using 1 1/4 inch (31.75 mm) conduit, minimum junction box size shall be 4 11/16 inches square by 2 1/8 inches deep.
- B. Where used with raceway(s) containing conductors of 4 AWG or larger, pull box shall be sized as required unless otherwise noted on the drawings.
- C. Where used with raceway(s) containing conductors on systems over 600V, size pull box per NEC 314 Part IV unless otherwise noted as larger on the drawings.
Size pull boxes for communications per ANSI/TIA-568-C.
- D. Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install approved access panels in non-accessible ceilings where boxes are installed. All boxes are to be readily-accessible.
- E. Provide Pull and Junction boxes for communications and other low voltage applications (a) in any section of conduit longer than 100 feet, (b) where there are bends totaling more than 180 degrees between pull points or pull boxes and (c) wherever there is a reverse bend in run. Locate boxes on straight section of raceway (e.g. do not use boxes in place of raceway bends).
- F. Support pull and junction boxes independent of conduit.

3.8 IN GRADE HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated and detailed, support units on a level bed of crushed stone or gravel, graded from 1/2 inch (12.5 mm) sieve to No. 4 (4.25 mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In finished areas, set so cover surface will be flush with finished grade.
- D. Handholes and boxes shall NOT be installed in paved or concrete drives or walks.
- E. Units shall be selected with depth sufficient to allow for conductor bending/ wire management and allow sufficient conduit elevation above compacted bed to prevent water infiltration in conduit.
- F. Provide conduit sealant to seal conduits against water and gas intrusion, such as Polywater® FST™-250 Foam Duct Sealant, Raychem RDSS Rayplate Duct Sealing System, or approved alternate. Sealant shall be re-enterable, shall be compatible with the conduit and conductor types being used, and shall comply with NEC 225.27, 230.8, and 300.5(G).

3.9 OUTLET BOX INSTALLATION

- A. Do not install boxes back to back in walls. Provide minimum 6 inch (150 mm) separation, except provide minimum 24 inch (600 mm) separation in acoustic rated walls.

- B. Power:
1. Recessed (1/4 inch maximum) outlet boxes in masonry, concrete, tile construction, or drywall shall be minimum 4 inch square, with device rings. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes. A single gang box can be used in drywall and masonry, for a single device location, when a single conduit enters box.
 2. Shallow 4 inch square by 1 1/2 inch deep boxes can be used as device boxes for power provided the box and plaster ring is sized for installed device and conductors.
- C. Low Voltage:
1. Recessed (1/4 inch maximum) outlet boxes in masonry, concrete, tile construction or drywall shall be minimum 4 11/16 inch square by 2 1/8 inch deep with single gang device ring (unless noted otherwise on drawings or in companion specifications). Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.
 2. Provide one conduit from each communications Equipment Outlet box. Conduit runs between outlet boxes for communications are not allowed. Terminate conduit on cable tray.
- D. Provide knockout closures for unused openings.
- E. Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches (300 mm) of box.
- F. Install boxes in walls without damaging wall insulation.
- G. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- H. Ceiling outlets shall be 4 inch square, minimum 2 1/8 inch (54 mm) deep except that concrete boxes and plates will be approved where applicable. Position outlets to locate luminaires as shown on reflected ceiling plans.
- I. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches (150 mm) of recessed luminaire, to be accessible through luminaire ceiling opening.
- J. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- K. Align wall mounted outlet boxes for switches, thermostats, and similar devices.
- L. Provide cast ferroalloy or aluminum outlet boxes in exterior and wet locations.
- M. Surface wall outlets shall be 4 inch (100 mm) square with raised covers for one and two gang requirements. For three gang or larger requirements, use gang boxes with non-overlapping covers.
- N. Outlet Box adjustable ring and depth device applications:
- Provide box extenders for boxes that are set too far back in the wall due to un-anticipated wall finishes. Place the box extender over the existing box face to make the box face flush with the wall finish.

3.10 FLOOR BOX INSTALLATION

- A. Set boxes level and flush with finish flooring material.
- B. Serve communications compartments (Tele/Data and AV) in Floor Boxes with conduit(s) dedicated to each compartment. Conduit runs between floor boxes for communications are not allowed. Conduit shall be part of path that allows for cable to be terminated at wiring hub (e.g. Telecom Room) on same floor on which floor box appears unless noted otherwise.

END OF SECTION 23 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers.
- D. Field-painted identification of conduit.

1.2 RELATED REQUIREMENTS

- A. Division 01 - Painting and Coating.

1.3 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National Fire Protection Association; 2017.

1.4 SUBMITTALS

- A. See Division 01 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide catalog data for nameplates, labels, and markers.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Brady Corporation.
- B. Seton Identification Products.
- C. HellermannTyton.
- D. 3M.
- E. Substitutions: See Division 01 - Product Requirements.

2.2 NAMEPLATES AND LABELS

- A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
- B. Locations:
 - 1. Each electrical distribution and control equipment enclosure.
 - 2. Communication cabinets.
 - 3. Disconnects, starters, and relays.

- C. Letter Size:
 - 1. Use 1/8 inch letters for identifying individual equipment and loads.
 - 2. Use 1/4 inch letters for identifying grouped equipment and loads.
 - 3. Use 1 inch letters for identifying distribution and control equipment enclosures.
- D. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use only for identification of individual wall switches and receptacles, control device stations.

2.3 WIRE MARKERS

- A. Description: Cloth type wire markers.
- B. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.
- C. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
 - 2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on drawings.

2.4 CONDUIT MARKERS

- A. Description: Use tape or paint to mark conduit.
- B. Location: Furnish markers for each conduit longer than 6 feet.
- C. Spacing: 20 feet on center.
- D. Color:
 - 1. 120/208 Volt System: White.
 - 2. Emergency 120/208: White/Red.
 - 3. Option Standby 120/208: Black/Yellow.
 - 4. Fire Alarm System: Red.
 - 5. Telephone System: Yellow.
 - 6. Data System: Blue.

2.5 UNDERGROUND WARNING TAPE

- A. Description: 4 inch wide plastic tape, detectable type colored red with suitable warning legend describing buried electrical lines.

2.6 WIRING DEVICE IDENTIFICATION

- A. Wall switches, receptacles, occupancy sensors, photocells, poke-through fittings, access floor boxes, and time clocks shall be identified with circuit numbers and panelboard source (ex. Panel ABC-3). In exposed areas, identifications should be made inside of device covers, unless directed otherwise. Use machine-generated adhesive labels, or neatly hand-written permanent marker.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels.

3.2 INSTALLATION

- A. Install nameplates and labels parallel to equipment lines.
- B. Secure nameplates to equipment front using screws.
- C. Secure nameplates to inside surface of door on panelboard that is recessed in finished locations.

- D. Identify conduit using field painting under provisions of Division 01.
 - 1. Paint colored band on each conduit longer than 6 feet.
 - 2. Paint bands 20 feet on center.
 - 3. Colors:
 - a. 120/208 Volt System: White.
 - b. Emergency 120/208: White/Red.
 - c. Option Standby 120/208: Black/Yellow.
 - d. Fire Alarm System: Red.
 - e. Telephone System: Yellow.
 - f. Data System: Blue.
- E. Identify underground conduits using underground warning tape. Install one tape per trench at a minimum of 12" above the underground installation.
- F. Label electrical service meters and disconnects per utilities and NEC specifications.

END OF SECTION 26 05 53

SECTION 26 05 73 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Performance requirements for overcurrent protective devices.
- B. Short circuit study.
- C. Coordination study and analysis.

1.2 RELATED REQUIREMENTS

- A. Section 26 24 16 - Panelboards: Overcurrent protective devices in panelboards.
- B. Section 26 28 13 - Fuses.

1.3 REFERENCE STANDARDS

- A. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001.
- B. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.
- C. NFPA 70 - National Electrical Code; 2017.

1.4 SUBMITTALS

- A. See Division 01 - Administrative Requirements, for submittal procedures.
- B. Study Preparer's Qualifications.
- C. Study Report: Submit protective device studies as specified, prior to submission of product data submittals or ordering or fabrication of protective devices.
 - 1. Evaluation of product data submittals by Architect will not commence until acceptable studies have been submitted.
 - 2. Evaluation of product data submittals by Architect will not commence until acceptable preliminary studies in sufficient detail to ensure that device selection will be adequate have been submitted.
 - 3. Include stamp or seal and signature of preparing engineer.
- D. Product Data: In addition to submittals specified elsewhere, submit manufacturer's time-current curves for all protective devices.
- E. Field Engineer Qualifications.
- F. Field Inspection Report: Show final adjusted settings of protective devices.
- G. Certificates: Prior to final inspection, certify that field adjustable protective devices have been set according to requirements of protective device analysis.
- H. Project Record Documents: Revise protective device study as required to show as-built conditions.
 - 1. Submit not less than 60 days prior to final inspection of electrical system.
 - 2. Include hard copies in operation and maintenance data submittals.
 - 3. Include all files prepared using software packages, on CD-ROM, with file name cross-references to specific pieces of equipment and systems.

1.5 PROTECTIVE DEVICE STUDY

- A. Analyze the specific electrical and utilization equipment (according to NEC definition), the actual protective devices to be used, and the actual feeder lengths to be installed.
 - 1. Scope of Studies: All new and existing distribution wiring and equipment, from primary source to buses and branch circuit panelboards.
 - 2. Primary Source, for Purposes of Studies: Utility company primary protective devices.

3. Study Methodology: Comply with requirements and recommendations of NFPA 70, IEEE 399, and IEEE 242.
 4. Report: State the methodology and rationale employed in making each type of calculation; identify computer software package(s) used.
- B. One-Line Diagrams: Prepare schematic drawing of electrical distribution system, with all electrical equipment and wiring to be protected by the protective devices; identify nodes on the diagrams for reference on report that includes:
1. Calculated fault impedance, X/R ratios, utility contribution, and short circuit values (asymmetric and symmetric) at the main switchboard bus and all downstream devices containing protective devices.
 2. Breaker and fuse ratings.
 3. Generator kW and voltage ratings, percent impedance, X/R ratios, and wiring connections.
 4. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
 5. Identification of each bus, with voltage.
 6. Conduit materials, feeder sizes, actual lengths, and X/R ratios.
- C. Short Circuit Study: Calculate the fault impedance to determine available 3-phase short circuit and ground fault currents at each bus and piece of equipment during normal conditions, alternate operations, emergency power conditions, and other operations that could result in maximum fault conditions.
1. Show fault currents available at key points in the system down to a fault current of 7,000 A at 208 V.
 2. Include motor contributions in determining the momentary and interrupting ratings of the protective devices.
 3. Primary Fault Level Assumptions: Obtain data from utility company.
 4. Report: Include all pertinent data used in calculations and for each device include:
 - a. Device identification.
 - b. Operating voltage.
 - c. Protective device.
 - d. Device rating.
 - e. Calculated short circuit current, asymmetrical and symmetrical, and ground fault current.
- D. Coordination Study: Perform an organized time-current analysis of each protective device in series from the individual device back to the primary source, under normal conditions, alternate operations, and emergency power conditions.
1. Graphically illustrate that adequate time separation exists between series devices, including upstream primary device.
 2. Plot the specific time-current characteristics of each protective device on log-log paper.
 3. Organize plots so that all upstream devices are clearly depicted on one sheet.
 4. Also show the following on curve plot sheets:
 - a. Device identification.
 - b. Voltage and current transformer ratios for curves.
 - c. 3-phase and 1-phase ANSI damage curves for each transformer.
 - d. No-damage, melting, and clearing curves for fuses.

- e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum short circuit cutoff point.
 - h. Simple one-line diagram for the portion of the system that each curve plot illustrates.
 - i. Software report for each curve plot, labeled for identification.
- E. Analysis: Determine ratings and settings of protective devices to minimize damage caused by a fault and so that the protective device closest to the fault will open first.
 - 1. Required Ratings and Settings: Derive required ratings and settings of protective devices in consideration of upstream protective device settings and optimize system to ensure selective coordination.
 - 2. Motors with Solid-State Protective Modules: Select settings for best possible motor protection, taking into consideration actual installed motor torque and current and thermal characteristics.
 - 3. Identify any equipment that is underrated as specified.
 - 4. Identify existing protective devices that will not achieve required coordination and cannot be field adjusted to do so.
 - 5. Identify specified protective devices that will not achieve required protection or coordination but with minor changes can be made to do so; provide such modified devices at no additional cost to Owner and identify them on submittals as "revised according to Protective Device Coordination Study"; minor changes include different trip sizes in the same frame, time curve characteristics of induction relays, CT ranges, etc.
 - 6. Identify specified protective devices that will not achieve required protection or coordination and cannot be field adjusted to do so, and for which adequate devices would involve a change to the contract sum.
 - 7. In all cases where adequate protection or coordination cannot be achieved at no extra cost to Owner, provide a discussion of alternatives and logical compromises for best achievable coordination.
 - 8. Do not order, furnish, or install protective devices that do not meet performance requirements unless specifically approved by Architect.
- F. Protective Device Rating and Setting Chart: Summarize in tabular format the required characteristics for each protective device based on the analysis; include:
 - 1. Device identification.
 - 2. Relay CT ratios, tap, time dial, and instantaneous pickup.
 - 3. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
 - 4. Fuse rating and type.
 - 5. Ground fault pickup and time delay.
 - 6. Input level and expected response time at two test points that are compatible with commonly available test equipment and the ratings of the protective device.
 - 7. Highlight all devices that as furnished by contractor will not achieve required protection.

1.6 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00

- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.7 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Qualified engineer of switchgear manufacturer or approved professional engineer.
- B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
 - 1. Acceptable Software Products:
 - a. EDSA Micro Corporation: www.edsa.com.
 - b. Operation Technology, Inc; ETAP: www.etap.com.
 - c. SKM Systems Analysis, Inc; Power Tools for Windows: www.skm.com.
 - d. Substitutions: See Division 01 - Product Requirements.
- C. Contractor Responsibility: Provide all project-related data needed by study preparer, including equipment, wire sizes, insulation types, conduit types, and actual circuit lengths.
- D. Contractor shall provide site survey of relevant Owner power distribution equipment to obtain needed data for study.

PART 2 PRODUCTS

2.1 PROTECTIVE DEVICES

- A. Provide protective devices of ratings and settings as required so that the protective device closest to the fault will open first.
- B. Replace existing protective devices to achieve specified performance.
- C. The specified equipment has been designed and selected to achieve the specified performance; ensure that equipment actually installed provides that performance.
- D. In addition to requirements specified elsewhere, provide overcurrent protective devices having ratings and settings according to results of this analysis.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Provide the services of a qualified field engineer and necessary tools and equipment to test, calibrate, and adjust the installed protective devices to conform to requirements determined by the coordination analysis.
- B. Adjust installed protective devices having adjustable settings to conform to requirements determined by the coordination analysis.
- C. Adjust solid-state protective modules for motors prior to applying load to motor.
- D. Submit report showing final adjusted settings of all protective devices.

END OF SECTION 26 05 73

SECTION 26 09 16 - ELECTRIC CONTROLS AND RELAYS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Relays and time-delay relays.
- B. Control power transformers.

1.2 RELATED REQUIREMENTS

- A. Section 26 27 16 - Electrical Cabinets and Enclosures: Cabinets and terminal blocks.

1.3 REFERENCE STANDARDS

- A. NEMA ICS 1 - Industrial Control and Systems: General Requirements; National Electrical Manufacturers Association; 2000 (R2015).
- B. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC; National Electrical Manufacturers Association; 2000 (R2005).
- C. NEMA ICS 6 - Industrial Control and Systems: Enclosures; National Electrical Manufacturers Association; 1993 (R2006).
- D. NEMA ST 1 - Specialty Transformers (Except General Purpose Type); National Electrical Manufacturers Association; 1988 (R1997).
- E. NFPA 70 - National Electrical Code; National Fire Protection Association; 2017.

1.4 SUBMITTALS

- A. See Division 01 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Submit to NEMA ICS 1 indicating control panel layouts, wiring connections and diagrams, dimensions, support points.
- C. Product Data: Provide for each component showing electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- C. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and indicated.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Allen-Bradley/Rockwell Automation.
- B. Eaton Corporation.

- C. GE Industrial.
- D. Siemens Corporation.
- E. Substitutions: See Division 01 - Product Requirements.

2.2 COMPONENTS

- A. Solid-State Relays: NEMA ICS 2.
 - 1. Contacts: NEMA ICS 2, Form Z.
 - 2. Contact Ratings: NEMA ICS 2, Class A150.
 - 3. Coil Voltage: 120 volts, 60 Hz, AC.
 - 4. Substitutions: See Division 01 - Product Requirements.
- B. Control Power Transformers: NEMA ST 1, machine tool transformer with isolated secondary winding.

2.3 ENCLOSURES

- A. Control Station Enclosures: NEMA ICS 6; Type 1.
- B. Relay Enclosures: NEMA ICS 6; Type 1.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install according to manufacturer's instructions.
- B. Install individual relays and time-delay relays in enclosures.
- C. Make electrical wiring interconnections as indicated.

END OF SECTION 23 09 16

SECTION 26 09 43 - DISTRIBUTED DIGITAL LIGHTING CONTROLS

PART 1 GENERAL

1.1 SCOPE OF PROJECT

- A. Provide Distributed Digital Lighting Controls (controls) as specified herein. The controls shall consist of a series of standalone digital load controllers and intelligent low-voltage devices dedicated to the room/space they are serving. All local devices shall be connected together via an In-Room Network, enabling digital communication between devices. Digital Lighting Control Panels may also be used for lighting control as part of the overall lighting control scheme.
- B. The system architecture shall connect multiple In-Room local networks for centralized building-wide monitoring and management via a Global Network and PC-based software. The system architecture shall allow standalone digital load controllers and associated devices to function in some default capacity, even if network connectivity to the Global Network is lost.
- C. The controls shall provide time-based, sensor-based (e.g. occupancy/vacancy and daylight sensors), and/or manual control. The controls shall turn lighting loads ON/OFF, and shall dim the lighting where indicated.

D. Included are the following topics:

PART 1 - GENERAL

- Scope of Project
- Related Work
- Reference Standards
- Design/Performance Requirements
- Federal Bidding Requirements
- Quality Assurance
- Submittals
- Operation and Maintenance Data
- Extra Materials

PART 2 - PRODUCTS

- System Requirements
- Digital Load Controllers (Room Controllers)
- Digital Motion Sensors
- Digital Daylight Sensors
- Digital Manual Controls
- Digital Auxiliary Input/Output (I/O) Interface Modules
- Digital Lighting Control Panels (Relay and Dimming Panels)
- Configuration Tools
- Network Cables
- Network Interfaces

PART 3 - EXECUTION

- Delivery, Storage, and Handling
- Project Conditions
- Sensor Layouts
- Installation
- Field Quality Control
- Post Start-up Tuning
- Warranty
- Product Support and Service
- Training

1.2 RELATED WORK

A. Section 26 51 00 – Interior Lighting.

1.3 REFERENCE STANDARDS

- A. NFPA 70 National Electrical Code; National Fire Protection Association.
- B. NEMA National Electrical Manufacturers Association.
- C. FCC Federal Communications Commission – Emission Standards.
- D. UL Underwriters Laboratories, Inc. Listings.
- E. UL 2043 Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products Installed in Air-Handling Spaces

- F. UL 20 General-Use Snap Switches
- G. UL 508 Standard for Industrial Control Equipment
- H. UL 916 Standard for Energy Management Equipment
- I. UL 924 Standard for Emergency Lighting and Power Equipment

1.4 DESIGN/PERFORMANCE REQUIREMENTS

- A. Distributed Digital Lighting Controls shall accommodate the square-footage coverage requirements for each area controlled utilizing digital load controllers, digital occupancy/vacancy sensors, digital daylighting sensors, digital switches, digital lighting control panels, and accessories that suit the required lighting and electrical system parameters.
- B. System shall conform to requirements of NFPA 70.
- C. System shall comply with FCC emission standards specified in part 15, sub-part J for commercial and residential application.
- D. System shall be listed under UL sections 916 and/or 508.

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Company certified by the manufacturer and specializing in installation of Distributed Digital Lighting Control products with minimum three years documented experience.

1.7 SUBMITTALS

- A. Shop Drawings: Shop drawings shall include the following:
 - Product Datasheets (general device descriptions, dimensions, electrical specifications, wiring details, nomenclature)
 - All manufacturers shall submit to the specifying engineer a line-by-line compliance comparison between each specifications requirement and the system being proposed. Any ambiguities in the drawings or specifications shall be brought to the attention of the specifying engineer for clarification.
 - Riser Diagrams – typical per room type (detailed drawings showing interconnectivity of devices)
 - Other Diagrams – as needed for special operation or interaction with other system(s)
 - Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up
 - Hardware and Software Operation Manuals
 - Other operational descriptions as needed
- B. Occupancy Sensor Shop Drawings:
 - Symbols on drawings are diagrammatic and represent design intent only. Provide manufacturer-recommended layout drawings showing quantity and location of sensors, and associated wiring diagrams.

C. Closeout Submittals:

- Project Record Documents: Record actual installed locations and settings for each lighting control device and show interconnecting wiring.
- Operation and Maintenance Manual:
 - o Include approved Shop Drawings and Product Data.
 - o Include Sequence of Operation, identifying operation for each room or space.
 - o Include manufacturer's maintenance information.
 - o Operation and Maintenance Data: Include detailed information on device programming and setup.
 - o Include startup and test reports.

1.8 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.9 EXTRA MATERIALS

- A. Provide the following spare materials:

- One (1) ON/OFF Load Controller with three relays
- One (1) ON/OFF/Dimming Load Controller with three relays
- One (1) of each type of motion sensor used
- One (1) daylight sensor
- One (1) two-button digital wall switch
- One (1) four-button digital wall switch
- One (1) eight-button digital wall switch

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

- A. Lighting control zones shall consist of one or more intelligent lighting control components (digital load controllers), be capable of stand-alone operation, and be capable of being connected to a higher-level network backbone.
- B. Network Characteristics
- In-Room Network:
 - o The In-Room network shall be a free topology lighting control network using physical wiring connections and communication protocol designed to control a room/space/small area of a building.
 - o Digital room devices connect to the In-Room network, which provides both communications and power to room devices.
 - Global Network (In-Room to In-Room Network):
 - o The Global network shall be a linear topology network to connect In-Room networks and relay panels (if applicable) for centralized control.
 - o Each In-Room Network to be connected to the Global Network shall include a single network bridge, and the network bridge is the only room-based device that is connected to the Global Network.
 - o The Global Network shall utilize communications cabling as specified by the manufacturer. The maximum cable run for each segment (distance between In-Room Networks) shall meet manufacturer limitations.

- C. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the Global Network or the management software becoming unavailable.
- D. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.
- E. System shall be capable of using a web-based software management program that enables remote system control, status monitoring, and creation of lighting control schedules and profiles.
- F. Connect all noted In-Room Networks to the Global Network for building-wide monitoring and management via PC-based Management Software and/or the building automation system (BAS). Provide optional Management Software for remote system control, status monitoring, and creation of lighting control schedules and profiles.

2.2 DIGITAL LOAD CONTROLLERS (ROOM CONTROLLERS)

- A. General:
 - 1. Digital load controllers shall be simple to install and shall not have dip switches or potentiometers, or require special configuration.
 - 2. The controllers shall include the following features:
 - Standard junction box mounting.
 - Low voltage connection using standard RJ-45 connectors and CAT5e cable. Other wiring topologies are acceptable if controls accomplish all requirements specified in these documents.
 - Each connected load shall be capable of any of the following behaviors: Manual ON, Automatic ON, Automatic ON to 50 percent, or Automatic ON to Preset level or last level set.
 - UL 2043 plenum rated.
 - Manual override and LED indication for each load.
 - Power supply to power the digital load controller itself and the peripheral sensors and controls connected to the In-Room Network.
 - Dual voltage (120/277 VAC, 60 Hz), rated for 20A total load, derating to 16A required for some dimmed loads (forward phase dimming).
 - Zero cross circuitry for each load.
 - All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
- B. ON/OFF Load Controllers. Controller shall include the following:
 - Multiple relay configurations per unit.
- C. ON/OFF/Dimming Load Controllers. Controllers shall include the following:
 - Multiple relay configurations per unit.
 - Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected LED driver.
 - One dimming output per relay.
 - o 0-10V Dimming: one 0-10 volt analog output per relay for control of compatible LED drivers. The 0-10 volt output shall automatically close upon loss of power to the Controller to assure full light output from the controlled lighting.

- o Line Voltage, Forward Phase Dimming: one forward phase control line voltage dimming output per relay for control of compatible LED drivers, forward phase compatible ELV, and incandescent loads.
- Each load shall have an independently configurable preset ON level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.

2.3 DIGITAL MOTION SENSORS

A. General:

1. Sensors shall be available in wall, ceiling, corner-mounted, or wall-switch configurations.
2. Sensors shall use either passive infrared (PIR) sensing, or if dual technology, passive infrared and passive acoustic or passive infrared and ultrasonic sensing for detecting room occupancy.
3. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas.

B. Features. Sensors shall be provided with the following features:

- Sensitivity Adjustment, Time Delay, Detection Technology, and Walk-Through Mode.
- Dual-Technology Sensors shall have independent configurable trigger modes to choose proper technology according to space use to eliminate false-triggers.
- Each sensor may be programmed to control specific loads within an In-Room network.
- Each sensor shall allow remote programming through a handheld commissioning tool via a two-way infrared (IR) transceiver or by configuration through a local network device.

C. Digital Wall Switch Motion Sensors. Digital wall switch motion sensors shall be provided with the following features:

- Shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
- One- or two-button switches for one or two switch-legs.
- Optional daylight sensor feature for daylighting override.

2.4 DIGITAL DAYLIGHT SENSORS

A. Daylight sensors shall be provided with the following features:

- Digital daylighting sensors shall work with room controllers to provide automatic switching, bi-level, tri-level, or dimming daylight harvesting capabilities for any load type connected to a room controller.
- Daylighting sensors shall be interchangeable without the need for rewiring.
- Sensor light level range shall be from 1-250 foot-candles (fc).
- For switching daylight harvesting, the daylight sensor shall provide a field-selectable deadband (separation) between the "ON" setpoint and the "OFF" setpoint that will prevent the lights from cycling excessively after they turn OFF.
- For dimming daylight harvesting, the daylight sensor shall provide the option, when the daylight contribution is sufficient, of turning lights OFF or dimming lights to a field-selectable minimum level.
- Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
- Daylight sensors shall have an independently configurable fade rate for both increasing and decreasing light level in units of percent-per-second.

- Daylight Sensors shall provide adjustable cut-off time (0-120 minutes). Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off.
- Optional wall switch override shall allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise lighting levels for a selectable period of time or cycle of occupancy.
- Each sensor shall allow remote programming through a handheld commissioning tool via a two-way infrared (IR) transceiver or by configuration through a local network device.

2.5 DIGITAL MANUAL CONTROLS

A. Wall Switches

1. Low voltage dimming and momentary pushbutton switches in 1, 2, 3, 4, 5, and 8 Button configurations.
2. Wall switches shall include the following features:
 - Buttons may be programmed as Load or Scene Buttons.
 - Buttons may be programmed as ON/OFF, ON only, or OFF only.
 - Switch buttons may be bound to any load on a room controller and are not load type dependent.

B. Dimmer Switches

- Raise/lower dimming adjustment controls.
- Dimmer switches shall include multiple LEDS to indicate load levels.
- Dimmer switches shall be able to be ganged with multi-button switches under the same wallplate.
- Three-way and 4-way switch locations are supported for ON/OFF or Dimming control.

C. Digital Scene Switches

- Scene switches allow for Preset Scene recall and dimming override control.

2.6 DIGITAL AUXILIARY INPUT/OUTPUT (I/O) INTERFACE MODULES

A. General:

- Operate on Class 2 power supplied by In-Room network.
- Status LEDs indicate if input is energized.
- UL 2043 plenum rated where required.

B. Switched Contact Closure Interface:

- Utilized for automatic control via input from other sources such as switches, relay-based system, BAS, etc.
- Includes 24VDC output and input terminals for momentary or maintained third party contact closure inputs.
- Utilize input module for an Auto ON and Sweep OFF function input from other sources for the controlled area. During normal hours of operation, all local low-voltage devices are fully operational. During after hours, a timer shall be applied to all low-voltage switches or dimmers so that the room will automatically sweep off every two hours following switch activation. Provide a blink warning to alert occupants of impending OFF.
- Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current.
- Specific I/O devices shall have an input that reads a 0-10 VDC signal from an external device.

- Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event (e.g. toggle the lighting load) or run a local/remote control profile.
- Specific I/O devices shall sense state of low-voltage outdoor photocells.
- Specific I/O devices shall sense momentary and maintained contact closures, and either toggle a connected load after a momentary contact or ramp the load high/low during a maintained contact (stopping when the contact releases).

C. Serial Data Interface:

- Utilized for control from A/V system to send ON/OFF/Preset commands to In-Room Network.
- Includes 24VDC output and 10 pin RS232 connection.
- Coordinate programming with the Distributed Digital Lighting Control System manufacturer's technician and the A/V system technician for successful interface between both systems.

2.7 DIGITAL LIGHTING CONTROL PANELS (RELAY AND DIMMING PANELS)

A. General:

1. It is the intent of this paragraph to provide a Digital Lighting Control Panel as part of an integrated lighting control system. Contractor is responsible for confirming that the panels and associated peripheral devices such as sensors and manual controls interoperate as a single system.
2. Digital Lighting Control Panels shall be incorporated into the lighting control system Global Network where used.
3. Provide lighting control panels as required. Each panel shall be of modular construction and consist of the following components:
 - The panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.
 - The interior construction shall provide total isolation of line voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel.
 - Direct wired switch inputs associated with each relay shall support two-wire, momentary or maintained contact switches.
 - Digital inputs shall support digital switches, digital I/O modules capable of receiving 0-5V or 0-10V analog photocell inputs, digital I/O modules capable of receiving momentary or maintained contact closure inputs, digital photocell modules, and digital occupancy sensors.
 - Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells associated with the lighting control panel as necessary to meet the project requirements.

B. Relays. Relays shall provide the following ratings and features:

- Panel shall provide one 0-10VDC dimming output paired with each relay.
- Each relay shall contain an LED status light and an override pushbutton. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet. Isolated low voltage contacts provide for true relay status feedback and pilot light indication.
- Relays shall be individually replaceable in a modular plug-in design.
- Relays shall be single-phase normally-closed latching type relays capable of switching 120/277 VAC or two-phase relays capable of switching 208/240/480 VAC loads.
- Relays shall be rated to switch up to a 30A ballast load at 277 VAC.

- Tested to 300,000 mechanical on/off cycles.
- Relay operation shall be automatically sequenced to reduce impact on the electrical distribution system when large loads are controlled simultaneously.

C. Digital Network Clock

- Each panel shall include a digital clock capable to issue system wide automation commands.
- The clock module shall provide astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and shall include battery backup for the clock function and for program retention. The clock capability of each panel shall employ non-volatile memory and shall retain user programming and time for a minimum of 10 years.
- The clock capability of each panel shall operate on a basis of ON/OFF or Normal Hours/After Hours to automation groups that implement pre-configured control scenarios. Scenarios shall include:
 - o Scheduled ON / OFF
 - o Manual ON / Scheduled OFF
 - o Astro ON / OFF (or Photo ON / OFF)
 - o Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF)
- Schedules programmed into the clock of any one panel shall be capable of executing local schedules or Dark/Light (photocell or Astro) events for that panel in the event that global network communication is lost.

2.8 CONFIGURATION TOOLS

A. A configuration tool facilitates optional customization of In-Room networks.

- Provide two Configuration Tools for the project.
- Provide free, downloadable PC software for direct programming of In-Room Networks.

B. Features and functionality of the wireless configuration tool shall include but not be limited to:

- Optional customization of In-Room networks using two-way wireless communications or USB interface.
- Must be able to read and modify parameters for room controllers, occupancy sensors, wall switches, daylighting sensors, network bridges and relay panels, and identify room devices by type and serial number.
- Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.

2.9 NETWORK CABLES

A. In-Room Networks

1. This specification is based on CAT5e data cables for In-Room Networks. Other wiring topologies are acceptable if controls accomplish all requirements specified in these documents.
2. Use manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors for In-Room Networks. If manufacturer's cables are not used, each field-terminated cable shall be tested prior to installation and testing results submitted to the Manufacturer's Representative for approval prior to proceeding with the Work.
3. UL 2043 plenum rated where required.

B. Global Network. The Global Network, where used, shall utilize communications cabling as specified by the manufacturer. The maximum cable run for each segment (distance between In-Room Networks) shall meet manufacturer limitations.

2.10 NETWORK INTERFACES

A. Global Network Bridge:

- Provide one bridge for each In-Room Network that is to be connected to the Global Network.
- UL 2043 plenum rated where required.
- Manufacturer-specified network cable shall daisy-chain all network bridges together.
- The Global Network Bridge module connects an In-Room Network to a segment of the Global Network for communication between rooms, relay panels, and a Global Management Controller or BAS.
- The Global Network Bridge shall be provided as a separate module connected on the In-Room network.
- Global Network Bridge shall make all room devices connected to the In-Room network and all device parameters visible to the Global Management Controller via the Global Network.
- The global network bridge shall link back to front-end controller for connection to building LAN for centralized programming and BAS interface (optional).
- If a network bridge loses communication with the Global Network, In-room network shall stay active and operate as normally programmed. There shall be no disruption to local control.

B. Global Management Controller:

- For networked applications, the system shall include at least one Global Management Controller to manage network communication. It shall be capable of serving up a graphical user interface via a standard web browser utilizing either unencrypted TCP/IP or encrypted SSL TCP/IP traffic via a configurable port.
- Each Global Management Controller shall have integral support for at least three segments of the Global Network. Each segment may alternately be connected to the Global Management Controller via external routers and switches, using standard Ethernet structured wiring. Each router shall accommodate one segment of the Global Network.

Operational features of the Controller shall include the following:

- Connection to PC or LAN via standard Ethernet TCP/IP with the option to use SSL encrypted connections for all traffic.
- Graphical user interface shall be compatible with current internet browsers, and shall not require installation of any lighting control software on an end-user PC.
- Log-in security capable of restricting some users to view-only or other limited operations.
- Ability to view and modify room device operational parameters. It shall be possible to set device parameters independently for normal hours and after-hours operation including sensor time delays and sensitivities, and load response to sensor including Manual-On or Auto-On.
- Ability to set up schedules for rooms and panels, view and override current status of panel channels and relays, and assign relays to groups. Schedules shall automatically set controlled zones or areas to either a normal-hours or after-hours mode of operation. Support for a minimum of 100 unique schedules, each with up to four time events per day. Support for annual schedules, holiday schedules and unique date-bound schedules.
- Ability to group rooms and loads for common control by schedules, switches, or network commands.

- C. Network Equipment
 - 1. Provide all necessary network components, i.e. routers, switches, repeaters, etc. as suggested by the manufacturer for a complete Global Network System.
 - 2. Global Network cables shall be furnished and installed by this contractor per manufacturer requirements.
- D. BAS Integration.
 - 1. Provide capabilities for integration with a Building Automation System (BAS) via BACnet protocol.
 - 2. At a minimum, the following points shall be available to the BAS via BACnet IP connection to the Global Management Controller: Room occupancy state; Room schedule mode; Room switch lock control; Individual occupancy sensor state; Load ON/OFF state; Load dimming level; Panel relay state; and Global Management Controller Group schedule state.
- E. Management Software
 - 1. Every device parameter (e.g. sensor time delay and photocell setpoint) shall be available and configurable remotely from the software.
 - 2. Software shall require all users to log in with a User Name and Password.
 - 3. Software shall provide at least three permission levels for users.
 - 4. All sensitive stored information and privileged communication by the software shall be encrypted.
 - 5. All device firmware and system software updates must be available for automatic download and installation via the internet.
 - 6. Software shall be capable of managing systems interconnected via a WAN (wide area network).

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

- A. Store products in a clean, dry space in original manufacturer's packaging according to manufacturer's written instructions until ready for installation.

3.2 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Do not install equipment until following conditions can be maintained in spaces to receive equipment:

Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).

Relative humidity: Maximum 90 percent, non-condensing.

3.3 SENSOR LAYOUTS

- A. Confirm quantity and provide appropriate coverage by sensors on a per-space requirement. Symbols on drawings are diagrammatic and represent design intent only.
- B. Occupancy sensors shall be installed at locations indicated on the manufacturer's submittal layout drawings. Sensors shall be located to prevent false triggering of the lights to ON when no occupant is present.

3.4 INSTALLATIONS

- A. Install system according to the approved system shop drawings and manufacturer's instructions.

- B. Install all room/space devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors.

If pre-terminated cable is not used for room/space wiring, each field-terminated cable shall be tested following installation and testing results submitted to the Manufacturer's Representative for approval prior to proceeding with the Work.

Install all room-to-room digital devices using manufacturer-supplied network wire. Network wire substitution is not permitted and may result in loss of product warranty.

Low-voltage wiring topology must comply with manufacturer's specifications.

Document final wiring locations, routing, and topology on as-built drawings.

- C. All line-voltage connections shall be tagged to indicate circuit and switched legs.
- D. Test all devices to ensure proper communication.
- E. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
- F. Adjust time delay so that controlled area remains lighted while occupied.
- G. Provide written or computer-generated documentation on the configuration of the system including room-by-room description including:
- Sensor parameters, time delays, sensitivities, and daylighting setpoints.
 - Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - Load Parameters (e.g. blink warning, etc.)
- H. Tighten all panel Class I conductors at circuit breakers and at loads to torque ratings as marked on enclosure UL label.
- I. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.
- J. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimmed loads shall have separate neutrals.
- K. Verify all loads to be free from short circuits prior to connection to room controllers.

3.5 FIELD QUALITY CONTROL

- A. Electrician/Low Voltage Technician: Any low voltage wiring made onsite by electrical or low voltage contractor must be verified end to end with industry standard test equipment capable of printing or producing a digital file of the testing results.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Manufacturer in writing a minimum of three (3) weeks prior to system start-up and testing.
- C. Tests and Inspections: Manufacturer's service representative or electrical/low-voltage contractor installing low voltage cabling that is not pre-terminated from the manufacturer shall perform the following inspections and prepare reports.
- D. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports:
- Verify end-to-end testing of all low voltage wiring that is not pre-terminated from the manufacturer. Provide detailed results via paper or digital format downloadable from testing equipment.
 - Verify Class I and II wiring connections by validating system performance.
 - Set IP addresses and other network settings of system front-end hardware per facility's IT instructions.
 - Verify/complete task programming for all switches, dimmers, time clocks, and sensors.

- Verify that the control of each space complies with the Lighting Sequence of Operation.
 - Correct any system issues and retest.
- E. Provide a report in table format with drawings, or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:
 - Date of test or inspection.
 - Loads per space.
 - Fixture Address identification.
 - Quantity and Type of each device installed.
 - Reports providing each device's settings.
- 3.6 POST START-UP TUNING
 - A. Adjust sensor time delays and sensitivities to meet the Owner's requirements 30 days from initial occupancy. Provide a detailed report to the Architect/Owner of post start-up activity.
- 3.7 WARRANTY
 - A. Manufacturer shall provide a 5-year limited warranty on products within this installation, except where otherwise noted, and consisting of a one-for-one device replacement.
- 3.8 PRODUCT SUPPORT AND SERVICE
 - A. Factory telephone support shall be available at no cost to the Owner following acceptance. Factory assistance shall consist of assistance in solving application issues pertaining to the control equipment.
- 3.9 TRAINING
 - A. The contractor, through their supplier, shall provide training on the system operation for the owner as part of this contract. The training shall consist of two (2) four-hour sessions

END OF SECTION 26 09 43

SECTION 26 24 16 - PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Coordination branch panelboards.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 53 - Identification for Electrical Systems.
- C. Section 26 28 13 - Fuses.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2015.
- B. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC; National Electrical Manufacturers Association; 2000 (R2005).
- C. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association; 2001 (R2006).
- D. NEMA PB 1 - Panelboards; National Electrical Manufacturers Association; 2011.
- E. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; National Electrical Manufacturers Association; 2013.
- F. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2017.
- G. NFPA 70 - National Electrical Code; National Fire Protection Association; 2017.

1.4 SUBMITTALS

- A. See Division 1 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- E. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 MAINTENANCE MATERIALS

- A. See Division 1 - Product Requirements, for additional provisions.
- B. Furnish two of each panelboard key.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Electrical/Cutler-Hammer.
- B. GE Industrial.
- C. Square D.
- D. Siemens.
- E. Substitutions: See Division 1 - Product Requirements.

2.2 POWER DISTRIBUTION PANELBOARDS

- A. Description: NEMA PB 1, circuit breaker type.
- B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
- C. Minimum integrated short circuit rating: As indicated on Panel Schedules.
- D. Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole; UL listed. For air conditioning equipment branch circuits provide circuit breakers UL listed as Type HACR.
- E. Molded Case Circuit Breakers with Current Limiters: With replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole; UL listed.
- F. Current Limiting Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole: UL listed. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
- G. Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower, with bimetal overload relay.
 - 1. Coil operating voltage: 120 volts, 60 Hz.
 - 2. Coil operating voltage: 120 volts, DC.
 - 3. Size as shown on Drawings.
 - 4. Provide unit mounted control power transformer, RED indicating light in front cover.
- H. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
- I. Enclosure: NEMA PB 1, Type 1.
- J. Cabinet Front: Surface type, fastened with concealed trim clamps, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.3 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.
- C. Minimum Integrated Short Circuit Rating: As indicated on Panel Schedules.
- D. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type, with common trip handle for all poles; UL listed.
 - 1. Type SWD for lighting circuits.
 - 2. Type HACR for air conditioning equipment circuits.
 - 3. Class A ground fault interrupter circuit breakers where scheduled.
 - 4. Do not use tandem circuit breakers.
- E. Current Limiting Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole; UL listed. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
- F. Enclosure: NEMA PB 1, Type 1.
- G. Cabinet Box: 6 inches deep, 20 inches wide for 240 volt and less panelboards, 20 inches wide for 480 volt panelboards.
- H. Cabinet Front: Flush cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

2.4 COORDINATION BRANCH PANELBOARDS

- A. Branch Circuit Panelboards: Fusible switch type with current limiting Class J time delay or equivalent protection.
- B. The panelboard and overcurrent devices contained within shall be fully-rated.
- C. Enclosure: Type 1. Minimum cabinet size: 5-3/4 inches deep; 20 inches wide with 5" minimum gutter space top and bottom. Constructed of galvanized code gauge steel. Panel enclosure (back box) shall be of non-stamped type (without KO's) to avoid concentric break out problem.
- D. Provide surface cabinet front with concealed trim clamps, concealed hinge and flush cylinder lock all keyed alike. Front cover shall be hinged to allow access to wiring gutters without removal of panel trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray enamel.
- E. Provide metal directory holders with clear plastic covers. Holder to be factory mounted.
- F. Provide panelboards with copper bus (phase buses, bus fingers, etc.), ratings as scheduled on Drawings. Provide ground bars in all panelboards. Phase, neutral and ground bar terminations can be dual rated ALCU9. All spaces shall have bus fully extended and drilled for the future installation of devices.
- G. Overcurrent devices shall be fused branch disconnects including compact base and fuse holder with the following features:
 - Current limiting Class J time delay or equivalent protection.
 - Single handle common trip, 1-, 2-, and 3 pole versions.
 - Bolt on type.
 - Local open fuse indication.
 - UL listed for type and temperature rating of wire specified.
 - Permanently installed integrated lockout/tag out provisions.
 - 600V AC rated.

- H. Surge Protective Device: Provide a surge protective device meeting the requirements of specification section 26 43 13.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install panelboards according to NEMA PB 1.1 and NECA 1.
- B. Install panelboards plumb. Install recessed panelboards flush with wall finishes.
- C. Height: 6 feet (1800 mm) to top of panelboard; install panelboards taller than 6 feet (1800 mm) with bottom no more than 4 inches (100 mm) above floor.
- D. Provide filler plates for unused spaces in panelboards.
- E. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- F. Provide engraved plastic nameplates under the provisions of Section 26 05 53.
- G. Ground and bond panelboard enclosure according to Section 26 05 26.

3.2 FIELD QUALITY CONTROL

- A. Perform field inspection and testing according to Division 1.
- B. Inspect and test according to NETA STD ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.5 for switches, Section 7.6 for circuit breakers.

3.3 ADJUSTING

- A. Measure steady state load currents at each panelboard feed. Re-arrange circuits to balance the phase loads to within 10 percent.

END OF SECTION 23 24 16

SECTION 26 27 01 - ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2015.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association; 2017.

1.2 SYSTEM DESCRIPTION

- A. System Characteristics: 208Y/120 volts, three phase, four-wire, 60 Hertz.
- B. Service Entrance:

1.3 SUBMITTALS

- A. See Division 1 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide ratings and dimensions of transformer cabinets and meter bases.
- C. Submit utility company-prepared drawings.

1.4 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.5 QUALITY ASSURANCE

- A. Utility Company:
- B. Perform work according to utility company written requirements and NFPA 70.
 - 1. Maintain one copy of each document on site.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 PRE-INSTALLATION MEETING

- A. Convene one week prior to commencing work of this section. Review service entrance requirements and details with Utility Company representative.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. GE Industrial.
- B. Milbank Manufacturing.
- C. Square D.
- D. Siemens.
- E. Substitutions: See Division 1 - Product Requirements.

PART 3 EXECUTION

3.1 PREPARATION

- A. Arrange with utility company to obtain permanent electric service to the Project.
- B. Verify that field measurements are as indicated on utility company drawings.

3.2 INSTALLATION

- A. Install service rack, weatherhead, transformer pad, metering transformer cabinets, and meter base as required by utility company.
- B. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

END OF SECTION 26 27 01

SECTION 26 27 17 - EQUIPMENT WIRING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical connections to equipment.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables (600 V and Less).
- B. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- C. Section 26 27 26 - Wiring Devices.

1.3 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2005).
- B. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2016.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; 2017.

1.4 SUBMITTALS

- A. See Division 1 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 COORDINATION

- A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- B. Determine connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Conform to NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
 - 4. Product:
 - 5. Substitutions: See Division 1 - Product Requirements.
- B. Disconnect Switches: As specified in Section 26 28 18 and in individual equipment sections.
- C. Wiring Devices: As specified in Section 26 27 26.
- D. Flexible Conduit: As specified in Section 26 05 33.
- E. Wire and Cable: As specified in Section 26 05 19.
- F. Boxes: As specified in Section 26 05 33.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections according to equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.
- J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

3.3 EQUIPMENT SCHEDULE

- A. Schedule on drawings.

END OF SECTION 26 27 17

SECTION 26 27 26 - WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Device plates and decorative box covers.
- D. Floor box service fittings.
- E. Poke-through service fittings.
- F. Access floor boxes.

1.2 REFERENCE STANDARDS

- A. NECA 1 - Standard Practices for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2015.
- B. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2005).
- C. NEMA WD 6 - Wiring Device -- Dimensional Requirements; National Electrical Manufacturers Association; 2016.
- D. NFPA 70 - National Electrical Code; National Fire Protection Association; 2017.

1.3 SUBMITTALS

- A. See Division 01 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Manufacturer's Installation Instructions.

1.4 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products: Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 EXTRA MATERIALS

- A. See Division 01 - Product Requirements, for additional provisions.
- B. Furnish two of each style, size, and finish wall plate.
- C. Provide two protective rings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Cooper Wiring Devices.
- B. GE Industrial.
- C. Leviton Manufacturing, Inc.

- D. Wiremold.
- E. Substitutions: See Division 01 - Product Requirements.

2.2 RECEPTACLES

- A. Receptacles: Heavy duty, complying with NEMA WD 6 and WD 1.
 - 1. Configuration: NEMA WD 6, type as specified and indicated.
- B. Convenience Receptacles: NEMA 5-20R.
- C. Single Convenience Receptacles: NEMA 5-20R.
- D. Duplex Convenience Receptacles: NEMA 5-20R.
- E. GFCI Receptacles: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
- F. Provide tamper and arc fault receptacles per NEC and Local codes.

2.3 WALL PLATES

- A. Decorative Cover Plates: 302/304 lined stainless steel.
- B. Jumbo Cover Plates: 302/304 lined stainless steel.
- C. Weatherproof Cover Plates: All receptacles installed in wet locations shall have an enclosure that is weatherproof whether or not the attachment plug is inserted. Covers shall be gasketed metal with hinged "in-use" device covers, powder coat painted. Non-metallic covers are not allowed. Covers shall be latching type and shall be lockable. Covers shall be identified as "extra-duty" type per NEC 406.9(B)(1).

2.4 FLOOR MOUNTED SERVICE FITTINGS

- A. Flush Cover Convenience Receptacles:
 - 1. Material: Aluminum.
 - 2. Configuration: Duplex flap opening.
- B. Flush Cover Communication Outlets:
 - 1. Material: Aluminum.
 - 2. Configuration: 2-1/8 inch (54 mm) x 1 inch (25 mm) combination threaded opening.
- C. Flush Cover Combination Fittings:
 - 1. Material: Aluminum.
 - 2. Configuration: Duplex flap opening with 2-1/8 inch (54 mm) x 1 inch (25 mm) combination threaded opening.
- D. Protective Ring: Brass finish.
- E. Split Nozzles: Brass finish.
- F. Carpet Rings: Brass.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that outlet boxes are installed at proper height.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that floor boxes are adjusted properly.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- E. Verify that openings in access floor are in proper locations.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
- B. Install devices plumb and level.
- C. Install receptacles with grounding pole on top.
- D. Connect wiring device grounding terminal to outlet box with bonding jumper.
- E. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- F. Connect wiring devices by wrapping conductor around screw terminal.
- G. Use jumbo size plates for outlets installed in masonry walls.
- H. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- I. Install protective rings on active flush cover service fittings.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights specified.
- B. Install wall switch 44 inches above finished floor.
- C. Install convenience receptacle 18 inches above finished floor.
- D. Install convenience receptacle 6 inches above counter.
- E. Install dimmer 44 inches above finished floor.
- F. Install telephone jack 18 inches above finished floor.
- G. Install telephone jack for side-reach wall telephone to position top of telephone at 44 inches above finished floor.
- H. Install telephone jack for forward-reach wall telephone to position top of telephone at 44 inches above finished floor.
- I. Coordinate installation of access floor boxes with access floor system provided under Division 09.
- J. Coordinate the installation of wiring devices with underfloor duct service fittings provided under Section 26 05 40.

3.5 FIELD QUALITY CONTROL

- A. Perform field inspection, testing, and adjusting according to Division 01.
- B. Inspect each wiring device for defects.
- C. Operate each wall switch with circuit energized and verify proper operation.
- D. Verify that each receptacle device is energized.
- E. Test each receptacle device for proper polarity.
- F. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 26 27 26

SECTION 26 27 29 - ELEVATOR DISTRIBUTION EQUIPMENT

PART 1 GENERAL

1.1 SCOPE OF PROJECT

- A. The work under this section includes elevator disconnect switches and distribution panels with integral shunt trip and fire safety interface. Included are the following topics:

1. PART 1 – GENERAL
 - a. Scope
 - b. Related Work
 - c. References
 - d. Submittals
 - e. Extra Materials
2. PART 2 – PRODUCTS
 - a. Acceptable Manufacturers
 - b. Elevator Distribution Equipment
 - c. Enclosures
3. PART 3 – EXECUTION
 - a. Shipping, Delivery, Storage and Handling
 - b. Examination and Preparation
 - c. Installation

1.2 RELATED WORK

- A. Applicable provisions of Division 1 govern work under this Section.
1. Section 26 05 19- Low Voltage Electrical Power Conductors and Cables
 2. Section 26 05 34- Conduit
 3. Section 26 05 37- Boxes for Electrical Systems
 4. Section 26 27 17- Equipment Wiring Systems
 5. Section 28 31 05- Fire Alarm System

1.3 REFERENCES

- A. NECA (National Electrical Contractors Association) "Standard of Installation."
- B. NEMA ICS 2 – Industrial Control Devices, Controllers, and Assemblies.
- C. NEMA KS 1 – Enclosed Switches.
- D. UL 50 – Enclosures for Electrical Equipment.
- E. UL 98 – Enclosed and Dead-front Switches.
- F. ANSI/ASME A17.1 – Safety Code for Elevators and Escalators
- G. NFPA 70 – National Electric Code
- H. NFPA 72 – National Fire Alarm Code

1.4 SUBMITTALS

- A. For Approval:
1. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends.
 2. Product Data: Provide electrical characteristics including voltage, trip ratings, fault current withstand ratings, and time current curves of all equipment and components.

3. Schematic Wiring Diagrams: Provide complete diagrams for device
 - B. For Record Purposes:
 1. As-built/Record Drawings shall accurately indicate the location of the equipment and the equipment shall be identified with the final designation as directed by the Owner.
 2. Record actual fuse sizes and type installed
- 1.5 FEDERAL BIDDING REQUIREMENTS
- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
 - B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.
- 1.6 OPERATION AND MAINTENANCE MANUALS
- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS
- 1.7 EXTRA MATERIALS
- A. Spare Materials: Provide three fuses of each size, type and rating.
 - B. Maintenance Materials: Provide two fuse pullers.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Eaton/Cutler-Hammer, Bussmann Power Module, Little Fuse POWR series or equal as approved by the engineer.

2.2 ELEVATOR DISTRIBUTION EQUIPMENT

- A. Power Module Disconnect Switch (PMS):
 1. Provide Elevator Disconnect Switch in a single NEMA enclosure with all necessary relay(s), control transformer and other options (as listed below), and as shown on drawings. The PMS shall be constructed, listed, and certified to the standards as listed in above.
 2. The PMS shall have an ampere rating as shown on the Contract Drawings, and shall include a horsepower rated fusible switch with shunt trip capabilities. The ampere rating of the switch shall be based upon elevator manufacturer requirements and utilize Class J Fuses.
 3. The control power transformer shall be 100 VA minimum with primary and secondary fuses. The primary voltage rating shall be as indicated in the Equipment Connection Schedule with a 120 volt secondary and an isolation relay (3PDT, 10 amp, 120Vac).
 4. The coil of the isolation relay shall be 120 Vac with a coil burden of 30 VA maximum. A normally open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt trip solenoid.
 5. The switch shall include a 120 volt key test switch and a 1-NO/1-NC mechanically interlocked auxiliary contact rated 5A, 120 Vac.

2.3 ENCLOSURES

- A. Indoor: NEMA Type 1; code gauge steel with rust inhibiting primer.
- B. Enclosure shall including padlocking provisions for the OFF position.
- C. Finish using manufacturer's standard enamel finish, gray color.

PART 3 EXECUTION

3.1 SHIPPING, DELIVERY, STORAGE AND HANDLING

- A. Inspect and report concealed damage to carrier.
- B. Handle carefully to avoid damage to switch internal components, enclosure and finish.
- C. Store equipment in a clean, dry location. Maintain factory packaging and, as required, provide additional heavy canvas or heavy plastic cover to protect panelboards from dirt, water construction debris and traffic

3.2 EXAMINATION AND PREPARATION

- A. Verify equipment dimension match approved submittals.
- B. Examine areas to receive panelboards to assure adequate working clearance for panelboard installation

3.3 INSTALLATION

- A. All material installation shall be according to manufacturer's recommendations and the provisions of applicable codes.
- B. Install disconnect switches where indicated on Drawings.
- C. Install equipment plumb. Provide supports according to Section 26 05 29. Do not directly attach to equipment subject to vibration.
- D. Verify fuses comply with Coordination Study if study is specified or with engineer if study is not specified.
- E. Provide engraved plastic nameplates under the provisions of Section 26 05 53.

END OF SECTION 26 27 29

SECTION 26 28 13 - FUSES

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Fuses.
- 1.2 REFERENCE STANDARDS
 - A. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2012.
 - B. NFPA 70 - National Electrical Code; National Fire Protection Association; 2017.
- 1.3 SUBMITTALS
 - A. See Division 1 - Administrative Requirements, for submittal procedures.
 - B. Product Data: Provide data sheets showing electrical characteristics, including time-current curves.
- 1.4 FEDERAL BIDDING REQUIREMENTS
 - A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
 - B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.
- 1.5 QUALITY ASSURANCE
 - A. Conform to requirements of NFPA 70.
 - B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles (160 km) of Project.
 - C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- 1.6 MAINTENANCE MATERIALS
 - A. See Division 1 - Product Requirements, for additional provisions.
 - B. Furnish two fuse pullers.
 - C. Furnish three of each size and type fuse installed.

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
 - A. Cooper Bussmann.
 - B. Ferraz Shawmut, Inc.
 - C. Littelfuse.
 - D. Substitutions: See Division 1 - Product Requirements.
- 2.2 FUSES - GENERAL
 - A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
 - B. Voltage: Rating suitable for circuit phase-to-phase voltage.
 - C. Power Load Feeder Switches: Class RK1 (time delay).
 - D. Motor Load Feeder Switches: Class RK1 (time delay).

- E. Other Feeder Switches: Class RK1 (time delay).
- F. General Purpose Branch Circuits: Class RK1 (time delay).
- G. Motor Branch Circuits: Class L time delay.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION 23 28 13

SECTION 26 28 18 - ENCLOSED SWITCHES

PART 1 GENERAL

- 1.1 SECTION INCLUDES
 - A. Fusible switches.
 - B. Nonfusible switches.
- 1.2 RELATED REQUIREMENTS
 - A. Section 26 28 13 - Fuses.
- 1.3 REFERENCE STANDARDS
 - A. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2012.
 - B. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association; 2013.
 - C. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2017.
 - D. NFPA 70 - National Electrical Code; National Fire Protection Association; 2017.
- 1.4 SUBMITTALS
 - A. See Division 1 - Administrative Requirements, for submittal procedures.
 - B. Product Data: Provide switch ratings and enclosure dimensions.
 - C. Project Record Documents: Record actual locations of enclosed switches.
- 1.5 FEDERAL BIDDING REQUIREMENTS
 - A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
 - B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.
- 1.6 QUALITY ASSURANCE
 - A. Conform to requirements of NFPA 70.
 - B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles (160 km) of Project.
 - C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

- 2.1 MANUFACTURERS
 - A. Eaton Electrical/Cutler-Hammer.
 - B. GE Industrial.
 - C. Square D.
 - D. Siemens.
 - E. Substitutions: See Division 1 - Product Requirements.

2.2 COMPONENTS

- A. Fusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
 - 1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
 - 2. Handle lockable in OFF position.
 - 3. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.
- B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
 - 1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
 - 2. Handle lockable in OFF position.
- C. Manual Toggle Controller/Disconnect
 - 1. Hubbell #HBL78 Series.
- D. Enclosures: NEMA KS 1.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install according to manufacturer's instructions.
- B. Install fuses in fusible disconnect switches.
- C. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.2 FIELD QUALITY CONTROL

- A. Perform field inspection according to Division 1.
- B. Inspect and test according to NETA STD ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.5.1.2.

END OF SECTION 26 28 18

SECTION 26 36 00 - TRANSFER SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Automatic Transfer Switch.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 53 - Identification for Electrical Systems: Engraved nameplates.
- B. Section 26 32 13 - Engine Generators: Testing requirements.

1.3 REFERENCE STANDARDS

- A. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment; National Electrical Manufacturers Association; 2005.
- B. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2007.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; 2008.
- D. UL 1008 – Standard for Automatic Transfer Switches.
- E. NFPA 110 – Emergency and Standby Power Systems.
- F. International Standard Organization ISO 9001: 2000.

1.4 SUBMITTALS

- A. See Division 1 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Operation Data: Instructions for operating equipment under emergency conditions when engine generator is running.
- E. Maintenance Data: Routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.5 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Supplier Qualifications: Authorized distributor of specified manufacturer with minimum three years documented experience.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 MAINTENANCE SERVICE

- A. Provide service and maintenance of transfer switches for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ASCO Power Technologies, LP.
- B. Eaton Electrical/Cutler-Hammer.
- C. Russelectric.
- D. Kohler.
- D. Substitutions: See Division 1 - Product Requirements.

2.2 AUTOMATIC TRANSFER SWITCH (Mechanically Held)

- A. The transfer switch unit shall be electrically operated and mechanically held. The electrical operator shall be a single-solenoid mechanism, momentarily energized. Main operators which include overcurrent disconnect devices will not be accepted. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.
- B. The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.
- C. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand current capability and be protected by separate arcing contacts.
- D. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to manually stop the contacts at any point throughout their entire travel to inspect and service the contacts when required.
- E. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.
- F. Where neutral conductors are to be solidly connected, a neutral terminal plate with fully-rated AL-CU pressure connectors shall be provided.

2.3 MICROPROCESSOR CONTROLLER WITH MEMBRANE INTERFACE PANEL

- A. The controller shall direct the operation of the transfer switch. The controller's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance, and inherent serial communications capability. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance.
- B. The controller shall be enclosed with a protective cover and be mounted separate from the transfer switch unit for safety and ease of maintenance. Sensing and control logic shall be provided on printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers.
- C. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
 - 1. ANSI C37.90A/IEEE 472 Voltage Surge Test
 - 2. NEMA ICS - 109.21 Impulse Withstand Test
 - 3. IEC801-2 Electrostatic discharge (ESD) immunity
 - 4. ENV50140 and IEC 801 - 3 Radiated electromagnetic field immunity
 - 5. IEC 801 - 4 Electrical fast transient (EFT) immunity
 - 6. ENV50142 Surge transient immunity

7. ENV50141: Conducted radio-frequency field immunity
8. EN55011: Group 1, Class A conducted and radiated emissions
9. EN61000 -4 - 11 Voltage dips and interruptions immunity

2.4 ENCLOSURE

- A. The ATS shall be furnished in a NEMA type 1 enclosure unless otherwise shown on the plans.
- B. Controller shall be flush-mounted display with LED indicators for switch position and source acceptability. It shall also include test and time delay bypass switches.

2.5 OPERATION

- A. Voltage and Frequency Sensing
 1. The voltage of each phase of the normal source shall be monitored, with pickup adjustable to 95% of nominal and dropout adjustable from 70% to 90% of pickup setting.
 2. Single-phase voltage and frequency sensing of the emergency source shall be provided.
- B. Time Delays
 1. An adjustable time delay shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.
 2. An adjustable time delay shall be provided on transfer to emergency, adjustable from 0 to 5 minutes for controlled timing of transfer of loads to emergency.
 3. A generator stabilization time delay shall be provided after transfer to emergency.
 4. An adjustable time delay shall be provided on retransfer to normal, adjustable to 30 minutes. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable.
 5. A 5-minute cool down time delay shall be provided on shutdown of engine generator.
 6. All adjustable time delays shall be field adjustable without the use of special tools.
- C. Additional Features
 1. A set of contacts rated 5 amps, 32 VDC shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
 2. A push-button type test switch shall be provided to simulate a normal source failure.
 3. A push-button type switch to bypass the time delay on transfer to emergency, the engine exerciser period on the retransfer to normal time delay whichever delay is active at the time the push-button is activated.
 4. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal.
 5. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact, closed, when the ATS is connected to the emergency source.
 6. Indicating lights shall be provided, one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red). Also provide indicating lights for both normal and emergency source availability.

7. Terminals shall be provided to indicate actual availability of the normal and emergency sources, as determined by the voltage sensing pickup and dropout settings for each source.
8. Engine Exerciser - An engine generator exercising timer shall be provided, including a selector switch to select exercise with or without load transfer.
9. Inphase Monitor - An Inphase monitor shall be inherently built into the controls. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer.
10. Communications Interface - Connectivity Module to allow several different serial devices that communicate at different baud rates and with different protocols to a common Ethernet media. The module shall be used to connect Annunciators to the standard Ethernet TCP/IP network with standard 10 base-T (RJ-45) connector. The module shall be designed to communicate with up to 4 clients such as Web applications (web pages) communication products simultaneously over an Ethernet connection.
11. Programmable Engine Exerciser - A seven or fourteen day programmable engine exerciser with digital readout display. Shall include one form C contact for availability of normal and emergency sources. Include "with or without" load control switch for exerciser period. The exerciser shall be backed up by a permanent battery. (Accessory11BG).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surface is suitable for transfer switch installation.

3.2 PREPARATION

- A. Provide housekeeping pads under the provisions of Division 3.

3.3 INSTALLATION

- A. Install according to manufacturer's instructions.
- B. Provide engraved plastic nameplates under the provisions of Section 26 05 53.

3.4 FIELD QUALITY CONTROL

- A. Perform field inspection and testing according to Division 1.
- B. Inspect and test according to NETA STD ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.22.3.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Provide the services of the manufacturer's technical representative to check transfer switch connections and operations and place in service.

3.6 CLOSEOUT ACTIVITIES

- A. Demonstrate operation of transfer switch in normal and emergency modes.

PART 4 ADDITIONAL REQUIREMENTS

4.1 WITHSTAND AND CLOSING RATINGS

- A. The ATS shall be rated to close on and withstand the available rms symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans. WCR ATS ratings as be as follows when used with specific circuit breakers:

ATS Size	Withstand & Closing Rating MCCB	W/CLF
30	22,000A	100,000
70 - 200	22,000A	200,000
230	22,000A	100,000
260 - 400	42,000A	200,000
600 - 1200	65,000A	200,000
1600 - 2000	85,000A	200,000
2600 - 3000	100,000A	200,000

4.2 TESTS AND CERTIFICATION

- A. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
- C. The ATS manufacturer shall be certified to ISO 9001: 2000 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing according to ISO 9001: 2000.

4.3 SERVICE REPRESENTATION

- A. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years. For ease of maintenance, the transfer switch nameplate shall include drawing numbers and serviceable part numbers.

END OF SECTION 23 36 00

SECTION 26 43 05 - SURGE SUPPRESSION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section describes the materials and installation requirements for surge protective devices (SPD). Surge protective devices are used for the protection of all AC electrical circuits from the effects of lightning induced currents, substation-switching transients and internally generated transients resulting from inductive and/or capacitive load switching.

1.2 RELATED SECTIONS

- A. Basic Electrical Requirements
- B. Raceways, boxes, and fittings
- C. Wire and cable
- D. Low Voltage motor control
- E. Variable frequency drives
- F. Grounding

1.3 SUBMITTALS

- A. Submit shop drawings, product data and manufacturer's installation instructions.
- B. The surge suppression submittals shall also include:
 - 1. Dimensional drawing of each suppressor type indicating mounting arrangements.
 - 2. Category C3 (20KV,10KA,8/20u sec. waveform) clamp voltage test results.
 - 3. UL 1449 clamp voltage documentation.

1.4 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.5 CERTIFIED TESTS

- A. The surge suppressor manufacturer shall provide certified test results on the actual product being shipped to the job site. An officer or engineer of the company as being performed on the product after manufacture shall certify the test results.
- B. The test conducted shall be per ANSI C62.41-1991 and ANSI C62.45. The units shall be tested in all modes listed in this specification for Category C1.
- C. The engineer, after review of test data, may require unit to be returned and a new unit provided that meets the requirements of this specification.
- D. See Division 1 - Administrative Requirements, for submittal procedures.

1.6 WARRANTY

- A. The surge suppressor manufacturer shall warrant the surge protective devices and supporting components against defects in material and workmanship for a period of five years.

1.7 MANUFACTURER QUALIFICATIONS

- A. Surge protective devices shall be manufactured in the USA by a company normally engaged in the design and manufacture of such devices for at least five (5) years.
- B. Both the service entrance and branch panel suppressors shall be of the same manufacturer.

1.8 SAFETY AGENCY APPROVALS

- A. Suppressors shall be listed according to UL 1449, standard for safety, transient voltage surge suppressors and UL 1283. They shall also be CSA or UL approved.
- B. See Division 1 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 SERVICE ENTRANCE

- A. Surge Protective Devices shall be installed integral in switchboards at all service entrances of building and/or as shown on the riser diagram.
- B. Suppressors shall be tested with the category C3 high exposure waveform (20KV, 10KA, 8/20u sec. waveform) per ANSI/IEEE C62.41- 1991.
- C. Wye systems shall have suppression elements between each phase conductor and the system neutral, between each phase conductor and the system ground and between the neutral conductor and ground.
- D. Each phase shall have a minimum of two modules. The surge modules shall be fused at a minimum rating of 20 amps and a current limit rating of 200,000 AIC. Modules and fuses shall be field replaceable.
- E. Visible indication of proper suppressor connection and operation shall be provided. The indicator shall consist of an LED array. No single LED or neon indicators will be used.
- F. The surge protective device shall be equipped with an audible alarm that shall actuate when any part of the surge circuitry has been damaged. A silence button shall be provided with the alarm.
- G. Suppressors shall meet or exceed the following criteria:
 - 1. Minimum single impulse current rating (L-N + L-G): 240,000 amperes per phase.
 - 2. Incorporate hybrid circuitry.
 - 3. The Category C3 clamping voltage ANSI/IEEE C.62.41-1991 (20KV- 1.2/50us., 10KA-8/20us.) shall not exceed the following:
 - a. VOLTAGE L-N L-G N-G
 - b. 277-480 975 975 975
 - 4. Suppressors shall exhibit redundant protection for each phase and consist of solid-state components and shall operate bi- directionally.
 - 5. Maximum continuous operating voltage of the suppressor shall be greater than 110% of the nominal system voltage.
 - 6. The surge suppressor shall incorporate an internal disconnect (200,000 AIC, 3 pole, UL approved).
 - 7. The following manufacturers will be approved, provided they meet the above specifications:
 - a. Advanced Protection Technologies, Inc.
 - b. Liebert/Control Concepts
 - c. Current Technology
 - d. LEA Dynatech
 - e. Square D
 - f. Or Approved Equal

2.2 SECONDARY SERVICE SUPPRESSORS FOR BRANCH PANELS

- A. Surge Protective Devices shall be installed integral in designated branch panels as shown on the riser diagram. All surge suppression controls/test buttons shall be located behind panel door.
- B. Wye systems shall have suppression elements between each phase conductor and the system neutral, between each phase conductor and the system ground and between the neutral conductor and ground.
- C. Visible indication of proper suppressor connection and operation shall be provided.
- D. The surge protective device shall be equipped with an audible alarm that shall actuate when any part of the surge circuitry has been damaged. A silence button shall be provided with the alarm.
- E. The suppressor shall exhibit Sine Wave Tracking circuitry. The surge suppressor shall have suppression circuitry that is field replaceable without disturbing the conduit, enclosure.
- F. Suppressors shall meet or exceed the following criteria:
 - 1. Minimum single impulse current rating (L-N + L-G): 80,000 amperes per phase.
- G. Suppressors shall be of solid-state components and operate bi-directionally. The manufacturer of the surge panel shall offer either a surface or flush cover, as required by the job conditions.
- H. Maximum continuous operating voltage of the suppressor shall be greater than 110% of the nominal system voltage.
- I. The following manufacturers will be approved, provided they meet the above specifications:
 - 1. EFI Electronics Corporation
 - 2. Liebert/Control Concepts
 - 3. Current Technology
 - 4. LEA Dynatech
 - 5. Square D
 - 6. Or Approved Equal

PART 3 EXECUTION

3.1 SERVICE ENTRANCE

- A. Install one primary suppressor integral in switchboards at each utility service entrance or as indicated on the riser diagram. Follow manufacturer's installation instructions.
- B. Suppressor shall be installed on the load side of the service entrance.
- C. Conductors between suppressor and point of attachment shall be #6 AWG stranded copper conductor or larger. The conductors shall be kept as short and straight as possible. Lead length of connecting conductors shall be within 36 inches.
- D. Suppressor's ground shall be bonded to the service entrance ground.

3.2 BRANCH PANELS

- A. Factory install surge suppression in branch panels and distribution panels where shown on panel schedules.

END OF SECTION 26 43 05

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires, egress fixtures, and accessories.
- B. Exit signs.
- C. LED Luminaires.
- D. LED Drivers.
- E. Accessories.

1.2 REFERENCE STANDARDS

- A. ANSI C78.379 - American National Standard for Electric Lamps -- Reflector Lamps -- Classification of Beam Patterns; 2006 (R2015).
- B. ANSI C82.1 - American National Standard for Lamp Ballast - Line Frequency Fluorescent Lamp Ballast; 2004 (R2015).
- C. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002.
- D. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; National Electrical Contractors Association; 2006.
- E. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; National Electrical Contractors Association; 2006.
- F. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2016.
- G. NFPA 70 - National Electrical Code; National Fire Protection Association; 2017.
- H. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association; 2018.

1.3 SUBMITTALS

- A. See Division 1 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.
 - 1. Photometric Data: Submit on CD or DVD, in IESNA LM-63 standard format.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Operation and Maintenance Data: Instructions for each product.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Division 1 - Product Requirements, for additional provisions.
 - 2. Extra Plastic Lenses: One of type and size.
 - 3. Extra Lamps: One of each type and size.
 - 4. Extra Ballasts: One of type and size.

1.4 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00

- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70 and NFPA 101.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 LUMINAIRES

- A. Furnish products as indicated in Schedule on drawings.
- B. Substitutions: See Division 1 - Product Requirements.

2.2 EXIT SIGNS

- A. Manufacturers:
 - 1. Cooper Lighting.
 - 2. Lithonia Lighting.
 - 3. Hubbell.
 - 4. Substitutions: See Division 1 - Product Requirements.
- B. Exit Signs: Exit sign fixture suitable for use as emergency lighting unit.
 - 1. Furnish products as indicated in schedule on drawings.

2.3 LED LUMINAIRES

- A. LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category are:
 - 1. Minimum Light Output.
 - 2. Zonal Lumen Requirements.
 - 3. Minimum Luminaire Efficacy.
 - 4. Minimum CRI.
 - 5. L70 Lumen Maintenance.
 - 6. Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
- B. Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a maximum 5-step MacAdam Ellipse binning process.
- C. Glare Control: Exterior luminaires shall meet DesignLights Consortium's® criteria for Zonal Lumen Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.
- D. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- E. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- F. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.

- G. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
- H. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- I. Luminaire and driver shall be furnished from a single manufacturer to ensure compatibility.
- J. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires.
- K. LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -20°F to 122°F (-29°C to 50°C).
- L. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- M. Luminaire shall have a maximum Total Harmonic Distortion (THD) of <20% at full input power and across specified voltage range.
- N. All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
- O. All luminaires shall be provided with knockouts for conduit connections.
- P. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).
- Q. Provide all of the following data on submittals:
 - 1. Delivered lumens
 - 2. Input watts
 - 3. Efficacy
 - 4. Color rendering index.
- R. The failure of one LED shall not affect the operation of the remaining LEDs.

2.4 LED DRIVERS

- A. General:
 - 1. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated on the luminaire schedule on the drawings.
 - 2. Minimum Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
 - 3. Driver shall have a rated life of 50,000 hours, minimum.
 - 4. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
 - 5. Driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
 - 6. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
 - 7. Driver shall have a maximum Total Harmonic Distortion (THD) of <20% at full input power and across specified voltage range.
 - 8. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
 - 9. Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.

10. Provide all of the following data on submittals:
 - a. Input watts
 - b. Power Factor (pf)
 - c. Crest Factor (cf) at full input power
 - d. Total Harmonic Distortion (THD).
- B. Dimming Drivers:
 1. LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC), Constant Voltage, or Pulse Width Modulation (PWM) operation.
 2. Step-Dimming Drivers: Easily switched from 0% to 50% to 100% output power. Both switch-leg inputs shall control 50% of the luminaire's light output equally.
 3. Continuous Dimming Drivers: LED luminaires shall dim to (10%, 1%, or 0.1%) as specified in the Luminaire Schedule on the plans without visible flicker or "popcorn effect". "Popcorn effect" is defined as the luminaire being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre-set level when power is returned to the luminaire. Continuous Dimming Drivers shall use 0-10V control.

2.5 ACCESSORIES

- A. Product:
 1. Substitutions: See Division 1 - Product Requirements.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).
- B. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- C. Support luminaires equal to or larger than 2 x 4 foot (600 x 1200 mm) size independent of ceiling framing.
- D. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- E. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- F. Exposed Grid Ceilings: Support surface mounted luminaires in grid ceiling directly from building structure.
- G. Exposed Grid Ceilings: Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires.
- H. Exposed Grid Ceilings: Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.
- I. Install recessed luminaires to permit removal from below.
- J. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- K. Install clips to secure recessed grid-supported luminaires in place.
- L. Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated on Drawings.
- M. Install accessories furnished with each luminaire.
- N. Connect luminaires and exit signs to branch circuit outlets provided under Section 26 05 34 using flexible conduit.

- O. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- P. Bond products and metal accessories to branch circuit equipment grounding conductor.
- Q. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.
- R. Interface with air handling accessories furnished and installed under Section 23 36 00.
- S. 0-to-10V Dimming Control Wiring Installation:
 - 1. Zero-to-10V dimming control conductors are classified by the NEC as Class 2 conductors and shall be kept separate from line-voltage conductors per NEC 725.136(A). Matching the insulation rating of Conductors of Different Systems does not apply to Class 2 conductors per NEC 300.3(C)(1), Informational Note No.1.
 - 2. Wall box dimmers will typically have two conduits: One conduit for line-voltage power, and one conduit or conduit stub for the 0-10V control wiring.
 - 3. At each luminaire, separate openings (either manufactured knock-outs or punched openings) shall be used for the line-voltage power and the 0-10V wiring. The EC shall use a cable connector at the opening for the 0-10V wiring. Zero-to-10V conductors entering and within a luminaire enclosure shall maintain a minimum separation of 6 mm (0.25 in.) per NEC 725.136(D).
 - 4. Exposed 0-10V cables shall be installed in separate conduits from line-voltage conductors.
 - 5. The 0-10V cables may be routed in free air where concealed above accessible ceilings. Cables routed in free air shall observe the following installation requirements:
 - a. The 0-10V cables may be tie-wrapped to the outside of the luminaire power raceway where allowed by NEC 300.11(B)(2). Tie-wraps shall be UL listed for UV resistance. Care should be taken in the use of cable ties to secure and anchor the cabling. Ties shall not be over tightened as to compress the cable jacket. No sharp burrs shall remain where excess length of the cable tie has been cut.
 - b. Cabling shall be neatly run at right angles and be kept clear of other trades work.
 - c. Cabling shall be secured within twelve (12) inches of direction change or termination.
 - d. Cabling shall be supported at a maximum of 5-foot intervals utilizing "J-Hook" or "Bridle Ring" supports anchored to ceiling concrete, piping supports or structural steel beams. If cable sag at mid-span exceeds 12-inches, another support shall be provided. Cable supports shall be installed to maintain cable bend to larger than the minimum bend radius.
 - e. Cabling shall not be attached to or supported by existing cabling, plumbing or steam piping, ductwork, suspended ceiling supports or electrical or communications conduit. Do not place cable directly on the ceiling grid or attach cable in any manner to the ceiling grid wires.
 - f. All cables shall be free of tension at both ends. Nylon strain relief connectors shall be provided at each device and junction box where cables enter. In cases where the cable must bear some stress, Kellum type grips may be used to spread the strain over a longer length of cable.
 - g. Cable manufacturer's minimum bend radius shall be observed in all instances.
 - h. Use suitable cable fittings and connectors.

T. Luminaire Connections – Metal-Clad (MC) Cable:

1. Metal-Clad (MC) type cable that combines power and Class 2 circuits into a single cable may be used for the luminaire wiring where 0-10V dimming control wiring is required. Examples of such products are Encore Wire® MC-LED™ or Southwire® MC-PCS Duo™. Manufacturer's names and catalog numbers are used for quality and performance only. MC Cables manufactured by others shall be equally acceptable provided they meet or exceed in performance and quality as specified.
2. Recessed, including Master-Satellite connections:
 - a. Use a luminaire fixture whip from a J-box for recessed lay-in luminaires. Luminaire fixture whips shall be aluminum or steel AC Cable (Armored Cable) or Flexible Metal Conduit (FMC). Metal Clad (MC) cable that combines power and Class 2 circuits (for 0-10V dimming control) into a single cable may be used as a whip for luminaires that are dimmed.
 - b. Cable/Conduit whips shall be 3/8" (10 mm) minimum diameter, six feet (1.8 m) maximum length.
 - c. Flexible whips or pre-wired systems between master and satellite luminaires may be supported by the ceiling grid wires.
 - d. The flexible connectors shall be steel, galvanized, clamp type with locknut, snap-in type with locknut, or snap-in connector type, including those used on the master-satellite units.
3. Chain or Cable Hung (unfinished spaces):
 - a. Use manufacturer's SO cord or a luminaire fixture whip from a J-box. Luminaire fixture whips shall be aluminum or steel AC Cable (Armored Cable) or Flexible Metal Conduit (FMC). Metal Clad (MC) cable that combines power and Class 2 circuits (for 0-10V dimming control) into a single cable may be used as a whip for luminaires that are dimmed.
 - b. Conduit whips shall be 3/8" (10 mm) minimum diameter. Conduit whip or SO cord shall be cut to length (six feet (1.8 m) maximum) and shall allow movement of the chain/cable/luminaire, but shall not be long enough to "loop" and shall present a neat and workmanlike appearance.
 - c. Luminaire field wired flexible cord installations shall be connected per NEC 410.62.
 - d. The flexible connectors shall be steel, galvanized, clamp type with locknut, snap-in type with locknut, or snap-in connector type, including those used on the master-satellite units.
 - e. Conduit whip slack shall be tie-wrapped to the chain supports. Tie-wraps shall be UL listed for UV resistance.
4. Cable Hung (finished spaces):
 - a. Use manufacturer's SO cord from luminaire to a J-box.
 - b. SO cord shall be cut to length (six feet (1.8 m) maximum) and shall allow movement of the cable/luminaire, but shall not be long enough to "loop" and shall present a neat and workmanlike appearance.
 - c. SO cord slack may be tie-wrapped to the cable supports. Tie-wraps shall be UL listed for UV resistance.
 - d. Luminaire field wired flexible cord installations shall be connected per NEC 410.62.
5. Surface Mounted (unfinished spaces): Provide direct conduit and box connection.
6. Surface Mounted (finished spaces): Provide direct conduit and box connection. Use surface metal raceway where indicated on drawings. Conceal box and conduit where appropriate. Flexible metal conduit shall not be used where the conduit is exposed.

3.2 FIELD QUALITY CONTROL

- A. Perform field inspection according to Division 1.
- B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTING

- A. Aim and adjust luminaires as indicated.
- B. Position exit sign directional arrows as indicated.

3.4 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

3.5 CLOSEOUT ACTIVITIES

- A. Demonstrate luminaire operation for minimum of two hours.

3.6 PROTECTION

- A. Relamp luminaires that have failed lamps at Substantial Completion.

3.7 SCHEDULE – On Drawings.

END OF SECTION 26 51 00

END OF DIVISION 26 – ELECTRICAL

DIVISION 27 – COMMUNICATIONS

TABLE OF CONTENTS

Section	Title
27 05 00	Basic Communications Systems Requirements
27 05 03	Through Penetration Firestopping
27 05 26	Communications Bonding
27 15 00	Horizontal Cabling Requirements
27 17 10	Testing
27 51 13	Paging Systems
END OF INDEX	

SECTION 27 05 00 - BASIC COMMUNICATIONS SYSTEMS REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic Communications Systems Requirements specifically applicable to Division 27 sections, in addition to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Communications Systems.
- B. The contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make the portion of the Communications Work a finished and working system.
- C. Separate contracts will be awarded for the following work.
- D. All work will be awarded under a single General Contract. The division of work listed below is for the contractor's convenience and lists normal breakdown of the work.
- E. Separate contracts will be awarded for the following work. The division of work listed below is for the contractors' convenience and lists a normal breakdown of the work. Please refer to the Construction Manager's scope statements for complete scope of work description.
- F. Description of Systems include, but are not limited to, the following:
 - 1. Complete Structured Cabling System including, but not limited to:
 - a. Voice and data backbone cabling and terminations.
 - b. Voice and data horizontal cabling and terminations.
 - c. Information outlets (IOs) including faceplates, jacks and labeling.
 - d. Equipment racks, cabinets, cable management and equipment.
 - e. Telecommunication Room equipment including patch panels, optical distribution cabinets, and termination blocks.
 - f. Cabling pathways.
 - g. Grounding and Bonding
 - h. Testing

2. Mounting and patching of wireless access points provided by others.
3. Firestopping of penetrations as described in Section 27 05 03.

1.3 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.4 OWNER FURNISHED PRODUCTS

- A. Active networking electronics
 1. Switches
 2. Rack mounted power supply
- B. Telecommunications 2 Post floor rack.
 1. Horizontal cable management
 2. Vertical cable management
- C. Data patch panels

1.5 DIVISION OF WORK BETWEEN ELECTRICAL AND COMMUNICATIONS CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.
- B. Definitions:
 1. "Electrical Contractor" as referred to herein refers to the contractors listed in Division 26 of this Specification.
 2. "Electrical Contractor" shall also refer to the contractor listed in Division 27 of this specification when the "Suggested Matrix of Scope Responsibility" indicates the work shall be provided by the EC.
 3. "Technology Contractor" as referred to herein refers to the contractors listed in Division 27 of this Specification.
 4. Low Voltage Technology Wiring: The wiring (less than 120VAC) associated with the Technology Systems, used for analog and/or digital signals between equipment.
 5. Telecommunications/Technology Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation and mounting of the telecommunications/technology outlet. Rough-in shall include conduit from the information outlet backbox to the nearest cable tray. Where surface mounted backboxes are required, conduit shall be routed to the nearest cable tray.
- C. General:
 1. The purpose of these specifications is to outline typical Electrical and Technology Contractor's work responsibilities as related to technology systems including telecommunications rough-in, audio/visual systems rough-in, conduit, cable tray, power wiring, and low voltage communications and technology wiring. The prime contractor is responsible for all divisions of work.

2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the technology drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the technology drawings but required for the successful operation of the systems shall be the responsibility of the Technology Contractor and included in the contractor's bid.
3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of technology systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Technology Contractor has convened to determine the exact location and requirements of the installation.
4. Where the Electrical Contractor is required to install cable tray that will contain low voltage technology wiring, the installation shall not begin until the Technology Contractor has completed a coordination review of the cable tray shop drawing.
5. This contractor shall establish electrical and technology utility elevations prior to fabrication and installation. The Technology Contractor shall cooperate with the Electrical Contractor and the determined elevations according to the guidelines below. This contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
 - a. Lighting Fixtures
 - b. Gravity Flow Piping, including Steam and Condensate
 - c. Sheet Metal
 - d. Electrical Busduct
 - e. Cable Trays, including 12" access space
 - f. Sprinkler Piping and other Piping
 - g. Conduit and Wireway
 - h. Open Cabling

D. Electrical Contractor's Responsibility:

1. Assumes all responsibility for all required conduit and power connections be provided by the Electrical Contractor.
2. Assumes all responsibility for providing and installing cable tray.
3. Responsible for Communications Systems grounding and bonding.
4. This contractor is responsible for coordination of utilities with all other contractors. If any field coordination conflicts are found, the contractor shall coordinate with other contractors to determine a viable layout.

E. Technology Contractor's Responsibility:

1. Assumes all responsibility for the low voltage technology wiring of all systems, including cable support where open cable is specified.
2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor.
3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).
4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of technology equipment which is required to be bonded to the technology bonding system.
5. This contractor is responsible for coordination of utilities with all other contractors. If any field coordination conflicts are found, the contractor shall coordinate with other contractors to determine a viable layout.

1.6 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify Architect/Engineer of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to Owner.
 - a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.
3. The contractors shall use the coordination process to identify the proper sequence of:
 - a. Installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

1.7 QUALITY ASSURANCE

A. Telecommunications Structured Cabling System Standards:

1. All work and equipment shall conform to the most current ratified version of the following published standards unless otherwise indicated that draft standards are to be followed:
 - a. ANSI/NECA/BICSI 568 - Standard for Installing Commercial Building Telecommunications Cabling
 - b. ANSI/TIA-568-C.0 - Generic Telecommunications Cabling for Customer Premises
 - 1) C.1 - Commercial Building Telecommunications Standard
 - 2) C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standard
 - 3) C.3 - Optical Fiber Cabling Components Standard
 - 4) C.4 - Broadband Coaxial Cabling and Components Standard
 - c. ANSI/TIA-569-C - Telecommunications Pathways and Spaces
 - d. ANSI/TIA-606-B - Administration Standard for Commercial Telecommunications Infrastructure
 - e. ANSI/TIA-607-B - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
 - f. ANSI/TIA-758-B - Customer-Owned Outside Plant Telecommunications Standard
 - g. ANSI/TIA-862-A - Building Automation Systems Cabling Standard
 - h. ANSI/TIA-942-A - Telecommunications Infrastructure Standard for Data Centers
 - i. ANSI/TIA-1152 - Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
 - j. ANSI/TIA-1179 Healthcare Facility Telecommunications Standard
 - k. ANSI/TIA/EIA-598-C - Optical Fiber Cable Color Coding
 - l. NFPA 70 (NEC) - National Electrical Code (Current Edition)
 - m. UL 444 - Standard for Safety for Communications Cable

B. Refer to individual sections for additional Quality Assurance requirements.

C. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer will be acceptable.
2. The Installing Contractor shall be certified by the manufacturer of the structured cabling system. Certification of Contractor shall have been in place for a minimum of one (1) year prior to bidding this project. Documentation of certification is required at the time of bid. Shop drawings will not be approved until proof of certification is submitted. Refer to the end of this specification section for certification documentation requirements.
3. Each contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the termination of cabling shall be individually certified by the manufacturer.
4. The contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.

5. The contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and copper structured cabling systems and have personnel adequately trained in the use of such tools and equipment.
6. The contractor must have a BICSI RCDD (Registered Communications Distribution Designer) or CNet CNIDP (Certified Network Infrastructure Design Professional) on-staff serving as a project manager. Project shop drawings and test reports shall be stamped by the RCDD or CNIDP.
7. The contractor shall obtain the services of a BICSI RCDD (Registered Communications Distribution Designer) or CNet CNIDP (Certified Network Infrastructure Design Professional) for the project. The RCDD or CNIDP shall perform the following tasks on the project:
 - a. Review contractor's submittals and stamp the submittals stating the submittals compliance with the contract documents.
 - b. Provide written and dated confirmation of an observation of the contractor's installation activities no less than every month during the construction period.
 - c. Provide a final written and dated confirmation of a final construction review prior to testing.
 - d. Review final testing of system and indication that the documented results or transmittal of the results stating the test results compliance with the contract documents.
8. The contractor shall have certified BICSI installation technicians or CNet CNIT (Certified Network Infrastructure Technician) on staff to perform the following tasks on the project:
 - a. Act as the field superintendent or job foreman with the responsibility of monitoring the daily work of each technician.
 - b. Oversee all testing and termination of cabling.
9. The contractor shall have certified BICSI Installer 2 or CNet CNCI (Certified Network Cabling Installer) on staff to perform the following tasks:
 - a. Installation and termination of copper cable.
 - b. Installation and termination of optical fiber.
10. A resume of qualification shall be submitted with the contractor's bid indicating the following:
 - a. Documentation of certification of This contractor by the proposed structured cabling system manufacturer as required at the end of this specification section.
 - b. A list of recently completed projects of similar type and size with contact names and telephone numbers for each.
 - c. A list of test equipment proposed for use in verifying the installed integrity of copper and fiber optic systems on the project.
 - d. A technical resume of experience for the contractor's project manager and on-site installation supervisor assigned to this project.
 - e. Resume and certification of the RCDD or CNIDP for the project as required by the form at the end of this specification section.
 - f. Resume and certification of the BICSI installation technician or CNet CNIT for the project.

D. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the State of Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction.
2. In the event there are no local codes having jurisdiction over this job, the current issue of the National Electrical Code shall be followed.

3. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, Architect/Engineer shall determine the method or equipment used.
 4. If the contractor notes, at the time of bidding, any parts of the drawings and specifications which are not according to the applicable codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, he shall submit with the proposal, a separate price required to make the system shown on the drawings comply with the codes and regulations.
 5. Verify the installation environment prior to purchasing or installing any cable. Cable installed in a plenum environment shall be appropriately rated. Bring all discrepancies between the contract documents and installation conditions to the attention of the Architect/Engineer prior to purchase or installation.
 6. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the contractor without cost to the Owner.
- E. Permits, Fees, Taxes, Inspections:
1. Procure all applicable permits and licenses.
 2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.
 3. Pay all applicable charges for such permits or licenses that may be required.
 4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
 5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.
 6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized independent agency/consultant.

1.8 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.
1. Submittals list
 - a. Through Penetration Firestopping
 - b. Bonding
 - c. Interior Communications Pathways
 - d. Exterior Communications Pathways
 - e. Identification and Administration Communication
 - f. Equipment Rooms
 - g. Backbone Cabling Requirements
 - h. Horizontal Cabling Requirements
 - i. Testing
 - j. Professional Audio Video System
 2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
 - a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses
 - f. Description of item submitted (using project nomenclature) and relevant.

- g. specification number
- h. Notations of deviations from the contract documents
- i. Other pertinent data
- j. Provide space for contractor's review stamps.

3. Composition:

- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
- b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
- c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

1.9 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.
- B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.
- C. Change order work shall not proceed until authorized.

1.10 WARRANTY

- A. At a minimum, provide a one year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 27 may require additional warranty requirements for specific equipment or systems.
- B. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.
- C. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.11 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION (NOT APPLICABLE)

END OF SECTION 27 05 00

SECTION 27 05 03 - THROUGH PENETRATION FIRESTOPPING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Through-Penetration Firestopping.

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this Section.
- B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.4 REFERENCES

- A. UL 263 - Fire Tests of Building Construction and Materials
- B. UL 723 - Surface Burning Characteristics of Building Materials
- C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
- D. UL 2079 - Tests for Fire Resistance of Building Joint Systems
- E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
- F. Intertek / Warnock Hersey - Directory of Listed Products
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
- I. HCAI - Health Care Access and Information (California)
- J. The Building Officials and Code Administrators National Building Code
- K. 1997 Uniform Building Code
- L. Wisconsin Administrative Code
- M. 2021 International Building Code
- N. NFPA 5000 – Building Construction Safety

1.5 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
 - 1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
 - 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
- B. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
- C. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

- D. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.
 - 1. 3M; Fire Protection Products Division
 - 2. Hilti, Inc.
 - 3. RectorSeal Corporation, Metacaulk

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

- A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.
- B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.
- C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.
- D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.
- E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.
- F. Provide firestopping systems allowing continuous insulation for all insulated pipes.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.
- B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.
- C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.
- D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

- A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily fire stopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.
- B. Install penetration seal materials according to printed instructions of the UL or Intertek /Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

- C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 IDENTIFICATION

- A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:
 - 1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.4 INSPECTION

- A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.
- B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.
- C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.
- D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the contractor's expense.

END OF SECTION 27 05 03

SECTION 27 05 26 - COMMUNICATIONS BONDING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Bonding Conductors
- B. Bonding Connectors
- C. Grounding Busbar (TMGB and TGB)
- D. Rack-mount Telecommunications Grounding Busbar

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 QUALITY ASSURANCE

- A. Refer to Section 27 05 00 for relevant standards.
- B. Communications bonding system component, device, equipment, and material manufacturer(s) shall have a minimum of five (5) years documented experience in the manufacture of communications bonding products.
- C. The entire installation shall comply with all applicable electrical codes, safety codes, and standards.

1.4 REFERENCES

- A. ANSI/IEEE 1100 - Recommended Practice for Power and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems
- B. ANSI/TIA/EIA 568-C - Commercial Building Telecommunications Cabling Standard
- C. ANSI/TIA/EIA 569-A - Commercial Building Standard for Telecommunications Pathways and Spaces
- D. ANSI/TIA/EIA 606 - Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- E. ANSI/TIA/EIA 758 - Customer Owned Outside Plant
- F. ANSI-J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- G. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
- H. IEEE 837 - IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding
- I. NFPA 70 - National Electrical Code
- J. NFPA 780 - Standard for the Installation of Lightning Protection Systems
- K. UL 96 - Lightning Protection Components
- L. UL 96A - Installation Requirements for Lightning Protection Systems
- M. UL 467 - Grounding and Bonding Equipment

1.5 SUBMITTALS

- A. Submit product data and shop drawings under provisions of Section 27 05 00 and Division 1.
- B. Provide manufacturer's technical product specification sheet for each individual component type. Submitted data shall show the following:
 - 1. Compliance with each requirement of these documents. The submittal shall acknowledge each requirement of this section, item-by-item, including construction, materials, ratings, and all other parameters identified in Part 2 - Products.
 - 2. Manufacturer's installation instructions indicating application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- C. Provide CAD-generated, project-specific system shop drawings as follows:
 - 1. Provide a system block diagram indicating system configuration, system components, interconnection between components, and conductor routing. The diagram shall clearly indicate all wiring and connections required in the system. When multiple devices or pieces of equipment are required in the exact same configuration (e.g., multiple identical equipment racks or sections of ladder tray), the diagram may show one device and refer to the others as "typical" of the device shown. The diagram shall list room numbers where system equipment will be located.
 - 2. Installation details for all system components.
- D. Provide system checkout test procedure to be performed at acceptance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the site under the provisions of Section 27 05 00.
- B. Store and protect products under the provisions of Section 27 05 00.
- C. Contractor shall exercise care to prevent corrosion of any products prior to installation. Corroded products shall not be acceptable for use on this project.

1.7 SYSTEM DESCRIPTION

- A. This section describes the requirements for the furnishing, installation, adjusting, and testing of complete turnkey communications bonding system, including connection to the electrical ground grid.
- B. Performance Statement: This specification section and the accompanying drawings are performance based, describing the minimum material quality, required features, operational requirements, and performance of the system. These documents do not convey every wire that must be installed, every equipment connection that must be made, or every feature and function that must be configured. Based on the equipment constraints described and the performance required of the system as presented in these documents, the contractor is solely responsible for determining all components, devices, equipment, wiring, connections, and terminations required for a complete and operational system that provides the required performance.
- C. This document describes the major components of the system. All additional hardware, subassemblies, supporting equipment, and other miscellaneous equipment required for complete, proper system installation and operation shall be provided by the contractor.
- D. Basic System Requirements:
 - 1. A complete communications bonding infrastructure is required for this project. Refer to the drawings and the requirements of ANSI-J-STD-607-A and NFPA 70 for complete information.

2. The bonding system shall include, but not be limited to, the following major components:
 - a. Bonding Conductor for Telecommunications (BCT)
 - b. Telecommunications Main Grounding Busbar (TMGB)
 - c. Telecommunications Bonding Backbone (TBB)
 - d. Telecommunications Grounding Busbar(s) (TGB)
 - e. Rack mount Telecommunications Grounding Busbar(s)
 - f. Bonding Conductor(s) (BC)
 - g. Bonding Connectors
 - h. Bonding system labeling and administration as defined in Section 27 05 53.

1.8 PROJECT RECORD DOCUMENTS

- A. Submit documents under the provisions of Section 27 05 00.
- B. Provide final system block diagram showing any deviations from approved shop drawing submittal.
- C. Provide floor plans that document the following:
 1. Actual locations of system components, devices, and equipment.
 2. Actual conductor routing.
 3. Actual system component, device, equipment, and conductor labels.
- D. Provide statement that system checkout test, as outlined in the approved shop drawing submittal, is complete and test results were satisfactory.
- E. Complete all operation and maintenance manuals as described below.

PART 2 – PRODUCTS

2.1 BONDING CONDUCTORS

- A. Bare Copper:
 1. Annealed uncoated stranded conductor.
 2. Minimum size 6 AWG.
- B. Insulated Copper:
 1. Annealed uncoated stranded conductor.
 2. Insulation:
 - a. PVC insulation with nylon outer jacket.
 - b. Rated at 600 volts.
 - c. Green
 3. Minimum size 6 AWG.
- C. All bonding conductors shall be listed and recognized by a nationally recognized testing laboratory as being suitable for the intended purpose and for installation in the space in which they are installed.
- D. Bonding Conductor Sizing:
 1. All communications bonding system conductors shall be sized by length as follows:

Length Linear feet (m)	Size (AWG)
Less than 13 (4)	6
14 - 20 (4 - 6)	4
21 - 26 (6 - 8)	3
27 - 33 (8 - 10)	2
34 - 41 (10 - 13)	1
42 - 52 (13 - 16)	1/0
53 - 66 (16 - 20)	2/0
Greater than 66 (20)	3/0

2. The BCT shall be the same size as the TBB or larger.

2.2 BONDING CONNECTORS

- A. Acceptable Types:
 1. Two-hole compression lug
 2. Exothermic weld
 3. Irreversible compression
- B. Connectors shall be provided in kit form and selected per manufacturer's written instructions.
- C. Connectors shall comply with IEEE 837 and UL 467 and be listed for use for specific types, sizes, and combinations of conductors and connected items.

2.3 GROUNDING BUSBAR (TMGB AND TGB)

- A. Features:
 1. Wall-mount configuration.
 2. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended purpose.
 3. Hole patterns compliant with BICSI recommendations and ANSI-J-STD-607-A standards.
 4. Predrilled holes.
 5. Integral insulators.
 6. Stainless steel offset mounting brackets.
- B. Specifications:
 1. Material: Electrolytic tough pitch copper bar with tin plating .
 2. Minimum Dimensions: 1/4" thick x 4" high x 12" long.
 - a. Increase dimensions and/or quantity furnished and installed as required to accommodate all terminations required by the project, plus 20% spare capacity.

3. Hole pattern shall include:
 - a. A minimum of 15 sets of 5/16" holes, 5/8" on center, to accommodate "A" spaced 2-hole compression lugs.
 - b. A minimum of three sets of 7/16" holes, 1" on center, to accommodate "C" spaced 2-hole compression lugs.

2.4 RACK-MOUNT TELECOMMUNICATIONS GROUNDING BUSBAR

- A. Features:
 1. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended purpose.
 2. Predrilled holes.
 3. Mounts in a standard 19" equipment rack.
- B. Specifications:
 1. Material: Electrolytic tough pitch copper bar with tin plating.
 2. Minimum Dimensions: 3/16" thick x 3/4" high x 19" long.
 - a. Increase dimensions and/or quantity furnished and installed as required to accommodate all terminations required by the project, plus 20% spare capacity.
 3. Hole pattern shall include:
 - a. A minimum of eight 6-32 tapped lug mounting holes on 1" centers.
 - b. A minimum of two pairs of 5/16" diameter holes spaced 3/4" apart.

END OF SECTION 27 05 26

SECTION 27 15 00 - HORIZONTAL CABLING REQUIREMENTS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. This section describes the products and execution requirements relating to furnishing and installing horizontal communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of copper cabling.

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 QUALITY ASSURANCE

- A. Refer to Section 27 05 00 for relevant standards and plenum or non-plenum cable requirements.
- B. The channel shall be required to meet the performance requirements indicated herein. The manufacturer shall warranty the performance of their system to the required performance (and not just to the Standard, should the required performance exceed the Standard). Specific components of the channel shall be required, at a minimum, to meet the Standard component requirements for that particular component.
- C. The installing contractor must be certified by the manufacturer of the structured cabling system.

1.4 SUBMITTALS

- A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the contractor shall submit:
 - 1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
 - 2. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 PRODUCT

- A. CAT 6A Cable:
 - 1. The horizontal cable requirements must be met, as well as the following channel requirements.
 - 2. CAT 6A cable shall terminate on rack-mounted modular patch panels in their respective communication equipment room as indicated on the drawings.
 - 3. Cable shall exceed transmission requirements listed in ANSI/TIA/EIA-568-C.2. Performance tests shall be conducted using swept frequency testing through 500 MHz for the channel. All numbers given are for a 4-connection channel. Discrete frequency testing results at 500 MHz is not acceptable.
 - 4. Performance tests shall be conducted using swept frequency testing through 500 MHz for the channel. All numbers given are for a 4-connection channel. Discrete frequency testing results at 500 MHz is not acceptable.

5. Performance data shall be provided by third-party independent testing laboratories only. Testing data shall be submitted on the third-party testing laboratory letterhead. Test data will only be accepted if it displays testing as a channel. Electrical characteristics of the performance of the cable itself will not satisfy this requirement.
6. The structured cabling and connectivity may be provided by the same company. For the purpose of this specification that shall mean that the cabling and connectivity must be marketed, branded, supported, warranted, and distributed by the same company. Specifically, ally or partnerships between cabling manufacturers and connectivity manufacturers do not meet this requirement unless otherwise listed in Section 27 17 20 as an acceptable manufacturer. Specifically, products made by others through an OEM relationship are acceptable if the products are marketed, branded, supported, warranted, and distributed by the same company.
7. The 4-connector channel performance margins in the table below shall be guaranteed margins above ANSI/TIA/EIA-568-C.2:

Electrical Value (1 - 500 MHz)	Minimum Margin
Insertion Loss:	3%
NEXT:	2 dB
PS NEXT:	3 dB
PSA NEXT:	3 dB
PSA NEXT (Average):	
ACR-F:	2 dB
PS ACR-F:	3 dB
PSA ACR-F:	3 dB
PSA ACR-F (Average):	3 dB
Return Loss:	2 dB

8. The jacket color for CAT 6A cable shall be blue.
9. Basis of Design:
 - a. Commscope
 - b. Belden
 - c. Berk-tech
 - d. Or compatible with Build America Buy America

B. Cat 6A Jacks

1. CAT 6A horizontal cable shall each be terminated at its designated work area location on RJ- 45 modular jacks. These modular jack assemblies shall snap into a modular mounting frame. The combined modular jack assembly is referred to as an information outlet.
2. The same orientation and positioning of modular jacks shall be utilized throughout the installation. Prior to installation, the contractor shall submit the proposed configuration for each information outlet type for review by the Architect/Engineer.

3. Information outlet faceplates shall incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.
4. Where standalone CAT 6A only modular jacks are identified, the information outlet faceplate shall be configured as to allow for the addition of one (1) additional modular jack (CAT 6A) to be installed to supplement each such modular jack as defined by this project. The installation of these supplemental modular jacks is NOT part of this project.
5. Any unused modular jack positions on an information outlet faceplate shall be fitted with a removable blank inserted into the opening.
6. All modular jacks will be fitted with a dust cover. Modular jacks shall incorporate a dust cover that fits over and/or into the modular jack opening. The dust cover shall be designed to remain with the modular jack assembly when the modular jack is in use. No damage to the modular jack pinning shall result from insertion or removal of these covers. Dust covers that result in deformation of the modular jack pinning, will not be accepted.
7. The information outlet faceplate shall be constructed of high impact plastic (except where noted otherwise). The information outlet faceplate color shall
 - a. Match the receptacle color used for other utilities in the building, or When installed in surface raceway (if applicable), match the color of that raceway.
8. Different faceplate and frame designs for locations, which include optical fiber cabling relative to those, that terminate only copper cabling are acceptable. Information outlets that incorporate optical fiber shall be compliant with the above requirements plus:
 - a. Be a low-profile assembly.
 - b. Incorporate a mechanism for storage of cable and fiber slack needed for termination.
 - c. Position the optical fiber couplings to face downward or at a downward angle to prevent contamination.
 - d. Incorporate a shroud that protects the optical fiber couplings from impact damage
9. All information outlets and the associated modular jacks shall be of the same manufacturer throughout the project.
10. The CAT 6A modular jacks shall be non-keyed 8-pin modular jacks.
11. The interface between the modular jack and the horizontal cable shall be an angled insulation displacement type contact and shall provide separation for ANEXT suppression. Termination components shall be designed to maintain the horizontal cable's pair twists as closely as possible to the point of mechanical termination.
12. CAT 6A modular jacks shall be pinned per TIA-568B.
13. CAT 6A termination hardware shall, as a minimum, meet all the mechanical and electrical performance requirements of the following standards:
 - a. ANSI/TIA/EIA-568-B.2-10
 - b. IEEE 802.af (PoE)
 - c. IEEE 802.an 10GBASE-T
 - d. ISO/IEC 60603-7
 - e. ISO 11801 Class E Compliant
 - f. FCC PART 68.5 SUBPART F
14. The color for CAT 6A jacks shall be blue.

2.2 COPPER WORK AREA CORDS

A. RJ-45:

1. Provide the same quantity of Category 6A copper work area cords as copper patch panel cords specified in Section 27 11 00. Copper work area cords shall be equipped with an 8-pin modular RJ-45 connector on each end.
2. Work area cords shall be 10' in length.
3. Manufacturer of copper patch cable shall be the same as the manufacturer of the horizontal copper cable.

2.3 OPTICAL FIBER BACKBONE PERFORMANCE

A. Singlemode (SM):

1. Fiber Type: Singlemode; doped silica core surrounded by a concentric glass cladding.
2. Core Diameter: 8 to 9 μm . All optical fibers shall be of the same nominal core diameter and profile.
3. Cladding Diameter: $125 \pm 1.0 \mu\text{m}$.
4. Cladding Non-circularity: $\pm 1\%$.
5. Core to Cladding Offset: $\pm 0.8 \mu\text{m}$.
6. Fiber Coating Diameter:
 - a. $245 \pm 15\mu\text{m}$ (primary coating).
 - b. 900-nm (nominal) secondary coating (tight buffer).
 - c. All coatings shall be mechanically strippable without damaging the optical fiber.
7. Cut-off Wavelength (cabled fiber; λ_{ccf}) $\pm 1260\text{-nm}$.
8. Mode Field Diameter: 8.3 to 9.8 μm at 1300-nm; $10.5 \pm 1.0 \mu\text{m}$ at 1550-nm.
9. Zero Dispersion Wavelength (λ_0): 1301.5 nm less than λ_0 less than 1321.5 nm.
10. Zero Dispersion Slope (S_0): Less than $0.092 \text{ ps/nm}^2\text{km}$.
11. Fiber Attenuation (maximum @ $23 \pm 5^\circ\text{C}$; Backbone):
 - a. @ 1300-nm: 2.0 dB/km
 - b. @ 1550-nm: 1.75 dB/km
12. When tested according to FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components," the average change in attenuation over the rated temperature range of the optical fiber cable shall not exceed 0.05 dB/km at 1550-nm. The magnitude of the maximum attenuation change of each individual optical fiber shall not be greater than 0.15 dB/km at 1550-nm.
13. Fiber Dispersion (maximum):
 - a. @ 1285 to 1330-nm: $3.2\text{-ps/nm}\cdot\text{km}$
 - b. @ 1550-nm: $18\text{-ps/nm}\cdot\text{km}$
14. No optical fiber shall show a point discontinuity greater than 0.1 dB at the specified wavelengths. Such a discontinuity or any discontinuity showing a reflection at that point shall be cause for rejection of that optical fiber by the Owner.

2.4 OPTICAL FIBER COUPLERS/ADAPTERS

A. Optical Fiber Couplings (LC type) (Multimode/Singlemode):

1. LC-type optical fiber couplings shall be used to terminate optical fiber backbone cable on fiber distribution cabinet panels in communication equipment rooms. Horizontal optical fiber cables shall also be terminated using optical fiber couplings at their designated work area locations on information outlet faceplates for "fiber to the desk."
2. LC-type optical fiber couplings shall be snap-type with locking washer and nut.
3. LC-type optical fiber couplings shall incorporate domed zirconia ferrule and shall utilize a PC polish to ensure fiber-to-fiber physical contact for low loss and reflections.
4. LC-type optical fiber couplings shall accept 125-micron outside diameter multimode fiber.
5. The attenuation per mated pair shall not exceed 0.7 dB (individual) and 0.5 dB (average). Connectors shall sustain a minimum of 200 mating cycles per TIA/EIA-455-21 without violating specifications.
6. LC-type optical fiber couplings shall meet the following performance criteria:

Test Procedure	Maximum Attenuation Change	Cable Retention
(FOTP-6)	0.2 dB	
Durability (FOTP-21)	0.2 dB	
Impact (FOTP-2)	0.2 dB	
Thermal Shock (FOTP-3)	0.2 dB	
Humidity (FOTP-5)	0.2 dB	
7. Performance Requirements:
 - a. Length: 2 inches
 - b. Operating Temperature: -40 to 85 degrees C

PART 3 - EXECUTION

3.1 CABLE INSTALLATION REQUIREMENTS

A. Horizontal Cabling:

1. The maximum horizontal cable drop length for Data UTP shall not exceed 295 feet (90 meters) in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and must include any slack required for the installation and termination. The contractor is responsible for installing horizontal cabling in a fashion so as to avoid unnecessarily long runs. Any area that cannot be reached within the above constraints should be identified and reported to the Architect/Engineer prior to installation. Changes to the contract documents shall be approved by the Architect/Engineer.
2. All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellum grips may be used to spread the strain over a longer length of cable.
3. Manufacturer's minimum bend radius specifications shall be observed in all instances.
4. Horizontal cabling installed as open cabling shall be supported at a maximum of 5' between supports. Refer to the specifications for required cable supports.
5. Horizontal cabling installed as open cable or in cable tray shall be bundled at not less than 10' intervals with hook-and-loop tie wraps. The use of plastic cable ties is strictly prohibited.

6. The maximum conduit fill for horizontal cabling shall not exceed 40% regardless of conduit length.
 7. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.
- B. A coil of 3 feet in each cable shall be placed in the ceiling at the last support (e.g., J-hook, bridle ring, etc.) before the cables enter a fishable wall, conduit, surface raceway or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15-feet of slack shall be left in each horizontal cable under 250 feet in length to allow for change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.
- C. Category 6A cables shall not be mixed with any other category cable in any bundle. Bundles of Category 6A cable shall maintain a 0.5" separation from bundles of cables containing different categories (e.g., Cat 6, Cat 5E).
- D. To reduce or eliminate EMI, the following minimum separation distances from 480V power lines shall be adhered to:
1. Twelve inches from power lines of less than 5-kVa.
 2. Eighteen inches from high-voltage lighting (including fluorescent).
 3. Thirty-nine inches from power lines of 5-kVa or greater.
 4. Thirty-nine inches from transformers and motors.
- E. Information outlets shown on floor plans with the subscript "W" are intended to be used for wall mounted telephones. Back boxes for wall mounted telephones shall not be located within 12" vertically, or horizontally, from any light switches, power receptacles, nurse call devices, thermostats, or any other architectural element that would otherwise prevent the installation of a wall mounted telephone on the mating lugs.

3.2 CABLE TERMINATION REQUIREMENTS

- A. Cable Terminations - Data UTP:
1. Modular patch panels shall be designed and installed in a fashion as to allow future horizontal cabling to be terminated on the panel without disruption to existing connections.
 2. If the "last" patch (per rack) is greater than 50% utilized, one additional patch panel shall be provided for future use.
 3. At information outlets and modular patch panels, the contractor shall ensure that the twists in each cable pair are preserved to within 0.5-inch of the termination for data cables. The cable jacket shall be removed only to the extent required to make the termination.

END OF SECTION 27 15 00

SECTION 27 17 10 – TESTING

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. This section describes the testing requirements relating to the structured cabling system and its termination components and related subsystems.

1.2 RELATED WORK

- A. Section 27 05 00 - Basic Communications Systems Requirements

1.3 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.4 QUALITY ASSURANCE

- A. Refer to Section 27 05 00 for relevant standards.

1.5 SUBMITTALS

- A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work, the contractor shall submit:
 - 1. Complete information on testing procedure as described herein.
 - 2. Test plan summary for each cable type to be tested including equipment to be used, setup, test frequencies or wavelengths, results format, etc.

PART 2 – PRODUCTS

2.1 TESTING COPPER

- A. General Requirements:
 - 1. Perform acceptance tests as indicated below for each sub-system (e.g., backbone, horizontal, etc.) as it is completed.
 - 2. Supply all equipment and personnel necessary to conduct the acceptance tests. The method of testing shall be approved by the Architect/Engineer.
 - 3. Visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. Provide the Architect/Engineer with a written certification that this inspection has been made.
 - 4. Conduct acceptance testing according to a schedule coordinated with the Owner/Architect/Engineer. Representatives of the Owner may be in attendance to witness the test procedures. Provide a minimum of one (1) week's advance notice to the Architect/Engineer to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.
 - 5. Tests related to connected equipment of others shall only be done with the permission and presence of the contractor involved. The contractor shall ascertain that testing only is required to prove the wiring connections are correct.
 - 6. Provide test results and describe the conduct of the tests including the date of the tests, the equipment used, and the procedures followed. At the request of the Architect/Engineer, provide copies of the original test results in their native format.

7. All cabling shall be 100% fault-free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the expense of the contractor. The applicable tests shall then be repeated. 8. Should it be found by the Architect/Engineer that the materials or any portion thereof furnished and installed under this Contract fail to comply with the specifications and drawings with respect or regard to the quality, amount, or value of materials, appliances, or labor used in the work, it shall be rejected and replaced by the contractor and all work disturbed by changes necessitated in consequence of said defects or imperfections shall be made good at the contractor's expense.

a. CAT 6A Cable:

- 1) Testing shall be from the modular jack at the information outlet to the modular patch panel in the communication equipment room.
- 2) Horizontal cable shall be free of shorts within the pairs and be verified for continuity, pair validity and polarity, and conductor position on the modular jack (e.g., wire map). Any defective, split, or mis-positioned pairs must be identified and corrected.
- 3) CAT 6A horizontal cable shall be tested to 500 MHz as defined by TIA/EIA-568-C.2. Measurements shall be of the "Permanent Link", including cabling and modular jacks at the information outlet and modular patch panel. Parameters to be tested must include:
 - a) Wire Map
 - b) Length
 - c) NEXT Loss (Pair-to-Pair)
 - d) NEXT (Power Sum)
 - e) ELFEXT (Pair-to-Pair)
 - f) ELFEXT (Power Sum)
 - g) Return Loss
 - h) Attenuation
 - i) Propagation Delay
 - j) Delay Skew
- 4) The maximum length of horizontal cable shall not exceed 295 feet, which allows 33 feet for technology equipment and modular patch cords.
- 5) To establish testing baselines, cable samples of known length and of the cable type and lot installed shall be tested. The cable may be terminated with an eight position CAT 6A modular connector (8-pin) to facilitate testing. Nominal Velocity of Propagation (NVP) and nominal attenuation values shall be calculated based on this test and be used during the testing of the installed cable plant. This requirement can be waived if NVP and nominal attenuation data is available from the cable manufacturer for the exact cable type under test.
- 6) CAT 6A horizontal cable testing shall be performed using a test instrument designed for testing to 500 MHz or higher. Test records shall verify "PASS" on each cable and display the specified parameters, comparing test values with standards based "templates" integral to the unit. Test records that report a PASS*, FAIL*, or FAIL result for any of the parameters will not be accepted.

- 7) In the event results of the tests are not satisfactory, the contractor shall make adjustments, replacements, and changes as necessary and shall then repeat the test or tests that disclosed faulty or defective material, equipment, or installation methods, and shall make additional tests as the Architect/Engineer deems necessary at no additional expense to the project or user agency.

2.2 TESTING FIBER

A. General Requirements:

1. Perform acceptance tests as indicated below for each optical fiber sub-system (e.g., backbone, horizontal, etc.) as it is completed.
2. Supply all equipment and personnel necessary to conduct the acceptance tests. The method of testing shall be approved by the Architect/Engineer.
3. Visually inspect all optical fiber cabling and termination points to ensure that they are complete and conform to the standards defined herein. Provide the Architect/Engineer with a written certification that this inspection has been made.
4. Conduct acceptance testing according to a schedule coordinated with the Owner/Architect/Engineer. Representatives of the Owner may be in attendance to witness the test procedures. Provide a minimum of one (1) week's advance notice to the Architect/Engineer to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.
5. Tests related to connected equipment of others shall only be done with the permission and presence of the contractor involved. The contractor shall ascertain that testing only is required to prove that the optical fiber connections are correct.
6. Provide test results and describe the conduct of the tests including the date of the tests, the equipment used and the procedures followed. At the request of the Architect/Engineer, provide copies of the original test results.
7. All optical fiber cabling shall be 100% fault-free unless noted otherwise. If any optical fiber cable is found to be outside the specification defined herein, that optical fiber cable and the associated connector(s) shall be replaced at the expense of the contractor. The applicable tests shall then be repeated.
8. Should it be found by the Architect/Engineer that the materials or any portion thereof furnished and installed under this Contract fail to comply with the specifications and drawings with respect or regard to the quality, amount, or value of materials, appliances, or labor used in the work, it shall be rejected and replaced by the contractor and all work disturbed by changes necessitated in consequence of said defects or imperfections shall be made good at the contractor's expense.
9. The optical fibers utilized in the installed cable shall be traceable to the manufacturer. Upon request by the Owner, provide cable manufacturer's test report for each reel of cable provided. These test reports shall include manufacturer's on-reel attenuation test results at 850-nm and 1300-nm for each optical fiber of each reel prior to shipment from the manufacturer.
 - a. On-the-reel bandwidth performance as tested at the factory. Factory data shall be provided upon request.
 - b. The testing noted for optical fiber cabling utilizes an Optical Time Domain Reflectometer (OTDR). However, the contractor may submit to the Architect/Engineer for pre-approval of alternate fiber optic testing equipment.

- ### B. Tests Prior to Installation:
- The contractor, at their discretion and at no cost to the Owner, may perform an attenuation test with an OTDR at 850-nm or 1300-nm on each optical fiber of each cable reel prior to installation. Supply this test data to the Architect/Engineer prior to installation.

- C. Tests After Installation: Upon completion of cable installation and termination, the optical fiber cabling shall be tested to include:
1. Optical Attenuation ("Insertion Loss" Method):
 - a. Optical Attenuation shall be measured on all terminated optical fibers in one direction of transmission using the "Insertion Loss" method measurement according to the TIA/EIA 526-14, Method B, and be inclusive of the optical connectors and couplings installed at the system endpoints. Access jumpers shall be used at both the transmit and receive ends to ensure that an accurate measurement of connector losses is made. Multimode optical fibers shall be tested at 850 ± 30 nm. Singlemode optical fibers (if applicable) shall be tested at 1300 ± 20 nm.
 - b. Attenuation of optical fibers shall not exceed the values calculated as follows:
 - 1) Attenuation (max.) = $2 * C + L * F + S$ dB.
 - 2) Where C is the maximum allowable Connector Loss (in dB), L is the length of the run (in kilometers), and F is the maximum allowable optical fiber loss (in dB/km). S is the total splice loss (# of splices * maximum attenuation per splice).
 - c. Verification of Link Integrity (OTDR):
 - 1) All optical fibers shall be documented in one direction of transmission using an Optical Time Domain Reflectometer (OTDR). Multimode optical fibers shall be tested at 850-nm and 1300-nm (nominal). Singlemode optical fibers (if applicable) shall be tested at 1310-nm and 1550-nm (nominal). The OTDR(s) shall incorporate high-resolution optics optimized for viewing of short cable sections. Access jumpers of adequate length to allow viewing of the entire length of the cable, including the connectors at the launch and receive end, shall be used. Access jumpers used for testing shall match the type and core diameter of the fiber optic strand under test.
 - 2) Set OTDR's test variables to the manufacturer's published backscatter coefficient and velocity of propagation figure for the specific strand of fiber under test. OTDR's range should be set to approximately 1.5 times the length of the strand under test, pulse width should be optimized for the length of the fiber optic strand under test, and number of averages should be adjusted to approximately 120 seconds per wavelength.
 - 3) OTDR traces revealing a point discontinuity greater than 0.2 dB in a multimode optical fiber or 0.1 dB in a singlemode optical fiber (if applicable) at any of the tested wavelengths or any discontinuity showing a reflection at that point shall be a valid basis for rejection of that optical fiber by the Owner. The installation of that optical fiber cable shall be reviewed in an effort to remove any external stress that may be causing the fault. If such efforts do not remove the fault, that optical fiber cable and the associated terminations shall be replaced at the expense of the contractor.

2.3 DOCUMENTATION/AS-BUILTS/RECORDS

- A. General:
1. Upon completion of the installation, submit as-builts per the requirements of Section 27 05 00 and Division 1. Documentation shall include the items detailed in the subsections below.
 2. All documentation, including hard copy and electronic forms, shall become the property of the Owner.

3. The Architect/Engineer may request that a 10% random field retest be conducted on the cable system at no additional cost to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the contractor, additional testing can be requested to the extent determined necessary by the Architect/Engineer, including a 100% retest. This retest shall be at no additional cost to the Owner.
- B. Copper Media Test Data:
1. Test results shall include a record of test frequencies, cable type, conductor pair and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).
 2. Printouts generated for each cable by the wire test instrument shall be submitted as part of the documentation package. The contractor shall furnish this information in electronic form (USB thumb drive). The thumb drive shall contain the electronic equivalent of the test results as defined by the bid specification and be in the tester's native format as well as summaries of each test in pdf format. Provide a licensed copy of the software required to view and print the data that is provided in a proprietary format. Furnish one (1) copy of the data and display (if applicable) software.
- C. Optical Fiber Media Test Data:
1. 1. Test results shall include a record of test wavelengths, cable type, fiber and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).
 2. OTDR traces of individual optical fiber "signatures" obtained as specified above shall be provided to the Architect/Engineer in electronic form for review. Trace files shall be so named as to identify each individual optical fiber by location in the cable system and optical fiber number or color. Where traces are provided in electronic form, provide along with the above documentation, one (1) licensed copy of software that will allow for the display of OTDR traces provided. The software shall run on a Microsoft Windows-based personal computer.
- D. Record Drawings:
1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided.

END OF SECTION 27 17 10

SECTION 27 51 13 – PAGING SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

- A. The work includes a complete new building paging and intercom system including all cabling and speakers.

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 SHOP DRAWINGS

- A. Project Shop Drawings shall be submitted for review by the Architect's Technology Designer in PDF format.
- B. The shop drawing shall be prepared specifically for this project and shall include the following:
 - 1. Title sheet clearly defining the project name, address and telephone number of contractor, date of submittal and subcontractors. The title sheet shall have blank space for Architect's review stamp.
 - 2. Complete material list listing manufacturer, model number and description of all materials.
 - 3. Manufacturer's specification sheets for all equipment.
- C. Poorly made reproductions will be rejected.

1.4 CONTRACTOR QUALIFICATIONS

- A. The contractor shall be a factory authorized dealer of the specified products and equipment and shall be required to show proof of dealership and appropriate certifications for training on all audio and control equipment integrated within this project. Two stepping of equipment shall not be permitted.

1.5 SYSTEM DESCRIPTION

- A. The work includes a building paging and classroom intercom system. The system shall operate through the existing telephone system for all paging and intercom functions.
- B. The paging system headend shall be located next to the existing data equipment rack.
- C. Furnish and install all equipment, accessories, and materials according to these specifications and drawings to provide a complete and operating school communications system including but not limited to:
 - 1. Administrative display phone with integrated 4x16 character display.
 - 2. One built-in network interface port for system combining and LAN station-to-station calling and district-wide all-calls.
 - 3. One built-in network interface port for first-time system configuration.
 - 4. Built-in Web Server for full system programming with Quantum Commander.
 - 5. Administrative Web-Browser Application for Programming and System Operation.
- D. All items of equipment shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.

- E. System wiring and equipment installation shall be according to good engineering practices as established by the EIA and the NEC. Wiring shall meet all state and local electrical codes. All wiring shall test free from all grounds and shorts.
- F. All communication system wiring shall be labeled at both ends of the cable. All labeling shall be based on the room numbers as indicated in the architectural graphics package.
- G. The contractor shall provide all necessary transient protection on the AC power feed.
- H. Speaker circuits shall be assigned to zones as directed by Owner.

1.6 SYSTEM COMPONENTS AND DESCRIPTIONS

- A. The Quantum Multicom IP shall support any existing Multicom 2000 hardware and functions as well as the new features across the Quantum Processor's interfaced over the LAN. The VoIP capabilities of the QSPC1 Quantum Processor Card will enable the support of the features across the various processors' nodes.
- B. Quantum Multicom IP:
 - 1. The Quantum facility shall have a minimum of one node/processor and a maximum of 64 interconnected nodes/processors. A maximum of 99 facilities can be interconnected into a district.
 - 2. Audio Information shall be transmitted between the processors on the LAN using VoIP technology. Quantum shall utilize all of the existing Multicom 2000 hardware except the current processor card.
 - 3. The processor software shall be up-gradeable via Quantum Commander. The Quantum automatically reboots after it installs the software upgrade. If for some reason the newly installed software will not boot properly, the system shall revert to the previous working load.
 - 4. It shall be possible for Quantum to exchange 'station-to-station' calls and 'inter-facility All-Call paging' to a single facility or all facilities in a district using VoIP technology.
 - 5. The primary QSPC1 shall be configured to act as a Gateway for facility point-to-point calls. Using Quantum Commander, every facility shall be configured with the IP addresses of the primary QSPC1 systems of all the other known facilities (maximum of 98 additional), and an organizationally private multicast IP address (i.e. 239.x.y.z series), which shall be used for inter-facility paging.
 - 6. The maximum number of simultaneous inter-facility point-to-point calls supported is based on the actual performance of the network and the CPU load. The voice quality of the inter-facility calls may vary based on the network conditions.
 - 7. The system shall facilitate the playing of short audio clips repetitively played until stopped by the Quantum Commander User or administrative display phone MCDS4 whichever occurs earlier.
- C. Quantum Commander Programming Software:
 - 1. The processor utilizes a web-based programming tool. The Quantum Commander is built into the QSPC1 processor card and upon boot up, users can login to the Quantum Commander Web Server via their web browser.
 - 2. The Quantum Commander shall be broken into three access levels depending on user access credentials. Systems that do not provide at least three (3) levels of access are not equal.
 - 3. Only the Administrator and Technician shall have access to add/delete/modify the database objects.
 - 4. Users shall have display only access to see the data objects that include configuration, alarms, and performance data and perform certain operations based on the user's CoS (Class of Service).

- D. Administrative Display Phone:
 - 1. The administrative telephone display panel shows the time of day and day of week, the current time signaling schedule, and the station numbers and call-in priority of staff stations that have called that particular station. A 3-key response is used to scroll the display, and answer or erase normal, urgent, and security calls. Depending upon the system programming, an administrative station can use display menus to activate zone pages, alarm signals and external functions, as well as select program sources and distribute or cancel a program to any or all speakers or zones.
 - 2. Administrative Display Phones shall have the ability to dial the loudspeaker at each station location.
- E. Quantum Commander:
 - 1. The processor utilizes a web-based programming tool. The Quantum Commander is built into the QSPC1 processor card, and upon boot up, user can login to the Quantum Commander Web Server.
 - 2. The Quantum Commander shall be broken into three access levels depending on user access credentials. Systems that do not provide at least three (3) Levels of access are not equivalent. The three levels are:
 - a. User
 - b. Administrator
 - c. Technician
 - 3. Only the Administrator and Technician shall have access to add/delete/modify the database objects.
 - 4. Users shall have display only access to see the data objects that include configuration, alarms, and performance data and perform certain operations based on the user's CoS (Class of Service).
 - 5. The following Menu Items shall be available on the Multicom IP Quantum Commander:
 - a. File - Open Database, New System, Save, Delete, Report and Exit, Upload Database, Download Database, Download Software, Diagnostics, Tones and Announcements, Relay Configuration, Program Distribution, Media Assignment, List Passwords, Add Password, and Change Password.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. The installation, adjustment, testing and final connection of all conduit, wiring, boxes, cabinets, etc., shall conform to local electrical requirements and shall be sized and installed according to manufacturer's approved shop drawings.
- B. Low-voltage wiring may be run concealed above accessible ceilings.
- C. Contractor shall install new rack console at location shown on plans.
- D. All work required for a complete operational system is the complete responsibility of the contractor.
- E. The conduit, outlets, terminal cabinets, etc., which form part of the rough-in work shall be furnished and installed completely by the contractor.
- F. All Administrative Phones shall be desk- or counter-mounted.
- G. Provide standard wall 120V AC receptacles as necessary. The paging system contractor shall subcontract a qualified electrical contractor to perform the high voltage work.
- H. Speaker and telephone lines run above ceiling shall be tie-wrapped to ceiling joist with a maximum spacing of 8' between supports. No wires shall be laid on top of ceiling tile.

- I. Connect field cable to each speaker transformer using UL butt splices for 22 AWG wire.
- J. Terminate field wiring on wall adjacent to rack using Telco 66 type blocks. Provide neat cross connect system for wiring. Wiring to be labeled to indicate final architectural room number that it services on the Telco block.
- K. All outside speakers shall be on a separate page zone.
- L. Grounding:
 - 1. Provide equipment grounding connections for Integrated Telecommunications/Time/Audio/Media System as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.
 - 2. Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments.
 - 3. The contractor shall provide all necessary transient protection on the AC power feed and on all station lines leaving or entering the building. The contractor shall note in his drawing, the type and locations of these protection devices as well as all wiring information.
 - 4. The contractor shall furnish and install a dedicated, isolated earth ground from the central equipment rack and bond to the incoming electrical service ground buss bar.
- M. Plug disconnect: All major equipment components shall be fully pluggable by means of multi-pin receptacles and matching plugs to provide for ease of maintenance and service.
- N. Protection of cables: Cables within terminal cabinets, equipment racks, etc., shall be grouped and bundled (harnessed) as to type and laced with No. 12 cord waxed linen lacing twine or T & B "Ty-Rap" cable. Edge protection material shall be installed on edges of holes, lips of ducts or any other point where cables or harnesses cross metallic edge.
- O. Cable identification: Cable conductors shall be color-coded and individual cables shall be individually identified. Each cable identification shall have a unique number located approximately 1-1/2" from cable connection at both ends of cable. Numbers shall be approximately 1/4" in height. These unique numbers shall appear on the As-Built Drawings.

3.2 AS-BUILT DOCUMENTATION

- A. The Following Information Shall Be Submitted Electronically In PDF Format:
 - 1. Project cover sheet.
 - 2. Contractor's information including contact information for service and warranty calls.
 - 3. Full material list of all equipment used.
 - 4. Manufacturer's specification catalog sheets for each piece of equipment.
 - 5. Operation Instructions.
 - 6. Locations of all system devices on building drawings in PDF format.
- B. The project close out and final payments will not be made until all as-built documentation has been successfully submitted.

3.3 CUSTOMER INSTRUCTION

- A. The contractor shall be responsible to train the Owner on the proper operation of the system:
 - 1. All training shall be coordinated through the District Facilities Manager and school principal to assure that all necessary personnel are in attendance at each training session.
 - 2. The contractor shall have a sign-up sheet for each training session to keep a record of who received training and when.

3. All training hours shall be documented in writing and signed by the person receiving the training to assure that the Owner receives the training hours specified.
- B. Provide a minimum of four hours of on-site in-service training in the operation of the system. The training may be divided into separate sessions as required by the Owner within the one year warranty period. This includes multiple trips to the site as required.
- C. On the first day following installation, the contractor shall provide a technician to standby and assist in system operation.

END OF SECTION 27 51 13

END OF DIVISION 27 - COMMUNICATIONS

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

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Section	Title
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28 23 00	Video Surveillance System

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SECTION 28 10 00 ACCESS CONTROL SYSTEM

PART 1 – GENERAL

- A. Scope
- B. Related Work
- C. Quality Assurance
- D. References
- E. Inspections and Permits/Submittals
- F. Bidder Qualifications
- G. Shop Drawings

PART 2 – PRODUCTS

- A. Control Panel (Controller) Product shall be Software House iSTAR Ultra door controller.
- B. Door Control Module: Software House RM including enclosure.
- C. Power Supply Enclosure with Control Board:
- D. USTAR-GCM ISTAR Ultra GCM Board
- E. USTAR-ACM- ISTAR Ultra CCM Board for readers
- F. Credential Readers and Keypads

PART 3 – EXECUTION

- A. Coordination
- B. Installation
- C. Identification and Labeling
- D. Acceptance Testing
- E. Documentation
- F. Warranty

PART 1- GENERAL

- A. SCOPE
 - 1. This specification section describes the products and execution requirements relating to the furnishing, installation, testing, and commissioning of a complete Access Control System and placing it into satisfactory operation.
 - 2. This system is to be a Software House iSTAR Access Control System. The Access Control system must be compatible with existing C-Cure 9000 systems administered by the state.

3. In general, work consists of installation of new access control field equipment and devices and all associated cabling as part of this project.
4. Contractor to communicate with DOA DCP Electronic Security (Renee Scovill) DOADCPElectronicSecurity@wisconsin.gov for coordination of door access system including monitoring.
5. CLASS 1 NOTICE:
6. Notice is hereby given according to Section 16.855(10), Wisconsin Statutes, that the Division believes it is in the best interests of the State to contract the following work from only one source, without the usual statutory procedures:
7. Software House CCure 9000
8. Major features of the Access Control System and responsibilities to furnish and/or install equipment, install cabling, and terminate cabling are as follows:
9. Division 28 contractor-furnished, Division 28 contractor installed.
 - a. Cabling
 - b. Field Device to Controller (inc. signal and power)
 - c. Network Cabling (Controller to Network Switch)
 - d. Cable Termination at Field Devices
 - e. Cable Termination at Controller
 - f. Credential Readers and/or Keypads.
 - g. Door Lock Power Supplies
 - h. Key Switch (Door Access Override)
 - i. Request-to-Exit Devices (PIR)
 - j. Local Locking/Unlocking Switch
 - k. Control Panels (Controllers)
 - l. Control Panel Enclosures
 - m. Door-Position Switches
 - n. Any Additional licenses and /or updates as required for new readers or controllers.

1.2 RELATED WORK (BY OTHERS)

- A. Division 08 contractor-furnished, Division 08 contractor-installed
 1. ADA Door Operators
 2. ADA Door Operator Pushbuttons
 3. Electric Latches and Strikes
 4. Push-bars with integrated request-to-exit switches
 5. Power-transfer Door Hinges
- B. Agency-furnished, Agency-installed or Existing
 1. Badging System
 2. Central Equipment Hardware
 3. Central Equipment Software / Credential Database
 4. Database Updates (door assignments, scheduling other programming)
 5. Network Switches

All raceways and pull boxes, conduit and cables supports, grounding hardware, and bonding as required for a full and functioning system shall be installed and documented by this Division 28 Contractor, as detailed in this and related section(s).

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 01 91 01 – Commissioning Process

Section 08 71 00 – Door Hardware

Section 26 05 26 – Grounding and Bonding for Electrical Systems

Section 26 05 29 – Hangers and Supports for Electrical Systems

Section 26 05 36 – Cable Tray for Electrical Systems

Section 26 05 53 – Identification for Electrical Systems

Section 27 05 53 – Identification for Communications Systems

Section 27 10 00 – Structured Cabling

Section 27 11 00 – Communications Equipment Room Fittings

Section 27 16 19 – Communications Patch Cords, Work Area Cords, and Cross Connect Wire

1.3 QUALITY ASSURANCE

- A. The intent of these Quality assurance requirements is to ensure that the installing contractor has the capabilities to engineer, install, and commission, the devices as specified under this section. Installing contractor must be a firm specializing and experienced in Access Control system installation for no less than 3 year.
- B. The installation contractor must be a branch office or an authorized representative of the manufacturer of the specified Access Control System” as required to support the required warranty. Such authorization must have been in effect for a period of not less than three years at the time of Bidding and remain so throughout project.
- C. Review any existing maintenance contracts.
- D. Installation of equipment and cabling shall be done by qualified staff in direct employment or directly subcontracted and under the supervision of the manufacturer or Authorized Representative.

1.4 REFERENCES

- A. All work and materials are to conform to applicable rules and requirements of the Wisconsin State Electrical Code (SPS 316), the National Electrical Code (NFPA 70), other applicable National Fire Protection Association codes, the National Electrical Safety Code, Federal Communications Commission (FCC) rules, and present manufacturing standards (including NEMA).
- B. All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply, and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be labeled.
- C. Other applicable standards are as follows:
- D. FCC Part 15 as applicable to the equipment type(s) included.
- E. UL 294 Standard for Access Control System Units

1.5 INSPECTIONS AND PERMITS

- A. Refer also to Division 1, General Conditions, Permits, Regulations, Utilities and Taxes.
- B. Obtain and pay for all required state or local installation inspections and permits except those provided by the Architect/Engineer.
- C. Deliver originals of required certificates Construction Representative. Include copies of the certificates and reports in the Operating and Maintenance Manuals.

1.6 SUBMITTALS

General

- A. Under the provisions of Division 1, prior to the start of work, submit:
- B. Bidder Qualifications
- C. Shop Drawings
- D. Product Specification Sheets
- E. Group Submittals to include complete documentation of related systems, products, and accessories in a single submittal.
- F. Submittals shall be electronic format (ADOBE Portable Document format “.pdf”) thereof.

1.7 BIDDER QUALIFICATIONS

- A. Furnish documentation of contractor capabilities as identified under “Quality Assurance / Bidder Qualifications” above.
- B. Where the installing contractor is an authorized representative of the Card Access System manufacturer, submit written confirmation of such authorization from the manufacturer. Indicate in letter of authorization that installing contractor has successfully completed all necessary training required for engineering, installation, and commissioning of equipment. Letter should indicate the start date of such authorization.

1.8 SHOP DRAWINGS

- A. Product data for all equipment, hardware cabling and miscellaneous components proposed.
- B. Schematic drawings - specific to project - of all circuits from the field devices to the required connection points. The diagrams shall show schematic wiring of equipment and all connections to be made to devices. Terminal connections in the equipment shall be numbered to correspond to the diagrams for use in making connections. Wiring diagrams shall be coordinated so that terminal numbering, circuit designation and equipment or device designations are the same on all drawings. All drawings must be submitted and approved by the engineer before installation starts, but such approval will not waive specification requirements unless specifically stated.
- C. Mark the submittal package with specification section number. Do not mix sections in a single submittal.
- D. Work shall not proceed without engineer Approval of the submitted items.

No substituted materials shall be installed except by written approval from the engineer.

1.9 TEST PLAN

Submit Test Plan during construction. See Part 3.

1.10 WORK PERMIT

None required.

1.11 MOCK-UPS

Upon request, provide a mock-up of Control Panel enclosure. Include applicable hardware, cabling, interface types (barrier strip, modular jack, etc.).

PART 2 - PRODUCTS

2.1 GENERAL

- A. All contractor-furnished items shall be compatible with the existing system as identified above.
- B. New system devices installed as part of this project will integrate into the existing agency wide system. No substitutions will be allowed unless otherwise noted.
- C. Licensing where applicable will be provided by the contractor.

2.2 CONTROL PANEL (CONTROLLER)

- A. Control Panel and Enclosure
- B. Control Panel: shall be Software House iSTAR Ultra door controller USTAROO8.

2.3 CREDENTIAL READERS AND KEYPADS

- A. Proximity Card Reader
- B. Frequency: 125 kHz, 13.56 MHz, and 2.4 GHz
- C. Credential Compatibility
- D. Output format: Wiegand and Open Supervised Device Protocol (OSDP) for Card Authentication
- E. Read Range: up to 8.0 inches (Wall-mount); up to 6.0 inches (Mullion-mount). Dependent upon installation conditions and credential type.
- F. Power: 5-16 VDC
- G. Bluetooth enabled to support mobile devices.
- H. Able to support Smart Card Operating System (SCOS) type cards.
- I. Polycarbonate housing, IP55 rated for indoor and outdoor use, operating temperature of -22 to 150 degrees Fahrenheit.
- J. The reader provides visual – typically a change in color of LED from red to green – and an audible indication of acceptance or denial of credentials when card is presented to the reader.
- K. HID Signo 20K Mullion
- L. HID Signo 40K Wall mount
- M. Mounts in 1-gang electrical box.
- N. Heavy Duty In-Ground Pedestal (w/ large faceplate) for outdoor gates
- O. Proximity Card Readers manufactured by others shall be considered equals provided they meet or exceed in performance and quality as specified.

2.4 COLOR: ARCHITECT TO SELECT STANDARD COLOER OPTIONS

- A. Keypad
- B. HID Signo 20 Reader with Keypad Mullion Mount
- C. HID Signo 40 Reader with Keypad Wall Mount.
- D. HID Signo 40 Reader with Keypad Pedestal mount outdoor rated
- E. Mounts in 1-gang electrical box
- F. Heavy Duty In-Ground Pedestal (w/ large faceplate) for outdoor gates, example Pedestal Pro HD-DK-IN

2.5 MISCELLANEOUS FIELD DEVICES

- A. Request-to-Exit (REX)
- B. Bosch DS 160 Series or equal, white includes tamper switch, passive infrared, indicator light detection range of up to 20ft or an approved equal.
- C. Motion-Sensor type:
 - 1. Passive infrared (PIR) sensing with an adjustable 8 ft. x 10 ft. coverage area.
 - 2. Designed for wall mounting above a door.
 - 3. Listed as an access control device under the UL 294 standard.
 - 4. Configured with a minimum of two from “C” relay contacts with an adjustable latch time.
 - 5. Programmable for fail-safe or fail-secure modes. Configured with an activation LED.

2.6 DOOR POSITION SWITCHES

- A. Magnetic-type contacts.
- B. Switch contacts shall be of the reed switch type with plating eliminating cold welding, sticking, and resistance build-up.
- C. All contacts shall be hermetically sealed for long term 10,000,000 contact cycles.
- D. Surface-mounted contacts: Magnetic contacts with a maximum gap range of 38 mm for standard applications and 64 mm for wide-gap applications. SENTROL 1085T series or approved equal.
- E. GRI Mini-Overhead Door Model 4532D or approved equal.
- F. Recessed contacts for steel doors: General Electric 1078C series or approved equal.

2.7 KEY SWITCH (DOOR ACCESS OVERRIDE)

- A. Momentary action, 5 amp rated, DPDT switch, with Bi-color LED – Green to signify secure, Red to signify unsecure.
- B. 1.25" or 1.125" mortise cylinder will be provided by Division 08. Keying shall be per user agency requirements.
- C. Faceplate: Etched labeled in red lettering with "FIRE DEPARTMENT OVERRIDE"
- D. Wiring: 18 AWG (minimum); conductor quantity per manufacturer recommendations.
- E. SECURITRON MK series (MKS) or approved equal.

2.8 INTEGRAL TO DOOR HARDWARE TYPE: By Division 08 Contractor.

- A. Local Locking/Unlocking Switch for door access override.
- B. Local switch for locking/unlocking door(s) shall be a DPDT toggle switch with indicator LED.
- C. DORTRONICS 5236 with optional DPDT toggle switch and optional LED or approved equal.

2.9 CABLING

- A. All cables shall be suitable for installation in the environment defined.
- B. Any cabling installed unenclosed shall meet all [CMR] ratings (or approved substitutes as defined by the referenced NEC).
- C. Cables shall be Underwriters Laboratory (UL) listed and comply with Article 800 (Communications Circuits) of the National Electrical Code.
- D. Field Device to Controller
- E. Per manufacturer's recommendations.
- F. Horizontal (Telecom) Cabling

Refer to specification Section 27 10 00 – Structured Cabling for cable and termination requirements for horizontal links designated for Access Control System locations.

PART 3 - EXECUTION

3.1 GENERAL

- A. The complete installation shall be done in a neat, workmanlike manner according to Division 26 of these documents and manufacturer's recommendations.
- B. Review the project drawings to identify rough-in, cabling and device requirements for all controlled and monitored doors.

3.2 COORDINATION

- A. Coordinate with the Division 08 contractor regarding the doorframes and hardware equipment which is associated with the Access Control System. Verify rough-in and installation requirements for all door frame mounted and/or door mounted control and monitoring equipment.

- B. Prior to the start of construction, confirm installation requirements with the Agency. The coordination shall include, but not be limited to, hardware, cabling and wiring requirements including types, sizes, color-coding schemes, labeling, wire way requirements, termination responsibilities, and cable identification requirements.
- C. Confirm with Capital Police the setup for the monitoring of the Access Control System.
- D. Prior to the start of system installation, schedule and facilitate a pre-installation meeting with the pertinent hardware, lock, exit device, and door closer manufacturers' representative(s), and related trades to coordinate materials, techniques, and to sequence complex hardware items and system installation. Proper installation and adjustment of hardware is to be reviewed. Convene at least one week prior to commencement of access control installation. Provide written documentation of the meeting including date, attendee/participant list and minutes. Distribute to A/E, Agency within seven days of the meeting date.
- E. Coordinate with Division 26 installer to confirm required cabling pathways, device rough-ins, and line-voltage power requirements.

3.3 CONTINUITY OF EXISTING SERVICES AND SYSTEMS

- A. No outages shall be permitted on existing systems except at the time and during the interval specified by the Agency and site representatives. Obtain written approval for any outages.
- B. Schedule any outage when the interruption causes the least interference with normal site schedules and business routines. No extra costs will be paid to the contractor for such outages which must occur outside of regular weekly working hours.
- C. Refer to General Requirements.
- D. Restore any service interrupted as a result of this work to proper operation as soon as possible.

3.4 INSTALLATION - GENERAL

- A. Receive, store, and install Access Control System equipment and cabling as specified.
- B. Comply with the manufacturer's instructions and recommendations for installation of all products.
- C. Provide all system wiring between all components according to manufacturer's guidelines. Each cable for each device shall be home run. No splices are allowed unless otherwise noted.
- D. Intermediate termination points within a wire run would be considered a splice. If intermediate termination points are allowed, with prior approval of the Agency and the engineer, provide pull boxes and terminal strips permanently labeled with the numbering scheme per Agency's requirements.
- E. Mount all credential readers where shown on plans. Placement shall be according to Americans with Disabilities Act (ADA) requirements.
- F. Locate all request-to-exit motion detectors directly above the door frame, centered on the door opening (as applicable). Adjust sensitivity to permit operation on motion of persons within 2' 0" of door. Avoid false activation by persons passing by where possible.
- G. Provide wiring to request-to-exit devices located in electrified door hardware.

3.5 Controller Installation – General

- A. Install, wire, and power per manufacturer's recommendations.
- B. Route Cable for field devices in raceway unless otherwise noted. Route system cabling to equipment per the Access Control System installation diagrams.
- C. Provide all interconnecting cabling from the head-end, between controllers, and between peripheral devices.
- D. Route cabling/conduit on secure side of door.
- E. Where cables are to be installed unenclosed (without raceway) the cable shall meet NEC requirements for the application and installation environment. See Cable Installation - Unenclosed below.
- F. Route in conduit, all exposed vertical cable extensions to devices located below the finished ceiling.

- G. Install and terminate cable as required at each door location.
- H. Observe cable manufacturers minimum bend radius in all instances.
- I. Take care in the use of cable ties to secure and anchor the station cabling.
- J. Do not overtighten cable ties to compress the cable jacket.
- K. No sharp burrs should remain where excess length of the cable tie has been cut.
- L. All cables shall be free of tension at both ends.
- M. Provide strain relief connectors at each device and junction box where cables enter.
- N. Use suitable cable fittings and connectors.

3.6 CABLE INSTALLATION – UNENCLOSED

- A. Where unenclosed cable installation is permitted and as designated on the plan drawings, route cabling to avoid areas of high traffic (i.e., aisle way) and as close as possible to outlining walls.
- B. Cable route shall be a minimum of ten (10) feet above the finished floor.
- C. Provide protection for exposed cables subject to damage.
- D. Route cabling neatly at right angles and be kept clear of other trades work.
- E. Support cabling at a maximum of 4-foot intervals utilizing “J-Hook” or “Bridle Ring” supports anchored to structure. Cable sag at mid-span shall not exceed 6-inches. Install supports to maintain cable bend to larger than the minimum bend radius.
- F. Do not attach-to or support cabling from existing cabling, plumbing or steam piping, ductwork, suspended ceiling supports, or electrical or communications conduit. Do not place cable directly on the ceiling grid or attach cable in any manner to the ceiling grid wires.
- G. Provide 4-foot slack in each cable in accessible ceiling at each device location. Secure cable slack–coiled from 100% to 200% of the cable recommended minimum bend radius– (wire tied) at the last cable support before the cable reaches the device and shall be.

3.7 FIELD DEVICE INSTALLATION

- A. Field devices are shown on the drawing locations diagrammatically and shall not be used for dimensioning of final location. The exact location of door control devices shall be determined by the Division 28 contractor and verified with the General and Division 08 contractors.
- B. Multiple devices (i.e., intercoms, card readers, etc.) at door locations shall be mounted adjacent to each other.
- C. Mount Credential Readers at 42" AFF to center unless noted otherwise on drawings.
- D. Card reader stations shall not be mounted back-to-back on a common wall. Maintain separation to eliminate one card reader reading through the wall to a card reader on the opposite side.
- E. When mounting credential readers on a new surface-mounted box, match box dimensions to the dimensions of the credential reader. (Example: For mounting HID 20K or 40K or reader of similar dimension, a Wiremold V5752 2-gang alarm device box, or equivalent, is appropriate.)
- F. Coordinate with Division 26 all 120-volt connections to access control panels, and at remote and local door power supply locations as indicated on the drawings.
- G. Door Control Interface Wiring
- H. Obtain from the Division 08 contractor all necessary cut sheets, wiring diagrams, and manufacturer’s installation instructions.
- I. Install door control wiring at each door location according to manufacturer’s wiring instructions and as provided by the hardware supplier, including standard locations and all special function controls for interlocking doors and fire release door locations.

3.8 NETWORK

- A. Where identified in PART 1, provide network electronics as required for links between Control Panels and Central Equipment. Otherwise, confirm network requirements to the agency.
- B. IDENTIFICATION AND LABELING
 - 1. Label all installed electronic access control cabling and equipment.
 - 2. Prior to installation, they provide samples of all label types planned for the project. These samples shall include examples of the lettering to be used.
 - 3. Label cables with the architectural door number for the opening served, the room number the opening is located in, the type of door device they serve ("reader", "REX", "lock", etc.), a unique numerical identification number for the control panel it originates in, and the room number the control panel is located in, on both ends of the cable. Example: "DOOR 1234A / RM 1234 / READER / CP 1 / RM B123".
 - 4. All system wiring shall be color coded as required by Agency. Maintain color coding and labeling throughout the system at all accessible locations to the cabling.

3.9 ACCEPTANCE TESTING

- A. Conduct acceptance testing according to a schedule coordinated with the Agency and DFD.
- B. Prior to testing, provide a summary of the proposed test plan. Test plan shall include – at minimum – proposed schedule, list of tests to be performed, equipment to be used, set-up, expected results and documentation format.
- C. Testing shall not proceed without approval by the engineer.
- D. Schedule shall allow time for correction of defects and remedial work.
- E. Representatives of the Owner may be in attendance to witness the test procedures. Provide a minimum of one week advance notice to allow for such participation.
- F. Supply all equipment and personnel necessary to conduct the acceptance tests.
- G. Perform tests related to connected equipment of others only with the permission and presence of the contractor responsible for that equipment.
- H. Assist the User Agency in the final system checkout and commissioning of the Access Control System.
- I. Document all tests. Refer to the Article "DOCUMENTATION" below which details requirements.
- J. Cable Testing
- K. Visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. Provide the engineer with written certification that this inspection has been made.
- L. Test all cables to verify continuity in both door-open and door-closed conditions.
- M. Test all cables for open circuits, ground faults or line-to-line short circuits.

3.10 SYSTEM TESTING

- A. At minimum, verify the following are properly wired and labeled:
- B. Field Devices and Control Panels.
- C. Associated equipment such as Power Supplies.
- D. Prior to the commencement of the Acceptance Tests, verify the installation and configuration of software related to the operation and control of the Access Control System.

- E. Assist User Agency in testing overall functionality of the Access Control System. The tests shall include verification of the following:
 - 1. The functional operation of each controlled access door and circuit.
 - 2. Demonstrate normal and abnormal modes of operation and required responses to each.

3.11 DOCUMENTATION

Upon completion of the installation, provide project documentation to the engineer for review. Including

- A. documentation to door/controller port mapping, addresses, and other information as required to support agency updated to system database.
- B. Documentation provide additional systems as detailed in the sub-sections below. Provide approved test results and documentation in Operating and Maintenance Manuals.
- C. At the request of any of the parties listed above, provide copies of the original test results.
- D. Provide a chart listing test results for each controlled door.
- E. All documentation, including hard copy and electronic forms shall become the property of the State.
- F. Operation and Maintenance Manuals
- G. Submit quantities required by Division 1 and Section 26 05 00.
- H. Provide documents in electronic format (Adobe Acrobat .pdf) and (when requested) hard copy.
- I. At minimum, O&M Manuals shall include:
 - 1. Drawings annotated to show as-installed field device locations, cable routes, and major equipment locations.
 - 2. Cabling Schematics
 - 3. Approved Submittals
 - 4. Test plan and test report sheets

3.12 WARRANTY

- A. This contractor shall guarantee the following for a period of two (2) years from date of substantial completion of this work:
 - 1. All provided materials and equipment.
 - 2. Installation of all equipment, hardware, cabling, and related components.
- B. Warranties shall include labor, materials, and travel time.
 - 1. See Division 1, GENERAL CONDITIONS, and GENERAL REQUIREMENTS - Guarantee Documents and the individual technical sections for further requirements.
 - 2. If while fulfilling requirements of this warranty, the contractor disturbs other work, the contractor shall arrange for such disturbed work to be restored to its original condition by the responsible contractor. This shall be at no cost to the State.

END OF SECTION 28 10 00

SECTION 28 23 00 - VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

- A. Scope
- B. Related Work
- C. References
- D. Quality Assurance
- E. Submittals

PART 2 - PRODUCTS

- A. Cameras
- B. Cabling
- C. Display Monitor
- D. Video and Network Electronics
- E. Miscellaneous Items

PART 3 - EXECUTION

- A. General
- B. Continuity of Existing Services and Systems
- C. Cable Installation
- D. Camera Installation
- E. Miscellaneous Items
- F. Testing and Acceptance
- G. Training
- H. Operating and Maintenance Manuals
- I. Warranty and Support

PART 1 - GENERAL

1.1 SCOPE

This specification section describes the products and execution requirements relating to the furnishing, installation, testing, and commissioning of a complete VSS System (Video Surveillance System and placing it into satisfactory operation.

CLASS 1 NOTICE:

Notice is hereby given according to Section 16.855(10), Wisconsin Statutes, that the Division believes it is in the best interests of the State to contract the following work from only one source, without the usual statutory procedures:

Exacq Network Video Recorder

Axis IP Network Cameras

Major features of the Video Surveillance System and responsibilities to furnish and/or install are as follows:

1.1 CONTRACTOR-FURNISHED, CONTRACTOR INSTALLED.

- A. IP Network Cameras
- B. Camera Housings
- C. Camera Mounts

- D. Cable Pathways
- E. Camera Rough-in
- F. Cable support hardware
- G. NVR and all associated hardware and software
- H. Patch Cords at Camera locations if required.
- I. Cabling (Signal, Power, Control) and Termination Hardware
- J. Display Monitor Support Hardware and Cabling
- K. PoE Injectors (as applicable; may be integrated into network electronics)
- L. Media Converters (Fiber-to-Copper for 2 long run ip cameras see drawings).
- M. Surge Suppressors.

1. RELATED WORK (BY OTHERS)

- N. Main network cabling coordinate with Division contractor 27 10 00

- O. Agency-furnished, Agency-installed

1. Network Electronics (Routers, switches, etc.)

[The system is also to be integrated with security alarms and other devices.]

All equipment, cables and related termination, support and grounding hardware, bonding as required for a full and functioning system, shall be installed, wired, tested, labeled, and documented by the contractor, as detailed in this and related section(s).

Applicable provisions of Division 1 govern work under this Section.

Section 01 91 01 or 01 91 02 – Commissioning Process

Section 26 05 26 – Grounding and Bonding for Electrical Systems

Section 26 05 29 – Hangers and Supports for Electrical Systems

Section 26 05 33 – Raceway and Boxes for Electrical Systems

Section 26 05 36 – Cable Tray for Electrical Systems

Section 26 05 53 – Identification for Electrical Systems

Section 27 05 53 – Identification for Communications Systems

Section 27 10 00 – Structured Cabling

Section 27 11 00 – Communications Equipment Room Fittings

Section 27 11 13 – Communications Protection

Section 27 16 19 – Communications Patch Cords, Work Area Cords, and Cross Connect Wire

Section 28 08 00 – Commissioning of Electronic Safety and Security

Section 28 13 00 – Access Control

Section 29 50 10 – Electronic Monitoring and Control System

1.3 QUALITY ASSURANCE

A. Manufactured Items

1. The manufacturer(s) of cabling and devices components shall be a company specializing in and having a minimum of two years documented experience in producing products similar to those specified in this and related sections.

1.4 REFERENCES

All materials shall be listed by UL and shall bear the UL label. If UL has no published standards for a particular item, then other national independent testing standards shall apply, and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be labeled.

Other applicable standards are as follows:

- A. ANSI/IEEE C2 - National Electrical Safety Code
- B. SPS Chapter 316 – Wisconsin Dept. of Safety and Professional Services Electrical Code
- C. FCC Part 15 as applicable to the equipment type(s) included.

1.5 BIDDER QUALIFICATIONS

- A. The contractor shall have been in this line of business for a minimum of five (5) years and have successfully completed one or more projects of scope 50% or more of the magnitude specified by these documents.
- B. Contractor shall have necessary certifications to provide for Guarantees as specified herein.

1.6 SUBMITTALS

- A. Submit the following for approval prior to ordering any equipment according to requirements of Division 1, General Conditions:
 - B. Product data for all equipment, hardware cabling and miscellaneous components proposed,
 - C. Floor plan drawings showing equipment and device locations with proposed conduit wiring, pull box and junction box locations,
 - D. Camera mounting details specific to location
 - E. Schematic drawings - specific to project - of all circuits from the field devices to the required connection points.
 - F. The diagrams shall show schematic wiring of equipment and all connections to be made to devices. Terminal connections in the equipment shall be numbered to correspond to the diagrams for use in making connections.
 - G. Wiring diagrams shall be coordinated so that terminal numbering, circuit designation and equipment or device designations are the same on all drawings.
 - H. All drawings must be submitted and approved by the engineer before installation starts, but such approval will not waive any specification requirements unless specifically stated.
 - I. Mark the submittal package with specification section number.
 - J. Do not mix sections in a single submittal.
 - K. Mark general catalog sheets and drawings to indicate specific items submitted and proper identification of equipment by name and/or number, as indicated in the contract documents.
 - L. Markings shall be reproducible (arrow, underlines, circled, checkmark, etc.).
 - M. Where sheet or drawing includes options, mark proposed option(s).
 - N. When manufacturer's reference numbers are different from those specified, provide explanation,
 - O. and cross-reference number for each item.
 - P. Work shall not proceed without engineer approval of the submitted items.
 - Q. No substituted materials shall be installed except by written approval from the engineer.

1.7 MOCKUPS

- A. On request, provide mockups for cameras, mounts, protection, and related hardware as applicable to demonstrate configuration and aesthetics and to set quality standards for fabrication and installation.
- B. The Owner reserves the right to make changes to descriptive information, component selection and nomenclature during shop drawing review without incurring any additional cost.

PART 2 - PRODUCTS

2.1 CAMERAS

- A. Provide cameras, camera housings and camera mounts as follows:
- B. Cameras, camera housing, and camera mounts shall be furnished and installed by the contractor. For purposes of bidding, refer to the Camera Schedule which is part of the project drawings for the camera types to be assumed. The following makes/models should be assumed:
 - 1. AXIS P3727-PLE
 - 2. AXIS M4327-P
 - 3. AXIS P1468-LE
 - 4. AXIS M3086-V
 - 5. AXIS P4705-PLVE
- C. Prior to construction, the Agency shall update camera makes/models to current products available at that time. Confirm intended products prior to construction.

2.2 MOUNT

- A. As required for camera type and location. Refer to project drawings field verify.

2.3 POWER SUPPLY

- A. Except where otherwise noted, cameras powered via network connection (e.g., Power-over-Ethernet; PoE)

2.4 CABLING

- A. Horizontal Cabling
- B. Refer to specification Section 27 10 00 – Structured Cabling for cable and termination requirements for horizontal links designated for video surveillance camera locations.
- C. Power Cabling
- D. Per manufacturer's recommendations for camera type, power supply and cable length.
- E. Camera (Work Area) Cords and Patch Cords
- F. Refer to project drawings and specification Section 27 16 19 - Communications Patch Cords, Work Area Cords, and Cross Connect Wire.

E. Note: Media Converters (e.g., Fiber to Copper) will be required for long outdoor wire runs.

2.5 DISPLAY MONITOR

For purposes of bidding, assume [22-inch] Flat Panel. Exact make/model shall be identified by the Agency prior to construction.

2.6 VIDEO AND NETWORK ELECTRONICS

Recording, Control and Storage Equipment

- A. NETWORK VIDEO RECORDER
- B. IP04-30T IP R2A Recorder With 4 IP Cameras Licenses (64 Max). exacqVision Professional Server, Client, Web/mobile Software Pre-installed with 3 Years Software Upgrades and Hardware Warranty. Win10 On SSD. HDMI, DVI-D, DisplayPort, VGA (2 Max Simultaneous)
- C. Provide camera license for all cameras for no less than 3 years. Record due dates for any software or license updates.
- D. Prior to construction, the Agency shall update Network Video Recorder makes/models to current product available at that time. Confirm intended products prior to construction. Also provide camera storage calculations.

Prior to construction, the Agency shall update camera makes/models to current products available at that time. Confirm intended products prior to construction.

2.7 VIDEO INTERCOM SYSTEM

- A. Iphone JP Series Video Intercom and Access Control System
- B. To be used as separate system for first and second floors.

MISCELLANEOUS ITEMS

- A. Provide and install Axis T8061 Surge Protection on all outdoor cameras.
- B. Axis T6101 if required.
- B. See specification Section 27 11 13 – Communications Protection.

PART 3 - EXECUTION

3.1 GENERAL

- A. The complete installation shall be done in a neat, workmanlike manner according to Division 26 of these documents and manufacturer's recommendations.
- B. The installation shall conform to site requirements for security, privacy, and care. Temporary or permanent installations, which conflict with site operations, security, privacy and/or care guidelines, shall be immediately corrected by the contractor with no additional compensation.
- C. Security guidelines for working within the secure areas of the facility shall be followed by the contractor.

3.2 CONTINUITY OF EXISTING SERVICES AND SYSTEMS

- A. No outages shall be permitted on existing systems except at the time and during the interval specified by the Agency and site representatives. Obtain written approval for any outages.
- B. Schedule any outage scheduled when the interruption causes the least interference with normal site schedules and business routines. No extra costs will be paid to the contractor for such outages which must occur outside of regular weekly working hours.
- C. Restore any circuit interrupted as a result of this work to proper operation as soon as possible.

3.3 CABLE INSTALLATION

- A. Install cable according to the project drawings and Section 27 10 00 – Structured Cabling.

3.4 CAMERA INSTALLATION

- A. Attach camera mounts securely to structural members. Cameras located on lay-in ceiling shall not be supported by the ceiling tile. Provide support from structural building members utilizing threaded rod and strut metal framing, tile bridge, or other approved means.
- B. Install cameras, mounts, power supplies, control equipment, monitors, recording equipment, and related hardware as applicable per manufacturer recommendations.
- C. Configure Pre-sets and Programmable Tours function (PTZ only if applicable).
- D. Connect Alarms Input(s) / Alarm Output(s) and/or connections to other systems as specified.
- E. Where IP (Network) type cameras are installed, coordinate network addresses and camera settings with Agency.
- F. The contractor is responsible for configuring the camera.
- G. Positioning and Lens Adjustment - Preliminary
- H. Prior to rough-in at camera locations, the contractor shall demonstrate all camera locations for the purposes of making final camera position and lens adjustments.

- I. Contractor shall provide 14-day notice (minimum) to allow for participation by Agency staff and engineer.
- J. Demonstration of the camera view at each location shall be as follows:
- K. Place a representative camera at the given location and display the video on a temporary monitor or workstation.
- L. Provide a laptop computer or other suitable display as required to perform this work.
- M. Camera placement may be by temporary support or by holding the camera in place by hand.
- N. (The Technician should not be visible in the image.)
- O. Agency representative and/or the Construction Representative will direct the contractor.
- P. to the desired field of view at that location.
- Q. Document the approved field of view by saving the image electronically (preferred),
- R. Taking a still photo of the viewing monitor or other approved means.
- S. No agency staff shall be visible in the recorded images.
- T. Contractor personnel with face or other identifying features obscured may be visible. in an image if required for purposes of scale.
- U. At locations where Pan-Tilt-Zoom capabilities are called for, the movement of the camera shall be simulated and the views at the extent of this movement documented.
- V. For purposes of bidding, contractor shall assume the responsibility to provide temporary power supply, PoE injector or other means to power camera for this demonstration.
- W. The contractor shall include in his estimate minor adjustments in camera location/placement relative to plan to account for unanticipated obstructions to the field of field, mechanical interferences with new raceway and lighting fixture obstructions. There shall be no additional cost for this adjustment. Minor adjustments are considered those that do not change the housing type or mounting conditions and either a) decreases the distance from the camera to the wiring hub, or b) increased the distance from the camera to the wiring hub by no more than ten (10) feet when compared to the location shown on the drawings.

3.4 MISCELLANEOUS ITEMS

Protection

Where outdoor cameras are served by copper cabling, provide Surge Protection in the path from camera to network electronics.

3.5 TESTING AND ACCEPTANCE

- A. Conduct tests upon completion of all work or during course of construction when identifiable portion(s) of overall work are complete.
- B. Sequence of Acceptance Testing shall be as follows:
- C. Submit Acceptance Test Plan
- D. Plan Accepted
- E. Perform Pre-Test Inspection
- F. Agency and site representatives, and an engineer may be in attendance to witness testing. Provide a minimum of one (1) week advance notice to allow for such participation. Failure to provide notification shall be grounds for the Owner/Engineer to reject any or all documentation of results on related testing and to require a repeat of the affected test.
- G. Test plan shall be established as to not delay project schedule. Obtain approval of schedule with the above parties before commencing Acceptance Tests. Schedule shall allow time for correction of defects and remedial work.
- H. Supply all equipment and personnel necessary to conduct acceptance tests.

- I. Perform tests related to connected equipment of others only with permission and presence of contractor(s) responsible for that equipment.
- J. Should it be found by the engineer that the materials or any portion thereof furnished and installed under this contract fail to comply with the specifications and drawings, with the respect or regard to the quality, amount or value of materials, appliances or labor used in the work, it shall be rejected and replaced by the contractor and all work distributed by changes necessitated in consequence of said defects or imperfections shall be made good at the contractor's expense.

3.6 DOCUMENT ALL TESTS .

- A. At the request of the engineer, provide copies of the original test results.
- B. Use of equipment for actual testing that is different than that submitted shall be cause for rejection of all tests performed with that equipment.

3.7 ACCEPTANCE TEST PLAN

- A. Prior to Acceptance Testing, submit a summary of the proposed test plan to Construction Representative, Agency and site representatives, and engineer.
- B. Test plan shall include – at minimum – proposed schedule, list of tests to be performed, equipment to be used, set-up, expected results and documentation format.
- C. Testing shall not proceed without approval by the engineer.

3.8 PRE-TEST INSPECTION

Prior to commencement of the Acceptance Tests, inspect equipment, hardware, and cabling.

- A. At minimum, verify the following:
- B. Cameras of the specified type are installed at the specified locations.
- C. Cameras are secured as required to protect against operational damage.
- D. Signal, power, and control cabling (as applicable) are installed and terminated as specified.
- E. External cameras are provided with adequate protection against moisture and other
- F. environmental conditions.
- G. Cameras, operator workstation equipment and cabling are properly labeled.
- H. Associated equipment such as power supplies are connected correctly and secured appropriately.
- I. Agency-provided equipment is in place and operational. (Confirm with Agency).
- J. Operator workstation equipment is installed at the specified location. Interconnecting cables are.
- K. routed in a neat and workmanlike manner, protected from mechanical damage and
- L. permanently connected.
- M. Prior to the commencement of the Acceptance Tests, verify the installation and configuration of software related to the operation and control of the VSS. verify the following:
- N. Software specified in the design documentation and/or modules required to perform all
- O. specified operations, and all functions installed and configured.
- P. The latest release version of all software modules including patches and upgrades have been provided.
- Q. The control equipment hardware has sufficient capacity to support the software routines and functions under worst-case demand conditions.
- R. Cameras, system reports, screens and menus have been correctly configured.
- T. The software has been registered with the Agency.

- U. Obtain written approval of the documentation from Agency representatives before commencing the Acceptance Tests.
- V. Perform tests to assess overall functionality of the VSS as per the project documents.
- W. Equipment and Sub-system specific testing requirements are as follows:

3.8.1 CAMERAS

- A. Verify the following for each Camera:
- B. The camera produces a clear picture and is aimed per site requirements.
- C. The camera maintains a clear picture and automatically compensates for changing light conditions, including day/night change.
- D. Camera has wide dynamic range installed where specified and operate to prevent camera blinding.
- E. Camera provides complete and correct coverage of the area specified.
- F. Pan, Tilt and Zoom (PTZ) functions (as applicable) is fully controllable and functions correctly.
- G. PTZ Cameras (if applicable) can perform calls to preset positions by simulating an event alarm.
- H. Cameras are fitted with anti-tamper devices where specified.
- I. Simulated tamper alarm is transmitted to the operator workstation.
- J. Functioning of Alarms Input(s)/Output(s) and/or connections to other systems as specified.

3.8.2 OPERATOR WORKSTATION/CONTROL

- A. Verify the following:
- B. Display orientation/position, camera/view identification.
- C. Display and/or notification of alarm condition (if applicable).
- D. Manual control of cameras (if applicable).
- E. [Real time video data analysis functions (such as movement detection) are performed in real time and the corresponding view displayed on the monitor.
- F. [VSS interfaces with the electronic monitoring and access control system and/or the intercom system to display the correct camera view on the monitor when the corresponding signal is received.]

3.8.3 RECORDING AND PLAYBACK FUNCTIONS

- A. Verify the following:
- B. Data storage capacity has been installed on the workstation as specified.
- C. The system hardware supplied is per specification.
- D. Correct video data is recorded by the system in response to simulated alarms.
- E. Manual Record function operates correctly.
- F. Playback functions operate correctly including Play, Stop, Pause, Rewind, Fast forward, Frame by
- G. frame view.
- H. Retrieval of stored video.
- I. Export of stored video.
- J. Retain copies of test results for inclusion in documentation at project completion.

3.9 TRAINING

- A. Provide training to Agency and site staff, and/or contract maintenance personnel on an overview of the system and on operation and maintenance of equipment installed by the contractor.
- B. Coordinate with Construction Representative, Agency and site staff, and engineer to schedule session(s). Provide adequate notification to allow Agency to schedule staff.
- C. Training to include:
 - 1. Overview of System Topology and General Concepts
 - 2. Overview of Product Used
 - 3. Overview of Monitoring/Control Layout
 - 4. Overview of Labeling Formats
 - 5. Camera control functionality (if applicable)
 - 6. Overview of Test Results and their meaning
 - 7. Training shall be held at Project Site and shall be conducted during normal working hours.
 - 8. For purposes of bidding, assume 2 Training Session(s).
 - 9. Coordinate training with Agency to accommodate staff schedules.
 - 10. Training session duration shall be not less than two (2) hours.
 - 11. Number of Students per session shall be 6 or less.
 - 12. Provide training materials for each student plus (2) additional copies.
 - 13. The owner reserves the right to videotape session(s) for use as future refresher materials for Agency technical staff.

3.10 OPERATING AND MAINTENANCE MANUALS

- A. Submit quantities required by Division 1 and Section 26 05 00.
- B. Provide documents in hard copy and in electronic form.
- C. Submit product and test data as Adobe Acrobat (.pdf) files.
- D. Submit drawings and schematics as Adobe Acrobat (.pdf) files and AutoCAD (.dwg) files.
- E. Submit images of individual camera views as JPEG (.jpg; preferred) or Adobe Acrobat (.pdf) files.
- F. As a minimum, O&M Manuals shall include:
- G. Drawings annotated to show as-installed camera locations, cable routes and major equipment locations.
- H. Cabling Schematics
- I. Approved Submittals
- J. Test plan and test report sheets
- K. Programming documents (pre-sets, tours, etc.)
- L. Hardware and software technical manuals
- M. Troubleshooting Guidelines
- N. All documentation, including hard copy and electronic forms shall become the property of the State.

3.11 WARRANTY AND SUPPORT

- A. This contractor shall guarantee the following for a period of two (2) years from date of substantial completion of this work:
 - 1. All provided materials and equipment.
 - 2. Installation of all equipment, hardware, cabling, and related components.
- B. Warranties shall include labor, materials, and travel time.
 - 1. See Division 1, GENERAL CONDITIONS, and GENERAL REQUIREMENTS - Guarantee Documents and the individual technical sections for further requirements.
 - 2. If while fulfilling requirements of this warranty, the contractor disturbs other work, the contractor shall arrange for such disturbed work to be restored to its original condition by the responsible contractor. This shall be at no cost to the State.

END OF SECTION 28 23 00

END OF DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

DIVISION 48 – ELECTRONIC POWER GENERATION

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Section 48 14 00 – Photovoltaic Solar Power Generation and Racking

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: This Section specifies solar electric modules.

1.2 FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3 REFERENCES

- A. Definitions:
 - 1. NOCT: Normal operation cell temperature.
 - 2. STC: Values of standard test conditions.

1.4 REFERENCE STANDARDS:

- A. American National Standards Institute (ANSI):
 - 1. ANSI/UL 1703 Standard for Flat-Plate Photovoltaic Modules and Panels.
- B. International Electrical Commission (IEC):
 - 1. IEC 61215 International Standard (Extended Version) - Crystalline silicon terrestrial photovoltaic (PV) mod-ules - Design qualification and type approval.
 - 2. IEC 61730-1 International Standard - Photovoltaic (PV) module safety qualification - Part 1 - Requirements for construction
 - 3. IEC 61730-2 International Standard - Photovoltaic (PV) module safety qualification - Part 2 - Requirements for testing.
- C. International Organization for Standardization (ISO):
 - 1. ISO 9001 Quality Management Systems.
 - 2. ISO 14001 Environmental Management Systems.
- D. Underwriters Laboratories, Inc. (UL):
 - 1. UL 790 Standard Test Methods for Fire Tests of Roof Coverings.
 - 2. UL 1703 Standard for Flat-Plate Photovoltaic Modules and Panels.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate work of this Section with work of other trades for proper time and sequence to avoid construction delays.
- B. Preinstallation Meetings: Conduct preinstallation meeting one week prior to commencing work.
- C. Sequencing: Sequence work of this section according to this section.
- D. Scheduling: Schedule work of this Section according to this section

1.6 ACTION SUBMITTALS

- A. General: Submit listed submittals according to Contract Conditions
- B. Product Data: Submit specified products as follows:
 - 1. Manufacturer's product data, including manufacturer's SPEC-DATA product sheet.
 - 2. Manufacturer's installation instructions.
 - 3. Catalog pages illustrating products to be incorporated into project.
 - 4. Shop Drawings: Indicate information on shop drawings as follows:
 - a. Layout and orientation of modules.
 - b. Roof surfaces and slopes.
 - c. Location of inverter, combiner box and disconnects.
 - d. Penetration plan.
 - e. Mounting details.
 - f. Electrical connection details.
 - g. String, wiring, and grounding plan details.

1.7 INFORMATION SUBMITTALS

- A. General: Submit listed submittals according to Contract Conditions
- B. Test and Evaluation Reports:
 - 1. Certified test reports showing compliance with specified performance characteristics and physical properties.
- C. Manufacturer's Instructions: Submit manufacturer's storage and installation instructions.
- D. Source Quality Control: Submit documentation verifying that components and materials specified in this section are from a single manufacturer.
- E. Manufacturer(s) Reports: Manufacturer's field reports specified.
 - 1. Qualification Statements:
 - a. Submit letter of verification for Manufacturer's Qualifications.
 - b. Submit letter of verification for Installer's Qualifications.

1.8 CLOSEOUT SUBMITTALS

- A. General: Submit listed submittals according to Contract Conditions
- B. Operation and Maintenance Data:
 - 1. Submit operation and maintenance data for installed products Include:
 - 2. Manufacturer's instructions detailing maintenance requirements.
- C. Warranty Documentation: Submit warranty documents specified.

1.9 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:
 - a. Having 15 years' experience manufacturing components similar to or exceeding requirements of project.
 - b. Having sufficient capacity to produce and deliver required materials without causing delay in work.
 - c. Capable of providing field service representation during construction.
 - d. Manufacturing facility certified to ISO 9001 and to ISO 14001.

1.10 DELIVERY, STORAGE & HANDLING

A. Delivery and Acceptance Requirements:

1. Deliver material according to manufacturer's written instructions.
2. Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.

B. Storage and Handling Requirements:

1. Store materials protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

C. Packaging Waste Management:

1. Separate waste materials for reuse and recycling.
2. Remove packaging materials from site and dispose of at appropriate recycling facilities.
3. Collect and separate for disposal paper, plastic, polystyrene, and corrugated cardboard packaging material for recycling.
4. Fold metal and plastic banding. Flatten and place in designated area for recycling.
5. Remove:
 - a. Pallets from site and return to supplier or manufacturer.

1.11 WARRANTY

A. Warranty: Refer to Contract Conditions for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and does not limit, other rights Owner may have under other Contract Documents.

C. Warranty Term:

1. Freedom from Defects in Materials and Workmanship: 5 years, commencing on date of substantial completion.
2. Modules must be warranted with a linear degradation of no more than 3% the first year and 0.7% all subsequent years for 25 year.
3. 85 Percent of Minimum Power Output: 25 years, commencing on date of substantial completion.
 - a. New Roof Warranty: The new standing seam metal roof warranty shall not be voided. Penetration through the new roof will not be permitted.

PART 2 - PRODUCT

2.1 PV MODULES

- A. Modules may be procured from the following vendors without approval from Independent Engineer. All other modules must be approved by the Independent Engineer prior to final selection.
 - 1. Silfab Solar (basis of design SIL-500 HM)
 - 2. Mission Solal
 - 3. Jinko Solar
 - 4. Hanwah Qcells
- B. Glass laminates or glazing with low reflectivity.
- C. Size: Approximately 83" x 45"
- D. Weight: Approximately 58 lbs
- E. Number of cells per module: Approximately 48
- F. Cell Type: Mono PERC
- G. Front: Anit-reflection coating, high transmission, tempered glass
- H. Frame: Anodized Aluminum
- I. J-Box: IP68 rated
- J. Connector: PV Wire with Amphenol UTX Connectors
- K. Maximum system voltage: 1500 VDC(UL)/1500 VCD(IEC)
- L. Operating Temperature: -40 to +85 degress C
- M. Manufactured to ISO9001:2000 and ISO 9001 quality and ISO14001:2004 environmental standards, NEC code requirements, and UL listing specifications.
- N. Modules must meet UL 1703, IEC 61730, IEC 61215 (crystalline technologies) or IEC 61646 (thin film technologies)
- O. Modules to be delivered in power tolerance of no worse than -0W and +3W as measured at the factory.

2.2 MODULE SUPPORT STRUCTURE – STANDING SEAM METAL ROOF, SLOPED

- A. Panel supports may be procured from the following vendors without approval from Independent Engineer. All other vendors must be approved by the Independent Engineer prior to final selection.
 - 1. UniRac
 - 2. Iron Ridge
 - 3. SnapNrack
- B. The module support structures shall be designed and constructed to provide a stable support system for the PV modules that will remain effective throughout the design life of the Project. Module support structures shall meet all applicable codes and standards.
- C. The maximum support structure deflections shall prevent PV module and electrical system damage and shall not exceed allowable limits provided by the manufacturer and the IBC 2009 and ASCE 7-05 codes.

- D. Sloped, Standing Seam, Roof Project Design
 - 1. Layout: as show on plan set
 - 2. Racking to include all hardware including module mounting, engineered for 115 mph wind speed
 - a. S-5-U Clamp approved by metal roof manufacturer
 - b. Rails and Brackets

2.3 INVERTER

- A. Manufacturer: Solar Edge
- B. Model: SE10KUS; three phase inverter; (-40C TO 60C) 120/208V - with AC RSD; DC safe-ty switch and AFCI; primary unit; 12 year warranty
- C. Power Optimizer: S500B 1:1; S series; 500W/80V PVRSS compliant (MC4 input connectors) - 208V/480V 25 year warranty included

2.4 OTHER INSULATION ITEMS

- A. 10 AWG Photovoltaic Wire (Black)
- B. 10 AWG Photovoltaic Wire (Red)
- C. MC4 10GA Female Connectors
- D. MC4 10GA Male Connectors

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that conditions of substrates previously installed under other sections or contracts are acceptable for product installation according to manufacturer's instructions prior to solar electric module installation.
 - 1. Inform Owner and Architect of unacceptable conditions immediately upon discovery.
 - 2. Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval from Owner and Architect.

3.2 PREPARATION

- A. Ensure structure or substrate is adequate to support solar electric module(s).
- B. Surface Preparation: Prepare surface according to manufacturer's written recommendations.
- C. Demolition/Removal: Contractor shall remove all existing ballast in proposed work area and shall have EPDM roof inspected prior to installation of slip sheet.
- D. Coordinate all work with Northwest Roofing Co. for new penetration through the existing roof.

3.3 INSTALLATION

- A. Coordinate installation of components according to manufacturer's installation instructions.
- B. Coordinate solar electric module work with work of other trades for proper time and sequence to avoid construction delays.
- C. Accurately fit, align, securely fasten and install free from distortion or defects.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer Services:
- B. Have manufacturer review work involved in handling, installation/application, protection and cleaning of products, and submit written reports in acceptable format to verify compliance of work with Contract.
- C. Manufacturer's Field Services: Provide manufacturer's field services, consisting of product use recommendations and periodic site visits, for product installation inspection according to manufacturer's instructions.
- D. Schedule site visits to review work at stages listed:
 - 1. After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
 - 2. Twice during progress of work at 25% and 60% complete.
 - 3. Upon completion of work, after cleaning is carried out.
- E. Obtain reports within three days of review and submit immediately to Owner and Architect.

3.5 SYSTEM STARTUP

- A. List actions applicable to operational systems and equipment startup.
- B. Commission the system to ensure that it complies with applicable code requirements and manufacturer's requirements.

3.6 ADJUSTING

- A. Adjust components and systems for correct function and operation according to manufacturer's written instructions.

3.7 CLEANING

- A. Upon completion, remove surplus materials, rubbish, tools and equipment.
- B. Waste Management:
 - 1. Coordinate recycling of waste materials
 - 2. Collect recyclable waste and dispose of or recycle field generated construction waste created during demolition, construction or final cleaning.
 - 3. Remove recycling containers and bins from site.

3.8 CLOSEOUT ACTIVITIES

- A. Demonstration:
 - 1. Coordinate requirements for solar electric module demonstration to owner.
 - 2. Training: Coordinate training in accordance manufacturer specifications
- B. Instruct Owner's designated maintenance personnel in care, adjustment and operation of solar electric module system.
- C. Provide competent instructor for not less than 1 two-hour training session after completion and acceptance of work.
- D. Forward statement to Owner and Architect countersigned by maintenance personnel confirming that these instructions have been provided.

3.9 PROTECTION

- A. Protect installed product from damage during construction.
- B. Repair damage to adjacent materials caused by solar electric module installation.

3.10 MAINTENANCE

- A. Coordinate maintenance requirements with Owner.

END OF SECTION 48 14 00

END OF DIVISION 48 - ELECTRICAL POWER GENERATION

DIVISION 26 – ELECTRICAL

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26 32 13	Engine Generators
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SECTION 26 32 13 - ENGINE GENERATORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

- A. This Section includes packaged engine-generator sets for Standby power supply with the following features:
 - 1. Diesel Engine
 - 2. Unit Mounted Cooling System
 - 3. DGC 2020 - Level 2 Fully Enhanced
 - 4. Level 2 - Basic Sound Attenuation (Steel) (Equal to or less than 75.0dBa @ 23')
 - 5. Performance Requirements for Sensitive Loads.
- B. Related Sections include the following:
 - 1. Division 1 for specifications covering demonstrations and training of the equipment.
 - 2. Section 26 05 53 "Identification for Electrical Systems" for specifications covering electrical systems.
 - 3. Section 26 05 26 "Grounding and Bonding for Electrical Systems" for specifications covering grounding of components.
 - 4. Section 26 36 00 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.
 - 5. Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for specifications covering wiring.

1.3 DEFINITIONS

- A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over a range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- B. Standby Rating: Power output rating equal to the power the generator set delivers continuously under normally varying load factors for the duration of the power outage.

1.4 SUBMITTALS

- A. Product Data: Include the following:
 - 1. Thermal Damage curve for generator.
 - 2. Time-current characteristic of curves for generator protective device.

- B. Shop Drawings: Detailed equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Dimensioned outline plan and elevation drawing of engine-generator set and other components specified.
 - 2. Design Calculations: Signed and sealed by a qualified engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 3. Vibration Isolation Base Details: Signed and sealed by a qualified engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
 - 4. Wiring Diagrams: Power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For packaged engine-generator sets to include emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Submittals" include the following:
 - 1. List of tools and replacement items recommended to be stored at the Project for ready access. Including part and drawing numbers, current prices, and source of supply.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: One for every ten of each type and rating, but no less than one of each.
 - 2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
 - 3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
 - 4. Belts: One set of each alternator and fan belt.
 - 5. Load Bank for code required testing.

1.7 FEDERAL BIDDING REQUIREMENTS

- A. Buy America: Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
 - 1. Maintenance Proximity: Not more than 2 hours normal travel time from Installer's place of business to Project site.
 - 2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on the testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association (NETA) or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Source Limitations: Obtain packaged engine-generator sets and auxiliary components through one source from a single manufacturer.
- D. Product Options: Drawings indicate size, profiles, and dimensional requirements of packaged generator sets and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Comply with ASME B15.1.
- G. Comply with NFPA 37.
- H. Comply with NFPA 30.
- I. Comply with NFPA 70.
- J. Comply with NFPA 99.
- K. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- L. Comply with UL 2200.
- M. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Construction Manager's and Owner's written permission.
- B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 1. Minimum Temperature: 0 °F / -17.78 °C
 2. Maximum Temperature: 100 °F / 37.78 °C
 3. Relative Humidity: 0 - 95 percent
 4. Altitude: 1000 feet / 304.8 meters

1.10 COORDINATION

- A. Coordinate size and location of concrete bases for package engine-generator sets. Cast anchor-bolt inters into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine-generator sets and associated auxiliary components that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: 2 Yr - 3000 Hr Basic Stdby Limited warranty from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Caterpillar Inc.
- B. Cummins Engine Company, I.
- C. Generac.
- D. Kohler.
- E. MTU.
- F. Substitutions: See Division 1 - Product Requirements.

2.2 ENGINE GENERATOR SET

- A. 500 kW / 208 Volt 3 Phase 60Hz packaged engine generator set shall be a coordinated assembly of compatible components.
- B. Factory-assembled and -tested, engine-generator set.
- C. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
- D. Capacities and Characteristics:
 - 1. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidence by records of prototype testing.
 - 2. Output Connections: 208 Volt 3 Phase 60Hz.
 - 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- E. Generator-Set Performance with PMG excitation:
 - 1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
 - a. Nameplate Data for Oversized Generator: Show rating required by the Contract Documents rather than ratings that would normally be applied to the generator size installed.
 - 2. Steady-State Voltage Operational Bandwidth: .25 percent of rated output voltage from no load to full load.
 - 3. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three to four seconds.
 - 4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
 - 5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variation outside the steady-state operational band and no hunting or surging of speed.
 - 6. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
 - 7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply minimum of 300 percent of rated full-load current for not less than 10 seconds without damage to winding insulation or other generator system components.
 - 8. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
 - a. Provide permanent magnet excitation for power source to voltage regulator.
 - 9. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

- A. Basic Engine: Cast-iron, Oil pan, Wet exhaust manifold and vibration damper.
- B. Rated Engine Speed: 1800 rpm.
- C. Starter: One electric starter 24v DC.
- D. Fuel System: Controlled by a microprocessor based engine control module (ECM) and a high speed electronic fuel pressure regulator (EPR). The ECM and EPR work with a three way catalyst and pre and post catalyst O2 sensors for feedback control. The system operates on the basis of a stoichiometric air fuel ratio.
- E. Alternator: Engine mounted belt drive.
- F. Lube Oil System: Forced feed lubrication, Lube oil filter, Lube oil heat exchanger, Filler neck and dip stick.
- G. Combustion Air System: Dry type air filter.
- H. Cooling System: Coolant circulation pump and Pusher fan.
- I. Governor: Electronic Control through ECU, with speed sensing.
- J. Engine Fuel System:
 - 1. Electronic Pressure Regulator: Regulates the fuel mixture based on Intake Air Temperature, Load, Etc.
 - 2. ECU: Coupled into the generator set control panel interface to allow direct control from the panel.
 - 3. System Control: Closed Loop fuel system using readings from O2 sensor(s) to maintain proper fuel mixture through control of the Electronic Pressure Regulator.
- K. Coolant Jacket Heater: An electric water heater with integral thermostatic control, properly sized to maintain engine jacket water at 90 degrees and suitable for operation in an ambient temperature of -20°F. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- L. Cooling system: Closed loop, liquid cooled, with radiator factory mounted on engine-generator set mounting frame and integral engine-driven coolant pump.
 - 1. Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 - 2. Size of radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent of load condition.
 - 3. Expansion Tank: Constructed withstand maximum closed-loop coolant system pressure for engine used.
 - 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 - 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber.
 - a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and non-collapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- M. Critical Grade Silencer: The silencer shall attenuate exhaust noise to a Critical level.
 - 1. An Exhaust silencer shall be furnished of industrial standard construction, all welded, for stationary engine application. Long radius, low restriction fittings will be used throughout, and pipe size will be sufficiently large to handle the engine exhaust flow at full load without causing back pressure in excess of that allowed by the engine manufacturer.

- N. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and “blocked filter” indicator.
- O. Starting System: 12 or 24 volt electric, with negative ground.
 - 1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 “Project Conditions” Article.
 - 2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
 - 3. Cranking Cycle: As required by NFPA 110 for system level specified.
 - 4. Battery: Adequate capacity within ambient temperature range specified in Part 1 “Project Conditions” Article to provide specified cranking cycle at least three times without recharging.
 - 5. Battery Cable: Sized as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
 - 6. Battery Compartment: Battery rack floor mounted constructed of steel, gloss black finish. Include accessories required to support and fasten batteries in place.
 - 7. Battery Charger: 12 or 24VDC, current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
 - a. Operation: Minimum equalizing-charging rate of 10 amps shall be initiated automatically after battery has lost charge until and adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - b. Automatic Temperature Compensation: Must be equipped with temperature compensation to assure correct charging in all conditions.
 - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus .5 percent.
 - d. Ammeter and Voltmeter: Digital display shall indicate charging rates.
 - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of AC input or DC output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
 - f. Enclosure and Mounting: NEMA-1.
- P. Ignition: Coil on plug electronic ignition.

2.4 FUEL STORAGE

- A. Skid mounted base tank to operate generator at full load for a minimum of 24 hours.

2.5 CONTROLS AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, the generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

- B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts the generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
- C. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Rigidly mounted to the generator set.
- D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following accessories:
- E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- F. Connection to Data Link: A separate terminal block, factor wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Section 260913 "electrical Power Monitoring and Control."
- G. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
 - 1. Overcrank Shutdown.
 - 2. Coolant Low-temperature Alarm.
 - 3. Control Switch Not in Auto Position.
 - 4. Battery-charger Malfunction Alarm.
 - 5. Battery Low-voltage Alarm.
- H. Common Remote Audible Alarm: Signal the occurrence of any even listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.
 - 1. Engine High-temperature Shutdown.
 - 2. Lube-oil, Low-pressure Shutdown.
 - 3. Overspeed Shutdown.
 - 4. Remote Emergency-stop Shutdown.
 - 5. Engine High-temperature Pre-alarm.
 - 6. Lube-oil, Low-pressure Pre-alarm.
 - 7. Fuel Tank, Low-fuel Level.
 - 8. Low Coolant Level.
- I. Remote Alarm Annunciator: Designed for compliance with NFPA 110. LEDs labeled with proper alarm conditions identify each alarm as well as an audible signal for each alarm condition. Silencing switch in face of panel silences signal without altering visual indication. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

LED indications are provided for the following:

- 1. Alarms:
 - a. Low Coolant Level
 - b. High Coolant Temperature
 - c. Low Oil Pressure
 - d. Overcrank

- e. Overspeed
 - f. Emergency Stop Activated
 - g. Fuel Leak
 - h. Sender Failure
- 2. Pre-alarms:
 - a. High Coolant Temperature
 - b. Low Coolant Temperature
 - c. Low Oil Pressure
 - d. Low Fuel Level
 - e. Battery Overvoltage
 - f. Weak Battery
 - g. Battery charger Failure
- 3. Operational status:
 - a. Switch Not in Auto
 - b. Display Panel On
 - c. EPS Supplying Load
- J. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button is protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Thermal-magnetic type; 80 percent rated; complying with NEMA AB 1 and UL 489.
 - 1. Tripping Characteristic: Designed specifically for generator protection.
 - 2. Trip Rating: Matched to generator rating.
 - 3. Mounting: On generator set in an enclosure.
 - 4. Bell Alarm: None
 - 5. Shunt Trip: Provides remote control capability to open circuit breaker.
- B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shut-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:
 - 1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 - 2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
 - 3. As overcurrent heating effects on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
 - 4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.
- C. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to the engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H or Class F.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Drip proof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: PM300 voltage regulator is an encapsulated electronic voltage regulator that controls the output of a brushless AC generator by regulating the current into the exciter field.
- I. Strip Heater: A small heater element mounted permanently in the generators winding or outlet box to provide a warm, moisture free environment.
- J. Bearing RTD: None
- K. Stator RTD: None

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Enclosure is designed to be wind resistant up to 100 mph. ASCE 7-05 Exposure C, 3-second wind gusts.
- B. Description: Steel enclosure with the following features:
 - 1. Construction: Formed and/or welded steel.
 - 2. Hinged doors for access with lockable latches.
 - 3. Motorized Louveres and/or baffled air inlet. Grated air outlet.
 - 4. Interior lined with acoustical foam for sound attenuation.
 - 5. Choice of standard colors. Custom colors available upon request.
 - 6. Integral heater.
 - 7. Integral lighting.

2.9 VIBRATION ISOLATION DEVICES

- A. Neoprene Pad
 - 1. $\frac{1}{4}$ inch thick elastomeric pad in square shape to be placed under the base frame at each of the pre-drilled isolator mounting holes.
 - 2. Helps to prevent sliding of the unit as well as reducing the transmission of sound and vibration into the floor.

2.10 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.11 SOURCE QUALITY CONTROL

- A. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 - 2. Full Load Run.

3. Maximum Power.
4. Voltage Regulation.
5. Transient and Steady-State Governing.
6. Single-Step Load Pickup.
7. Safety Shutdown.
8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
9. Report factory test results within 10 days of completion of test.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator set performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

- A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.
- C. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

- A. Identify system components according to Division 23 Section "Identification for HVAC Piping and Equipment" and Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

- C. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection except those indicated to be optional for "AC Generators and for Emergency Systems" specified by NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
 - 3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
 - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
 - c. Verify acceptance of charge for each element of the battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 - 4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
- E. Coordinate tests for transfer switches and run them concurrently.
- F. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- G. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- H. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- J. Remove and replace malfunctioning units and retest as specified above.
- K. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 26 32 13

63. SWEF\Post Building, Lightning and Grounding Protection, Item SPV.0060.105.

A Description

This special provision describes furnishing and installing a ground grid system to provide a ground path for lightning protection and an equal potential ground plane for the entire site. The Communication Tower will have a separate system and is included under a separate bid item. Install all work according to standard spec 651 through 660, as approved by the engineer, and as hereinafter provided.

B Materials

Ground rods shall be 10 foot long by 5/8 inch in diameter copper clad steel. Ground conductors shall be bare soft drawn stranded copper number 1/0 or larger. All connections between ground rods and ground conductors shall be exothermic welded.

C Construction

Install ground rods with ground whips to equipment noted as required by code. In addition, provide a minimum of three ground rods at each high mast lighting unit spaced a minimum of 20 feet apart and bonded together by a 1/0 ground wire. Provide a ground conductor from the base of this ground grid to the ground rod at the top of the high mast tower structure.

All conductors and ground grids shall be installed with a minimum of 12 inches of cover in areas with vegetative growth to allow the soil to maintain high moisture content.

Test ground grids by the contractor using the fall of potential method. Results shall be recorded and submitted to the engineer for review. Any readings below 10 ohms shall be given to the engineer immediately for further action.

D Measurement

The department will measure SWEF\Post Building, Lightning and Grounding Protection bid item as each individual installation, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.105	SWEF\Post Building, Lightning and Grounding Protection	EACH

Payment is full compensation for furnishing and installing system, for testing system, and incidentals necessary to complete the work.

64. SWEF\Post Building, Fire Suppression, Item SPV.0060.106.

DIVISION 21 – FIRE SUPPRESSION

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21 30 00	FIRE PUMPS
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SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 – GENERAL

1.1. SCOPE

- A. This section includes information common to two or more technical fire protection specification sections or items that are of a general nature, not conveniently fitting into other technical sections.

1.2. FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3. RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions, and the applicable provisions of Division 1, govern work under this section.
- B. This section applies to all Division 21 sections of the fire protection specifications.

1.4. GENERAL STANDARDS

- A. Abbreviations of standards organizations referenced in this and other sections are as follows:

AGA	American Gas Association
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
AWS	American Welding Society
CGA	Compressed Gas Association
EPA	Environmental Protection Agency
FM	Factory Mutual
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrument Society of America
MCA	Mechanical Contractors Association
MICA	Midwest Insulation Contractors Association
MSS	Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
NBS	National Bureau of Standards
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
UL	Underwriters Laboratories, Inc.

1.5. CODES AND PERMITS

- A. The work shall conform to all requirements of the Wisconsin Administrative Code (along with all local codes and standards), International Building Codes, City of Wrightstown Ordinance Standards, NFPA Standards, Insurance Underwriter, and Local Fire Chief or Fire Marshal (AHJ, Authority Having Jurisdiction) regarding design, materials and installation.

B. Obtain and pay for all permits or licenses required under this contract, including all state and local installation inspections and plan review. Deliver originals of these certificates to the Owner / Architect. Include copies of certificates, permits and payments of the same to the Owner, and provide a separate set of copies in the Operating and Maintenance Manual.

C. All fire protection work shall conform to all applicable local, state, and federal codes, along with NFPA standards, local requirements of the Fire Chief, and all applicable provisions and requirements of the insurance underwriter. Applicable codes and standards include, but are not limited to, the following:

ASSE 1015 Double Check Valve Backflow Preventers

NFPA 13 Standard for the Installation of Sprinkler Systems

NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection

NFPA 24 Installation of Private Fire Service Mains and Their Appurtenances

NFPA 25 Inspection, Testing & Maintenance of Water-Based Fire Protection Systems

NFPA 72 National Fire Alarm Code

NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems

Underwriters Laboratories Fire Protection Equipment Directory

Current Factory Mutual Approval Guide

Local and State Building, Mechanical and Fire Codes

1.6. QUALITY ASSURANCE

- A. Refer to the Instructions to Bidders, General Conditions, and the applicable sections of Division 1 for requirements in selecting products and requesting substitutions.
- B. All products and materials used are to be new, undamaged, clean and in good condition.
- C. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed.

1.7. ACCESSIBILITY

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

1.8. SEALING AND FIRESTOPPING

- A. Sealing and firestopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

1.9. OFF SITE STORAGE

- A. Prior approval by the Owner will be needed. The contractor shall submit Storage Agreement to the Owner for consideration of off-site materials storage. Generally, sleeves, pipe/pipe fittings and similar rough-in material will not be accepted for off-site storage. No material will be accepted for off-site storage unless shop drawings for the material have been approved.

1.10. PROTECTION OF FINISHED SURFACES

- A. Refer to Division 1, General Requirements, "Protection of Finished Surfaces".

1.11. SLEEVES AND OPENINGS

- A. Refer to Division 1, General Requirements, "Sleeves and Openings".

1.12. SUBMITTALS

- A. Refer to Division 1, General Conditions, "Submittals" and see Section 21 10 00 for clean agent submittal requirements.
- B. Refer to the General and Supplementary Conditions and the applicable sections of Division 1 for submittal definitions, requirements, and procedures. Submittals of shop drawings and product data will be accepted only when submitted by the contractor. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.
- C. Prepare additional floor plans, elevations, sections, and details necessary to conclusively coordinate and integrate all fire protection installations. Include locations where space is limited, and where sequencing and coordination of installations are of importance to other trades.
- D. Contractor shall provide Fire Protection System Data Sheets for all components of the fire protection system, including, but not limited to the following: identification, pipe, fittings, hangers and supports, sprinkler heads, valves, specialty valves, pipe specialties, fire protection specialties, control equipment, and fire protection equipment.
- E. Submittals are to be bound, labeled, contain the project manual cover page and a material index list page showing item designation, manufacturer and additional items supplied with the installation. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Include wiring diagrams of electrically powered equipment.
- F. Submit shop drawings indicating water supply location and size, piping layout and size, sprinkler locations and type, hanger locations and type, equipment locations and type, valve locations and type, occupancy classes, hydraulic reference points, design areas and discharge densities.
- G. Submit hydraulic calculations for water supply and sprinkler systems. Include summary sheet and detailed work sheets. Describe characteristics of water supply and location of effective point used in calculations. Include graph illustration of water supply, hose demand, sprinkler demand and in-rack sprinkler demand. Where a fire pump is used, graph primary rating point, secondary rating point and churn pressure of pump and combined water supply.
- H. Submittals shall be sent to the Local Fire Chief / Fire Marshal or the Department of Safety and Professional Services for review after review by the Architect/Engineer. A final copy of the AHJ approved submittal shall be provided to the Architect/Engineer for record.

1.13. OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Refer to Division 1, General Requirements, "Operating and Maintenance Instructions".
- B. Assemble material in three-ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment. In addition to the data indicated in the applicable sections of Division 1, include the following information.
 - 1. Copies of all approved shop drawings and product data.
 - 2. Record hydraulic and clean agent calculations.
 - 3. DSPS approved shop drawings and conditional approval letter.
 - 4. Record drawings.
 - 5. Manufacturer's wiring diagrams for electrically powered equipment.
 - 6. Certificates of inspection by regulatory agencies.
 - 7. Records of tests performed to certify compliance with system requirements.
 - 8. Parts list for fixtures, manufactured equipment, valves and specialties.
 - 9. Manufacturers' installation, operation and maintenance recommendations for fixtures, manufactured equipment, valves and specialties.
 - 10. Valve schedules.
 - 11. Lubrication instructions, including list/frequency of lubrication.
 - 12. Additional information as indicated in the technical specification sections.
 - 13. Warranties.

1.14. TRAINING OF OWNER PERSONNEL

- A. Instruct Owner personnel in the proper operation and maintenance of systems and equipment as provided as part of this project. Include not less than 8 hours of instruction, using the Operating and Maintenance Manual during this instruction. Demonstrate startup, operation and shutdown procedures for all equipment. All training shall be completed during normal working hours.

1.15. RECORD DRAWINGS

- A. Refer to Division 1, General Requirements, "Record Drawings".
- B. In addition to the data indicated in the General Requirements, maintain fire protection layout record drawings and hydraulic calculations on originals prepared by the installing contractor / subcontractor. Maintain at the site an up-to-date, marked set of "As-Built" or "Record" drawings, which shall be corrected and delivered to the Architect/Engineer upon completion.
- C. Furnish Owner with one reproducible print of record drawings revised to indicate "As-Built" conditions.
- D. Include copies of the "Record" drawings and calculations with the Operating and Maintenance manuals.

1.16. HOUSEKEEPING AND CLEANUP

- A. Refer to the applicable sections of Division 1, including "Project Closeout" and/or "Final Cleaning" for general requirements for final cleaning.
- B. Periodically as work progresses and/or as directed by the Architect/Engineer, the Contractor shall remove waste materials from the building and leave the area of the work broom clean. Upon completion of work remove all tools, scaffolding, broken and waste materials, etc., from the site.

1.17. FIRE PROTECTION

- A. Provide fire extinguishers of types and size recommended by NFPA 10. Provide special fire-prevention supervision of welding, cutting, and other hazardous operations. Place permanent fire protection facilities in operation at earliest date possible.

1.18. GUARANTEE

- A. The contractor, by acceptance of this contract, guarantees all labor and materials, provided hereunder and shall at his expense repair, remodel, rebuild, replace and/or rewire and further make good and acceptable all labor and materials found defective within one year from the date of final acceptance or found in violation of applicable Codes or regulations, in force at the time of bidding, within five years from said date.
- B. Guarantee that systems will operate without objectionable noise, vibration, and uncontrolled expansion.
- C. Repair, replace, or alter systems or parts of systems found defective at no extra cost to the Owner.

PART 2 – PRODUCTS

2.1. ACCESS PANELS AND DOORS

- A. Lay-in Ceilings: Removable lay-in ceiling tiles in 2 feet by 2 feet (2' x 2') or 2 feet by 4 feet (2' x 4') configuration provided under Division 9 are sufficient; no additional access provisions are required unless specifically indicated.
- B. Plaster Walls and Ceilings: 16-gauge frame with not less than a 20-gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch for general applications, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Stainless steel access panels for wet locations shall be field prepped for painting in finished locations. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 12" x 12".
- C. Key locks for access panels and doors throughout the facility shall be matched for access by a single master key.

2.2. IDENTIFICATION

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide mechanical identification materials by Allen Systems, W. H. Brady Co., Industrial Safety Supply Co., EMED Co., or Seton Name Plate Corp.
- B. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
- C. Engraved Name Plates: White letters on a black background, 1/16-inch thick plastic laminate, beveled edges, screw mounting. Seton Setonflex, or equal.
- D. Adhesive Labels: Pressure-sensitive, adhesive backed, vinyl pipe markers with applicable labeling, 3/4-inch minimum size for lettering and surrounding tape on both ends, with flow arrows on piping. Conforming to ANSI, ANSI and NFPA standards. Seton Opti-Code, or equal. Clean piping before application to ensure proper adhesion.
- E. Snap-Around Pipe Markers: One-piece, vinyl construction, snap-around or strap-around pipe markers with applicable labeling and flow direction arrows, 3/4-inch minimum size for lettering. Provide nylon ties on each end of pipe markers. Seton Setmark, or equal.
- F. Signs: Metal construction, baked porcelain enamel finish signs, sizes conforming to NFPA No. 13 and 7-1.2, with holes and "S" hooks/chains for hanging or securing, with applicable labeling. Seton or equal.
- G. Valve Tags: Round, 19-gauge polished brass valve tags with 1/2-inch numbers, 1/4-inch system identification abbreviation, 1 1/2-inch minimum diameter, with manufacturer's standard solid brass jack chains or solid brass "S" hooks of the sizes required for proper attachment of tags to valve stems available from EMED Co., Seton Name Plate Company, or W.H. Brady.

2.3. SEALING AND FIRESTOPPING, FIRE AND/OR SMOKE RATED PENETRATIONS

- A. Acceptable manufacturers include 3M, Hilti, Rectorseal, STI/SpecSeal, Tremco, or approved equal. All firestopping systems shall be provided by the same manufacturer.
- B. All firestopping systems shall be UL listed.
- C. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
- D. Use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop blocks, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.
- E. Submittals: Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawing for UL system with known performance for which an engineering judgment can be based upon.

2.4. SEALING AND FIRESTOPPING, NON-RATED PENETRATIONS

- A. At pipe penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between pipe insulation and sleeve. For non-rated drywall, plaster or wood partitions where sleeve is not required, use urethane caulk in annular space between pipe insulation and wall material.

PART 3 – EXECUTION

3.1. CUTTING AND PATCHING

- A. Refer to Division 1, General Requirements, "Cutting and Patching"
- B. Do not pierce beams or columns without permission of the Architect/Engineer and then only as directed. If any piping is required through walls or floors where no sleeve has been provided, use a core drill to avoid all unnecessary damage and structural weakening. Any penetration through a structural member must be approved (in writing) by the Structural Engineer. The contractor responsible for damage and/or structural weakening shall be fully responsible for the cost of the damages and/or repairs.

3.2. CONCRETE WORK

- A. Cast-in-place concrete within the building will be performed by the Division 3 Contractor unless otherwise noted. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for support or installation of fire protection piping, specialties and equipment. Coordinate locations of equipment, pipe penetrations in wet areas, etc. with the Division 3 Contractor.

3.3. BUILDING ACCESS

- A. Arrange for the necessary openings in the building to allow for admittance or removal of all apparatus. When the building access was not previously arranged and must be provided by the contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.4. EQUIPMENT ACCESS

- A. Install all piping, conduit, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster walls or ceilings, furnish the access doors to the General Contractor.

3.5. COORDINATION

- A. Coordinate all work with other contractors prior to installation. The contractor shall consult closely with all other trades to coordinate installation of heating and ventilating, plumbing, fire suppression, and electrical work. Any work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
- B. Coordinate alarm operation, controls, and electrical interlocks with the Fire Alarm Contractor and Security Contractor to establish required alarm interfaces and maintain security functions for building safety.
- C. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work.
- D. Verify that all devices are compatible for the type of construction and surfaces on which they will be used.
- E. Coordinate locations of sleeves, openings, chases, furred spaces, etc., with the building contractor. Furnish and install during progress of construction all sleeves, hangers, inserts, etc., that are to be built into the structure.
- F. Contractors and subcontractors shall closely and carefully review all construction documents. Information regarding the complete work is dispersed throughout the document set and cannot be accurately determined without reference to the complete drawing set.

3.6. IDENTIFICATION

- A. Identify equipment in mechanical equipment rooms with engraved nameplates.
- B. Identify interior piping not less than once every 25 feet, not less than once in each room, adjacent to each access door or panel, and on both sides of the partition where accessible piping passes through walls or floors. Place flow directional arrows at each pipe identification location with surrounding tape fully wrapping each end.
- C. Identify valves with signs per NFPA rulings.
- D. Provide hydraulic design information sign of permanently marked weatherproof metal or engraved nameplate material. Secure to alarm valve with brass chain. Information to include location of the design areas, discharge densities, required flow and residual pressure at the base of riser, hose stream demand and sprinkler demand.

3.7. LUBRICATION

- A. Upon completion of the work and before turning over to the Owner, clean and lubricate all bearings except sealed and permanently lubricated bearings. Lubricate bearings with lubricant as recommended by the manufacturer before the equipment is operated for any reason.

- B. The contractor is responsible for maintenance and lubrication of all fire protection equipment according to the manufacturer's instructions until the work is accepted by the Owner. Maintain a log of all lubricants used and frequency of lubrication. Include this information in the Operating and Maintenance Manuals at the completion of the project.
- 3.8. SLEEVES
- A. Provide galvanized sheet metal sleeves for pipe penetrations through interior and exterior walls to provide a backing for sealing or firestopping. Patch wall around sleeve to match adjacent wall construction and finish. Grout area around sleeve in masonry construction. In finished areas where pipe penetration through wall is exposed to view, sheet metal sleeve shall be installed flush with face of wall.
 - B. Pipe sleeves in new poured concrete construction shall be schedule 40 steel pipe (sized to allow insulated pipe to run through the sleeve where applicable), cast in place.
 - C. Pipe sleeves are not required in interior non-rated drywall, plaster or wood partitions and sleeves are not required in existing poured concrete walls where penetrations are core drilled.
 - D. In all piping floor penetrations, fire rated and non-fire rated, top of sleeve shall extend $\frac{3}{4}$ - inch above the adjacent finished floor. In existing floor penetrations, core drill sleeve opening large enough to insert schedule 40 sleeve and grout area around sleeve with hydraulic setting, non-shrink grout. If the pipe penetrating the sleeve is supported by a pipe clamp resting on the sleeve, weld a collar or struts to the sleeve that will transfer weight to existing floor structure.
- 3.9. SEALING AND FIRESTOPPING, FIRE AND/OR SMOKE RATED PENETRATIONS
- A. Install approved product according to the manufacturer's instructions where a pipe penetrates a fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the insulation and vapor barrier.
 - B. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support substantial weight.
- 3.10. SEALING AND FIRESTOPPING, NON-RATED PENETRATIONS
- A. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.
- 3.11. SEALING AND FIRESTOPPING, PENETRATIONS SUBJECT TO WATER INTRUSION
- A. For penetrations (both rated and non-rated) in floors subject to water intrusion or in rooms housing electrical equipment (but not within walls) provide one of the following:
 - 1. Pipe penetration where steel pipe sleeve is used extend steel sleeve 2" above the floor.
 - 2. Pipe penetration where cast in place fire stopping device/sleeve is used, extend device/sleeve 2" above the floor (provided it meets the device's UL listing).
 - 3. Pipe penetration where there is no steel sleeve or cast in place fire stopping device/sleeve, provide 2" x 2" x 1/8" galvanized steel angles fastened to floor surrounding the penetration or group of penetrations to prevent water from getting to penetration. Provide urethane caulk between angles and floor and fasten angles to floor minimum 8" on center. Seal corners watertight with urethane caulk.
 - B. Floors subject to water intrusion or rooms housing electrical equipment include the following locations:
 - 1. Restrooms
 - 2. Locker/Shower Rooms
 - 3. Janitor Rooms w/ Sinks
 - 4. Mechanical/Plumbing Equipment Rooms
 - 5. Chemical/Hazardous Waste Storage
 - 6. Maintenance/Industrial Shops

7. Vehicle Storage / Inspection Bays
 8. Data/Telecommunications Rooms
 9. Electrical Equipment Rooms
- C. Provide waterproof caulk sealant top coating on fire stopping system (or other approved means to protect the fire stopping system from water) in areas subject to wash down such as Food Service and Vehicle Storage / Inspection Bays.

END OF SECTION 21 05 00

SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1. SCOPE

- A. This section includes specifications for supports of all fire protection equipment and materials as well as piping system anchors.

1.2. FEDERAL BIDDING REQUIREMENTS

- A. Buy America:

Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.

- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3. REFERENCE

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions, and the applicable provisions of Division 1, govern work under this section.

1.4. RELATED WORK

- A. The following technical plumbing specifications sections are directly related to the provisions of this section.

Section 21 10 00 – Water-Based Fire Suppression Systems
Section 21 22 00 – Clean Agent Fire Extinguishing Systems
Section 21 30 00 – Fire Pumps

1.5. REFERENCE STANDARDS

- A. Specific standards referenced in this section are as follows: MSS SP-58 General Standard

MSS SP-58 General Standard

NFPA 13 Standard for the Installation of Sprinkler Systems

NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection

NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems

UL Underwriter's Laboratories Listed.

FM Factory Mutual Approved

1.6. QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, "Equals and Substitutions".

1.7. DESCRIPTION

- A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for building piping, and shall be UL-listed.
- B. Do not hang any mechanical item directly from a metal deck or run piping so it rests on the bottom chord of any truss or joist.
- C. Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.
- D. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.
- E. Refer to NFPA 13 and NFPA 2001 for acceptable support assemblies.

1.8. SHOP DRAWINGS

- A. Product data cutsheets and schedule of all hanger and support devices indicating shields, attachment methods, and type of device for each pipe size and type of service.
- B. Provide details on the shop drawings submitted for approval with all pertinent information listed.

1.9. DESIGN CRITERIA

- A. Materials and application of pipe hangers and supports shall be according to MSS SP-58 Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application and Installation unless noted otherwise.
- B. Piping connected to pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation supports for a distance of one hundred (100) pipe diameters or three supports away from the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond the one hundred pipe diameter / three support distance.
- C. Materials and application of pipe hangers and supports shall be according to NFPA ruling and be UL/FM listed and approved

PART 2 – PRODUCTS

2.1. MANUFACTURERS

- A. B-Line, Anvil, Erico, G-Strut, Tolco, Roof Products & Systems, or approved equal.

2.2. STRUCTURAL SUPPORTS

- A. Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically indicated on the drawings.

2.3. PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes ½-Inch through 4-Inches: Carbon steel, adjustable swivel ring with 3/8-inch minimum UL/FM approved hanger rods. B-Line B3170NF, Anvil 69 or 70. Carbon steel, adjustable clevis, standard, with UL/FM approved size hanger rods. B-Line B3100, Anvil 260.
- B. Hangers for Pipe Sizes larger than 4-inches through 8-inches: Carbon steel, adjustable swivel ring with ½-inch minimum UL/FM approved hanger rods. B-Line B3170NF, Anvil 69 or 70. Carbon steel, adjustable clevis, standard with UL/FM approved size hanger rods. B-Line B3100, Anvil 260.
- C. Hangers For Pipe Sizes 10" And Up: Carbon steel, adjustable clevis, standard with UL/FM approved size hanger rods. B-Line B3100, Anvil 260.
- D. Multiple or Trapeze Hangers: Manufactured steel channel system with manufacturers slotted interlocking pipe clamps with screw/nut securing and treaded hanger rods or steel channels with welded spacers and threaded hanger rods.
- E. For trapeze hangers, the minimum size of steel angle or pipe span between purlins or joists shall be as shown in NFPA 13.
- F. Location of hangers shall conform to NFPA 13 and NFPA 2001, except that no mains, parallel to joists shall be supported from a single joist. Mains parallel to joists shall be supported from a trapeze hanger and be positioned equally between two or more joists. The trapeze hangers shall be positioned to load the joists at the panel points only. Verify all weights and loading with structural engineer.
- G. Wall Support: Carbon steel welded bracket with hanger. B-Line 3060 Series, Anvil 190 Series.

Perforated epoxy painted finish, 12-gauge minimum, steel channels securely anchored to wall structure, with interlocking, split-type, bolt secured, galvanized pipe/tubing clamps. B-Line Type "S" Channel with B-2000 Series clamps, Anvil Type "PS" 200 H with "PS" 1200 clamps.
- H. Vertical Support: Carbon steel riser clamp. B-Line B3373, Anvil 261 for above floor use. Grinnell 40 with bolts and concrete anchors for attachment to underside of concrete floor deck.

- I. Floor Support: Painted carbon steel pipe saddle, stand and bolted floor flange. B-Line B3088T or B3093.
 - J. Copper Pipe Supports: All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or polyvinylchloride coated. Where steel channels are used, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT series, Grinnell PS 1400 series.
- 2.4. PIPE HANGER RODS
- A. Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.
 - B. Size rods for individual hangers and trapeze support as indicated in the following schedule.
- | <u>Pipe Size</u> | <u>Rod Diameter (Inches)</u> |
|------------------------|------------------------------|
| Up to and Including 4" | 3/8" or 9.5mm min. |
| 5" through 8" | 1/2" or 12.7mm min. |
| 10" and 12" | 5/8" or 15.9mm min. |
- 2.5. BEAM CLAMPS
- A. MSS SP-58 Types 19 and 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a retaining ring and threaded rod of 3/8, 1/2, and 5/8 inch diameter. Furnish with a hardened steel cup point set screw. B-Line B3036L/B3034, Anvil 86/92.
 - B. MSS SP-58 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1-1/2 inch diameter. B-Line B3054, Anvil 228.
- 2.6. CONCRETE INSERTS
- 2.6.1. POURED IN PLACE
- A. MSS SP-58 Type 18 wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. Wedge design to allow the insert to be held by concrete in compression to maximize the load carrying capacity. B-Line B2505, Anvil 281.
 - B. MSS SP-58 Type 18 universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. B-Line B3014N, Anvil 282.
- 2.6.2. DRILLED FASTENERS
- A. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead, or approved equal.
- 2.7. CONTINUOUS CONCRETE INSERT CHANNELS
- A. Steel inserts with an industry standard pre-galvanized finish, nominally 1-5/8 inch by 1-3/8 inch deep by length to suit the application, designed to be nailed to concrete forms and provide a linear slot for attaching other support devices. Installed channels to provide a load rating of 2000 pounds per foot in concrete. Manufacturer's standard brackets, inserts, and accessories designed to be used with channel inserts may be used. Select insert length to accommodate all pipe sizes in the area.
- 2.8. ANCHORS
- A. Use welding steel shapes, plates, and bars to secure piping to the structure.
- 2.9. EQUIPMENT STANDS
- A. Use structural steel members welded to and supported by pipe supports. Clean, prime and coat with three coat rust inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, treat with corrosive atmosphere coatings.

2.10. CORROSIVE ATMOSPHERE COATINGS

- A. Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM A123, 1.5 ounces/square foot of surface each side. Mechanical galvanize threaded products, ASTM B695 Class 50, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory coating.
- B. Corrosive atmospheres include the following locations:
 - 1. Exterior locations
 - 2. Chemical storage rooms
 - 3. Inspection, Maintenance and Vehicle Garages
 - 4. Locker rooms

PART 3 – EXECUTION

3.1. INSTALLATION

- A. Install supports to provide for free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
- B. Verify location of all sprinkler mains with structural engineer to ensure adequate structural capacity.
- C. Size, apply and install supports and anchors in compliance with manufacturers' recommendations.
- D. Coordinate hanger and support installation to properly group piping of all trades.
- E. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices, provided that similar types are used and all data is submitted for prior approval.
- F. Perform welding according to standards of American Welding Society.

3.2. HANGER AND SUPPORT SPACING

- A. Install hangers to provide minimum ½-inch space between finished covering and adjacent work.
- B. Place a hanger within 12-inches of each elbow, valve, strainer, or similar piping specialty item.
- C. Use hangers with minimum vertical adjustment.
- D. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- E. Support riser piping independently of connected horizontal piping.
- F. Adjust hangers to obtain the slope specified in the piping section of these specifications.
- G. Space hangers for pipe as follows:

<u>Pipe Material</u>	<u>Pipe Size</u>	Maximum	Maximum
		<u>Horiz. Spacing</u>	<u>Vert. Spacing</u>
Steel	1-inch through 1 ¼-inch	10'-0"	10'-0"
Steel	1 ½-inch through 4-inch	12'-0"	15'-0"
Steel	4-inch through 8-inch	15'-0"	15'-0"
Steel	8" through 12"	15'-0"	20'-0"
Copper	¾" through 1"	8'-0"	10'-0"

- H. Unsupported length from the last hanger and an end sprinkler shall be as follows:
 - 1. 1-inch piping Not greater than 24"
 - 2. 1 ¼-inch piping Not greater than 36"
 - 3. 1 ½-inch piping or larger Not greater than 48"
- 3.3. RISER CLAMPS
 - A. Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor. Use method of securing the vertical risers to the building structure below in stairwell locations.
- 3.4. CONCRETE INSERTS AND CONTINUOUS INSERT CHANNELS
 - A. Select size based on the manufacturer's stated load capacity and weight of material that will be supported. Locate continuous insert channels on 6-foot, 0-inch (6'-0") maximum centers and 2-foot, 0-inches (2'-0") from corners. Furnish inserts to the General Contractor for placement in concrete formwork. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4-inch size. Where concrete slabs form finished ceilings, provide inserts that are flush with the slab surface.
- 3.5. ANCHORS
 - A. Install anchors where indicated on the drawings and details, as required for proper pipe support, and according to manufacturer's recommendations, associated standards, applicable codes, and prudent engineering practice. Install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops.
 - B. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

END OF SECTION 21 05 29

SECTION 21 10 00 – WATER-BASED FIRE SUPPRESSION SYSTEMS

PART 1 – GENERAL

- SCOPE
- This section includes design criteria for water based fire suppression systems, associated piping materials, valves, sprinklers accessories and other related devices.
- The specifications and drawings are scope documents based on the Owner's requirements for the fire protection systems. It is the intent of the documents to detail and specify the minimum requirements and components. Pipe and equipment sizing shown in the documents is the minimum allowed. If a larger size or configuration is required, it is to be included in the bid.
- The Fire Protection Contractor shall be responsible for designing the complete sprinkler system according to all applicable NFPA standards, state and local codes, as well as any additional criteria set forth in these specifications. The installing contractor shall be the official Engineer-of-Record for this project.
- Provide complete installation drawings. The Fire Protection Contractor's system design shall be coordinated with drawings and specifications prepared for or by other trades. Include all modifications, relocations, or adjustments necessary to complete work or to avoid interference with other trades. Installation details shall be furnished for standard components and where coordination of work or particular design conditions necessitates.
- Fire Protection Contractor shall install all necessary piping, accessories and appurtenances required for complete sprinkler system installation and may install additional piping, fittings and valves for testing purposes or for the convenience of the installation. Where such materials are installed, they shall comply with the specifications and shall be sized to be compatible with the system design requirements.
- Where architectural features govern location of work, refer to architectural drawings. Check, verify, and coordinate work with drawings and specifications prepared for other trades. Include all modifications, relocations, or adjustments necessary to complete work or to avoid interference with other trades.
- Do not scale drawings for exact dimensions.
- Where installed materials interfere with the design conditions they shall be removed and relocated as required or as directed by the Architect/Engineer.
- DESIGN CRITERIA
- Available water supply data for system design is as follows:

Test Date and Time: September 1, 2022

Performed By: Accurate Fire Protection

Location: East Frontage Road and Poplar Road

Hydrant Location	Outlet Elevation	Flow GPM	Static PSI	Residual PSI
W1038		750	-	39
W1040		-	50	-

- **Fire Protection Contractor shall perform flow tests 90 days prior to the preparation of design calculations.** Test shall be representative of high water use periods. Submit a copy of the flow test data to the Owner, Architect, and Engineer for their records.
- Design fire protection systems according to codes, standards and regulations noted above. The fire suppression systems shall include the following:
 1. One wet pipe sprinkler system zone to serve the first floor Administrative Space.
 2. One wet pipe sprinkler system zone to serve the second floor Administrative Space.
 3. One single interlock preaction sprinkler system to serve the Evidence Area, Antenna Equipment Room, and Dispatch Area.
 4. One dry pipe sprinkler system to serve the Inspection Bay, Maintenance Garage and Storage Garage.

- The preaction and dry pipe sprinkler systems shall be provided with a nitrogen generator for supervisory gas. The nitrogen generator shall be sized based on the total system volume and provided with an air compressor sized to meet the NFPA-13 requirement for 30-minute fill time. The nitrogen generator model number included on the drawings is preliminary based on estimated system volume and must be confirmed by the contractor.
- Hydraulically design system for the most remote area based on the following:

<u>Location</u>	<u>Occupancy Classification</u>	<u>Density (GPM/S.F.)</u>	<u>Area (S.F.)</u>
General public spaces, corridors, vestibules, offices, and classrooms	Light Hazard	0.10	1,500
Mechanical rooms, custodial closets, storage rooms <8' high storage	Ordinary Group 1	0.15	1,500
Evidence storage, storage rooms >8' high storage	Ordinary Group 2	0.20	1,500
Inspection bays, maintenance and storage garage	Ordinary Group 2	0.20	2,000

- Note that the above data has been provided for typical areas. Remote area increase for dry pipe/preaction systems and other circumstances i.e. sloped or higher ceilings are to be added to the minimum remote areas noted above as required by code. Remote area reduction for use of quick response sprinkler heads will be allowed.
- Intermediate and high temperature sprinkler heads shall be provided where required by code. Some locations, but not all locations, have been identified on the drawings.
- Maximum head spacing per NFPA 13 for each occupancy hazard indicated.
- Hydraulic Calculations: Sprinkler systems which shall be hydraulically designed must be designed a minimum of 10 percent below the highest estimated available water supply curve.
- Hose Streams: Add indicated hose streams to all sprinkler zone hydraulic calculations, at the base of the riser.
- Concealed Spaces: Contractor shall be responsible for complying with all applicable requirements of NFPA 13 regarding sprinkler coverage of concealed spaces, including, but not limited to, the plenum spaces above the ceiling. If sprinklers are not required, contractor shall verify which NFPA exception applies and obtain written approval / verification from the authority having jurisdiction.
- Construct all piping systems for the highest pressures and temperatures in the respective system but not less than 175 psig.
- Where ASTM A53 or A795 Type F pipe is specified, Grade A, Type E or S, or Grade B, Type E or S may be substituted at contractor's option. Where ASTM A135 Grade A pipe is specified, Grade B pipe may be substituted at contractor's option. Where the grade or type is not specified, contractor may choose from those commercially available.
- **FEDERAL BIDDING REQUIREMENTS**
- Buy America:
 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
 2. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.
- **RELATED DOCUMENTS**
- Scope drawings and general provisions of the contract, including General and Supplementary Conditions, and the applicable provisions of Division 1, govern work under this section.

- The following technical fire suppression specifications sections are directly related to the provisions of this section.

Section 21 05 00 – Common Work Results for Fire Suppression

Section 21 05 29 – Hangers and Supports for Fire Suppression Piping and Equipment

Section 21 30 00 – Fire Pumps

- **REFERENCE STANDARDS**

- Specific standards referenced in this section are as follows: ANSI A21.4 General Standard

ANSI A21.11 General Standard

ANSI A21.51 General Standard

ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings

ANSI B16.3 Malleable Iron Threaded Fittings

ANSI B16.4 Cast Iron Threaded Fittings

ANSI B16.5 Pipe Flanged and Flanged Fittings

ANSI B16.9 Factory Made Wrought Steel Buttweld Fittings

ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

ASTM A105 Forgings, Carbon Steel, for Piping Components

ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

ASTM A135 Electric Resistance Welded Steel Pipe

ASTM A181 Forgings, Carbon Steel for General Purpose Piping

ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

ASTM A536 Ductile Iron Castings

ASTM A795 Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

ASW D10.9 Qualifications of Welding Procedures and Welders for Piping and Tubing, Level AR3

NFPA 13 Standard for the Installation of Sprinkler Systems

NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection

UL Underwriters' Laboratories Listing

FM Factory Mutual Approval

- **QUALITY ASSURANCE**

- The contractor shall be licensed by the State of Wisconsin for installation of sprinkler fire protection systems.
- Planning, calculations, layout, and installation shall be performed by licensed persons employed by the sprinkler contractor. A Certified Sprinkler Designer or licensed Professional Engineer for planning, design and calculations.
- The field installation shall be constantly supervised by competent, experienced journeyman fitter(s). The Supervisor shall be in charge of the installation of the work together with all subcontractors, skilled workmen, and their laborers. The Supervisor shall be responsible for the work so that it is properly coordinated and supervised to the satisfaction of the Architect / Engineer.
- The contractor(s) shall submit pre-qualification evidence of at least 5 projects of comparable size and scope successfully completed with their bid. Distortion or misrepresentation of qualification evidence may result in contract cessation.

- Throughout the course of work, minor changes and adjustments to the Plans and Specifications may be required by the Owner. The contractor shall make such adjustments without additional cost to the Owner, where adjustments are necessary to the proper installation and operation and within the intent of the Contract Documents. Fire protection work shall include all labor, material, and equipment necessary to provide a complete and operating fire protection system.
- Owner reserves the right to reject workmanship or material not in conformance with plans and specifications before or after installation. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.
- Substitution of Materials: Refer to Section GC – General Conditions of the Contract, “Equals and Substitutions”.
- Order all copper and steel pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- DELIVERY, STORAGE, AND HANDLING
- Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
- Cover pipe to prevent corrosion and deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage or by durable, waterproof, above ground packaging.
- Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- Storage and protection methods must allow inspection to verify products.
- Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.
- WELDER QUALIFICATIONS
- Welding procedures, welders, and welding operators for all building service piping to be according to certified welding procedures on the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic welding is performed, contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.
- The Architect or Engineer reserves the right to test the work of any welder employed on the project. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project and all defective welds replaced.

PART 2 – PRODUCTS

2.1. QUALITY ASSURANCE

- A. UL & FM Compliance: Unless otherwise indicated, all products shall be listed in the latest publication of Approval Guides for Underwriters Laboratory and Factory Mutual for the service intended. All system components shall be in conformance with applicable NFPA Standards.
- C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.
- D. All materials, including piping and fittings, shall meet the Buy America provisions noted in the Federal Bidding Requirements.

2.2. GENERAL

- A. Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

- B. Pipe/Tube Fitting: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.
- 2.3. FIRE PROTECTION PIPING
- A. PIPING – ABOVE GROUND (STEEL PIPE)
 - 1. Black steel pipe welded and seamless, Type F, Grade A, ASTM A53; black welded and seamless steel pipe for fire protection use, Type F, ASTM A795; electric resistance welded steel pipe, Grade A, ASTM A135.
 - 2. Pipe Wall Thickness:
 - i. Schedule 40 piping 2" and smaller.
 - ii. Schedule 10 on sizes over 2-1/2" in diameter.
 - 3. Fittings: Cast iron threaded fittings, Class 125 or 250, ASTM A126/ANSI B16.4. Malleable and ductile iron threaded fittings, Class 150 or 300, ASTM A197/ANSI B16.3. Standard weight seamless carbon steel weld fittings, ASTM A234 grade, ANSI B16.9. Mechanical grooved fittings with EPDM gaskets, ASTM A536 ductile iron, ASTM A47 malleable iron or ASTM A53 fabricated steel.
 - 4. Mechanical tee fittings with full iron back equal to Grinnell Figure 730 will be allowed only as needed for connection to existing systems. Outlets for dry pipe systems with galvanized piping shall be mechanical tees. Mechanical tees with U-bolt back or other fastening means are not allowed.
 - 5. Finish: Hot dipped zinc coated (galvanized) finish on piping and fittings shall be used in dry sprinkler pipe systems due to weather/moisture exposure within the garage areas, piping exposed to weather, and drain piping. Thread or groove hot dipped zinc and coated pipe ends for fitting connections. Preaction system piping shall be black steel pipe.
 - 6. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
 - B. PRESSURE SENSING LINE PIPE
 - 1. Seamless Red Brass pipe, ASTM 43, regular weight (Schedule 40), with ASTM B584 threaded copper alloy pressure fittings,
 - 2. Type L copper water tube, H (drawn) temper, ASTM B88; with cast copper pressure fittings, ANSI B16.18; wrought copper pressure fittings, lead free (<.2%) solder, ASTM B32; flux, ANSI B16.22; copper phosphorous brazing alloy, AWS A5.8 BCuP.
- 2.4. UNIONS AND FLANGES
- A. 2-INCHES AND SMALLER STEEL
 - 1. ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping.
 - B. 2" AND SMALLER COPPER
 - 1. ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.
 - C. 2 1/2-INCHES AND LARGER STEEL
 - 1. ASTM A181 or A105, Class 150 grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. ANSI B16.1 or ANSI B16.5, Class 150 cast iron threaded flanges. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with other flat face flanges on equipment.
 - D. 2-1/2" AND LARGER COPPER
 - 1. ANSI B16.24, Class 150 cast bronze flanges with raised face.

2.5. MECHANICAL GROOVED PIPE CONNECTIONS

- A. Mechanical grooved pipe couplings and fittings, ASTM F1476, as manufactured by Victaulic, Grinnell, or Anvil Fittings may be used with steel pipe. Mechanical grooved components and assemblies to be rated for minimum 175 psi working pressure unless noted otherwise.
- B. All mechanical grooved pipe material including gaskets, couplings, fittings and flange adaptors to be from the same manufacturer.
- C. Couplings and fittings to be malleable iron, ASTM A47, or ductile iron A536 with painted finish. Fittings used on galvanized steel pipe to have galvanized finish, ASTM A153.
- D. Gaskets to be EPDM, ASTM D2000. Gaskets for dry and preaction systems to be flush seal design. Heat treated carbon steel oval neck track bolts and nuts. ASTM A-183, with zinc electroplated finish.
- E. Flange adapters to be ductile iron, ASTM A536; except at lug type butterfly valves where standard threaded flanges shall be used.
- F. Credit for the inherent flexibility of mechanical grooved pipe connection when used for expansion joints or flexible connectors may be allowed upon specific application by the contractor. Three flexible couplings at first three connection points both upstream and downstream of pumps may be used in lieu of flexible connectors. Request for expansion joints shall be made in writing and shall include service, location, line size, proposed application and supporting calculations for the intended service.

2.6. SPRINKLER HEADS

- A. Manufacturer: Sprinkler head model numbers establish type and style of head. Products of the following manufacturers determined to be equal by the Architect/Engineer will be accepted: Tyco, Reliable Automatic Sprinkler Co., Viking Corporation, and Victaulic.
- B. All sprinkler heads shall be UL listed and FM approved, fusible link or glass bulb type, cast brass or bronze construction. Provide heads with nominal ½-inch discharge orifice except where greater than normal density requires large orifice.
- C. Select fusible link or glass bulb temperature rating to not exceed maximum ambient temperature rating allowed under normal conditions at installed location and as indicated. Provide the following sprinkler heads for the appropriate location:
 - 1. Ordinary Temperature (165°F): Fusible link or glass bulb type except at skylights, sealed display windows, unventilated attics and roof spaces, over cooking equipment, adjacent to diffusers, unit heaters, uninsulated heating pipes or ducts, garage spaces, mechanical rooms, storage rooms, or where otherwise indicated.
 - 2. Intermediate Temperature (212°F): Fusible link or glass bulb type.
 - 3. High Temperature (265°F): Fusible link or glass bulb type.
- D. Listed corrosion-resistant sprinkler heads shall be installed in locations where chemicals, moisture, or other corrosive vapors sufficient to cause corrosion of such devices exist. Sprinkler heads located in the janitor's storage / supplies, shower rooms, and all other exterior areas shall be listed corrosion-resistant heads.
- E. Sprinkler Cabinets: Provide cabinets complete with required number of spare heads of each type and temperature rating and special wrenches according to NFPA 13. Provide multiple cabinets as required. Cabinet shall be finished steel, suitable for wall mounting, with hinged cover and adequate space for required spare heads and wrenches. Coordinate cabinet location with Owner's Representative. Provide 6 spare heads per 300 or less installed heads, 12 per 1,000 or less installed heads, and 24 for more than 1,000 installed heads. Provide an equal number of concealed cover plates and/or sprinkler escutcheons for each spare sprinkler head.
- F. Sprinkler type and finish for each application shall be as follows (or approved equal):
 - 1. Concealed Pendent: Viking Mirage Quick Response
 - 2. Extended Coverage, Concealed Pendant: Viking Mirage EC Quick Response
 - 3. Concealed Sidewall: Viking VK481 Quick Response
 - 4. Extended Coverage, Standard Response Sidewall: Tyco SW-24
 - 5. Extended Coverage, Concealed Sidewall: Viking VK680 Quick Response

6. Extended Coverage, Sidewall: Viking Microfast HSW Standard or Quick Response
 7. Sidewall: Viking Micromatic HSW Standard Response
 8. Sidewall: Viking Microfast HSW Quick Response
 9. Upright: Viking Micromatic Standard Response
 10. Upright: Viking Microfast Quick Response
 11. Extended Coverage, Upright: Viking Microfast "EC/QREC"
 12. Pendant: Viking Micromatic Standard Response
 13. Pendant: Viking Microfast Quick Response
 - G. ** All sprinkler head selections shall be approved by Owner/Engineer prior to installation.
 - H. Brass sprinkler heads are to be utilized where sprinkler heads are installed on exposed piping.
 - I. Additional sprinkler heads may be required based upon application. Contractor shall verify and furnish and install as required.
- 2.7. FLEXIBLE SPRINKLER DROP FITTINGS
- A. Manufacturers: FlexHead Industries, Victaulic or Viking.
 - B. Corrugated Type 304 stainless steel hose with braided Type 304 stainless steel exterior cover, welded stainless steel or zinc plated steel inlet and outlet threaded fittings with EPDM seals. 175 PSI pressure rating. 225° F temperature rating, 1" minimum internal hose diameter. 40" maximum hose length, straight or angle outlet configuration. Galvanized steel ceiling support bar and brackets selected to match project ceiling support system requirements. UL Listed and FM approved.
 - C. Flexible drops are only allowed for use above fully accessible ACT ceilings.
- 2.8. SUPERVISORY / TAMPER SWITCHES
- A. Tamper switches shall be UL listed and FM approved, capable of transmitting a signal with only ¼ -inch turn of the valve operator. Unit shall be compatible with the fire alarm system.
 - B. For OS&Y valve or butterfly valve installations, to monitor position of valve, tamper resistant cover screws, single or double SPDT switch contacts, corrosion resistant, for indoor or outdoor use, NEMA 4 and 6P enclosures.
- 2.9. FLOW SWITCHES
- A. Flow switches shall be UL listed and FM approved, capable of transmitting a signal when the flow of water equals or exceeds the discharge of a single head. Unit shall be vane type, with metal enclosure, adjustable pneumatic retard chamber and electrical characteristics compatible with fire alarm system.
- 2.10. PRESSURE SWITCHES
- A. Pressure actuated switches shall be UL listed and FM approved, capable of transmitting a signal when the pressure drops due to loss of air in the system with field adjustable settings, metal enclosure and electrical characteristics compatible with fire alarm system.
- 2.11. PRESSURE GAUGES
- A. Manufacturers: Ametek / U.S. Gauge Division, Ashcroft, Marsh, Taylor, H.O. Trerice, Weiss, Weksler.
 - B. Pressure gauges shall be UL listed and FM approved. Cast aluminum, stainless steel or brass case of not less than 3.5 inches in diameter, double strength glass window, black lettering on a white background, phosphor bronze Bourbon tube with bronze bushings, recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale. Include bronze 3-way globe valve with plugged outlet for Fire Inspector's test gauge.
- 2.12. LOCAL ALARM BELL OR HORN/STROBE
- A. Fire Protection Contractor shall verify with the location and type of exterior notification device with the local fire department. Locate notification device above (or in line with) the fire department connection.

- B. Weatherproof horn/strobe with red housing, 24-Volt, capable of producing 115 candela, mounted on a weatherproof junction box. Horn/strobe shall have signage or bezel indicating automatic sprinkler system operation.
- 2.13. GATE VALVES
- A. Manufacturers: Kennedy, Mueller, Nibco, Reliable, Viking, Victaulic.
 - B. UL listed/FM approved, outside screw and yoke (OS&Y) gate valves, 300 psi test and 175 psi non-shock cold water working pressure, cast iron body, bronze mounted, bolted bonnet, rising stem, solid wedge, with normally open tamper switch with double wire leads. Valves shall be capable of being repacked under pressure, with valve wide open.
- 2.14. BUTTERFLY VALVES
- A. Manufacturers: Kennedy, Mueller, Nibco, Reliable, Viking, Victaulic.
 - B. Two-inches and Smaller: Bronze body butterfly valve, 175 psig, geared operator, visible position indicator, normally open tamper switch with double wire leads, Buna or Viton seat, stainless steel disc and stem.
 - C. Two-inches and Larger: Cast or ductile iron body butterfly valve, lug style or grooved, 175 psig, geared operator, visible position indicator, normally open tamper switch with double wire leads, EPDM resilient seat, EPDM seals, nickel plated ductile iron disc. Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe attached. Use cap screws for removal of downstream piping while using the valve for system shutoff.
- 2.15. CHECK VALVES
- A. Manufacturers: Kennedy, Milwaukee, Mueller, Nibco, Reliable, Viking, Victaulic.
 - B. 3-Inches and smaller: Bronze body, threaded end, Y-pattern, regrindable bronze seat, renewable bronze disc, 175 psig, suitable for installation in a horizontal or vertical line with flow upward.
 - C. 2-1/2-Inches and larger: Cast or ductile iron body, flanged or grooved ends, bronze trim, bolted cap, renewable bronze seat and disc, 175 psig, suitable for installation in a horizontal or vertical line with flow upward.
 - D. Provide 1/2" automatic drip drain on inlet of fire department connection check valve.
- 2.16. SPRING LOADED CHECK VALVES
- A. Manufacturers: Kennedy, Milwaukee, Mueller, Nibco, Watts.
 - B. 2-Inches and Smaller: Bronze body, threaded ends, bronze trim, stainless steel spring, stainless steel center guide pin, 175 psig, Teflon seat unless only bronze available.
 - C. 2 1/2-Inches and Larger: Cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required, 175 psig.
- 2.17. BALL VALVES
- A. Manufacturers: Kennedy, Milwaukee, Nibco, Victaulic, and Watts.
 - B. 2-Inches and smaller: Bronze, 2-piece, threaded or sweat ends, standard port, blowout proof stem, chrome plated ball, glass reinforced seats, UL approved @ 250 psi. Watts No. B-6000 UL.
- 2.18. TEST AND DRAIN VALVES
- A. Manufacturers: AGF Manufacturing, Reliable or approved equal.
 - B. Threaded bronze body, brass stem, impregnated Teflon seat, chrome coated brass ball, and a steel handle with positive stops at the TEST and DRAIN positions. Tamper resistant test orifice, integral tamper resistant sight glasses, a tapped and plugged port for system access, and a steel identification plate. Test orifice size shall be tapped for nominal sprinkler K-factors. UL listed/FM approved.
 - C. Provide pressure relief valve kit and drain piping factory rated at 175 PSI. Bronze body and stainless steel spring, Nylobraid flexible tube, Two 1/2" NPT by barbed 90 degree elbows, external identification plate and integral flushing handle to remove debris. Relief pressure shall be factory set to 175 PSI. Relief valve shall operate to the OPEN position between 90% and 105% of the set pressure. Relief valve shall reseal or CLOSE at a minimum of 80% of set pressure.

2.19. DRAIN VALVES

- A. Manufacturers: Kennedy, Milwaukee, Nibco, Victaulic, and Watts.
- B. UL listed, 1-inch minimum, two or three piece bronze body ball valve; threaded ends, chrome plated bronze ball; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 400 psig WOG. Low point drain valves shall have, in addition, a 1- inch brass nipple with $\frac{3}{4}$ -inch male hose threads and cap.

2.20. DOUBLE CHECK VALVE ASSEMBLY

- A. Manufacturers: Ames, Cla-Val, Conbraco, Febco, Watts, and Wilkins.
- B. Double check valve assembly shall be installed in one location to supply water to all sprinkler zones. Install vertically per Wisconsin Administrative Code requirements.
- C. ASSE 1015 double check backflow preventer with two independent spring loaded check valves, two isolation butterfly or gate valves with normally open tamper switches with double wire leads, 4-valved test ports. Size for minimum pressure drop. Constructed of bronze or epoxy coated cast/ductile iron or stainless steel body with bronze and plastic internal parts, stainless steel springs, silicone rubber valve discs, bronze seats, rated for 175 psig. Valve assembly size shall be 6-inch.

2.21. DRY PIPE VALVE AND ACCESSORIES

- A. Manufacturers: Reliable, Tyco, Victaulic, and Viking.
- B. The dry-pipe sprinkler system control valve installation shall be an FM approved assembly and not separately approved components.
- C. Dry Pipe Valve: Cast or ductile iron body, flanged or grooved ends, 175 psig, bronze grooved seat with O-ring seal, single hitch pin and latch design. Provide trim for air supply, drain, priming level, alarm connections, pressure gages, priming chamber attachment, ball drip valves, drip cup assembly piped to floor or hub drain, fill line attachment with strainer.
- D. Each system shall include, but not be limited to, the following components:
 - 1. Dry Pipe Valve with external reset differential, offset clapper design.
 - 2. Standard dry pipe valve trim.
 - 3. Check Valve.
 - 4. Dry Pipe Valve Accelerator or equal (if required).
 - 5. Low air pressure switch compatible with the building Fire Alarm System.
 - 6. Alarm pressure switch compatible with the building Fire Alarm System.
 - 7. Supply control valve with Tamper switch compatible with the building Fire Alarm System.
 - 8. Air Maintenance Device, Compressor control type or equal.
 - 9. Main Drain.
 - 10. Pressure Gauges each side of Alarm Valve.

2.22. DELUGE VALVE WITH PREACTION TRIM

- A. Manufacturers: Reliable, Tyco, Victaulic, and Viking.
- B. The preaction sprinkler system control valve installation shall be an FM approved assembly and not separately approved components. The system shall be configured as a single interlock design.
- C. Deluge/Precision Valve: Cast or ductile iron body, flanged or grooved ends, 175 psig, bronze grooved seat with o-ring seal. Provide trim for bypass, drain, electric sprinkler alarm switch, pressure gages, drip cup assembly piped to floor or hub drain, fill line attachment with strainer and push rod chamber assembly. Include dry pilot trim consisting of actuator, air and water pressure gages, low air warning switch, air relief valve and diaphragm actuation device with replaceable bronze seat and resilient diaphragm.
- D. Each system shall include, but not be limited to, the following components:
 - 1. Straight-Through Deluge Valve
 - 2. Preaction valve trim.
 - 3. Check Valve.
 - 4. Low air pressure switch compatible with the building Fire Alarm System.

5. Alarm pressure switch compatible with the building Fire Alarm System.
6. Supply control valve with Tamper switch compatible with the building Fire Alarm System.
7. Emergency pull box. ½" ball valve in metal enclosure with ½" pipe nipple, "Manual Emergency Station" label and breakaway door.
8. Air Maintenance Device, Compressor control type or equal.
9. Main Drain.
10. Pressure Gauges each side of Alarm Valve.

2.23. AIR PRESSURE MAINTENANCE DEVICE

- A. Automatic air maintenance control capable of maintaining system air pressure, rated for 175 psig, adjustable air pressure range of 15 to 60 psig, complete with isolation valves, bypass fill valve, pressure regulator or pressure switch and strainer.

2.24. NITROGEN GENERATOR

- A. Manufacturers: Engineered Corrosion Solutions, Potter, South-Tek Systems, Viking, or equivalent.
- B. The nitrogen generator shall be sized to provide all dry fire sprinkler systems with supervisory nitrogen gas. Sizing shall be based on the total volume of all fire sprinkler systems being served by the nitrogen generator as determined by hydraulic calculations for each system. Documentation of the calculations and nitrogen generator sizing must be provided with the shop drawing submittals. The basis of design included on the drawings is estimated. All volumes must be verified based on the final design.
- C. The nitrogen generator shall be UL Listed and/or FM Approved.
- D. The nitrogen generator shall be electronically controlled with the capability to adjust system operating pressure settings without the requirement of any additional equipment. The Fire Protection Contractor shall determine the operating pressure range for the dry pipe air compressor or nitrogen generator and set the system air or N2 maintenance device for each zone to the correct setting. Coordination of this final setting shall be achieved with input from the dry pipe and preaction valve manufacturer.
- E. The nitrogen generator shall be equipped with a filtration system to remove residual water and hydrocarbons from the compressed air stream.
- F. The nitrogen generator shall be designed to achieve a nitrogen concentration of 98% or greater within fourteen (14) days of start-up and maintain that concentration within the all- fire protection systems continuously.
- G. The nitrogen generator shall have an hour meter, cycle counter, air bypass alarm, leak alarm and flow meter. The nitrogen generator shall provide the following monitoring output points, bypass mode, nitrogen generator on (presence of power), leak monitor, nitrogen line pressure (analog).
- H. The nitrogen generator shall be equipped with an external bypass with bypass alarm to prevent long term oxygen exposure in fire sprinkler system.
- I. The nitrogen generator shall be powered by a 208VAC power supply. Coordinate power requirements and location with the Electrical Contractor. The nitrogen generator power supply shall be per NFPA 70 and all local requirements.
- J. OXYGEN PURGE VENT

1. The Fire Protection Contractor shall furnish and install an inerting vent for each preaction and dry pipe sprinkler system. The inerting vent shall be installed on the each sprinkler riser as shown on the drawings unless otherwise required by the manufacturer.
2. The inerting vent shall have an adjustable pressure regulator to prevent accidental depressurization of the fire sprinkler system should a disruption occur to the air/nitrogen supply.
3. The inerting vent shall have a connection to attach and sample the purity of nitrogen within the sprinkler system. Purity sampling device can be portable or fixed.
4. The piping between fire sprinkler system and inerting vent must not create a water trap; the connecting piping must drain when the sprinkler system is drained or the inerting vent will not function properly.

5. The inerting vent shall not require any power to properly function.
6. The isolation ball valve of the inerting vent shall be closed during hydrostatic and/or air pressure testing of the sprinkler system and then placed in the open position for commissioning and operation of the nitrogen generator.

K. **HANDHELD GAS ANALYZER**

1. The Fire Protection Contractor shall furnish a handheld gas analyzer with each nitrogen generator. The handheld gas analyzer shall be equipped with a quick connect fitting compatible with gas sampling ports on all nitrogen generation system equipment and inerting vents. The handheld gas analyzer shall include a one button calibration feature. The oxygen sensing element of the handheld gas analyzer shall have a minimum useful life of two (2) years.

L. **VENT CONTROLLER**

1. Provide multi-zone vent system controller to vent and monitor the nitrogen/oxygen levels the preaction and dry pipe fire sprinkler systems. Provide pressure rated tubing from the restricted vent orifice on the standard vent connection to the vent controller. The vent controller will automatically close once the system concentration level has been reached. Vent controller shall have an LCD touchscreen display with pressure and purity monitoring, datalogging and history for each connected zone, manual leak rate check and remote monitoring.
2. The vent controller shall be powered by a 120VAC power supply. Coordinate power requirements and location with the Electrical Contractor.

M. **AIR COMPRESSOR**

1. The Nitrogen generation system must be installed with a compressor sized appropriately for the application and capable of achieving system air pressure within 30 minutes according to requirements of NFPA 13. Air compressor(s) shall be capable of producing a continuous volume of compressed air that is sufficient to meet the design requirements of the fire protection system. Air compressor(s) shall be rated by the manufacturer for continuous duty service. The power source must be coordinated with the available power supply. Air compressor(s) shall have an output pressure rating of at least 100 psi. Air compressor shall be equipped with a refrigerated air dryer with automatic drain valve. This water discharge shall be piped to a floor drain or building exterior. All air compressor storage tank(s) must be ASME rated for indoor use. The contractor shall confirm the air maintenance device is taken out of the 30-minute bypass fill setting when the system is placed in service.

2.25. **FIRE PUMP TEST CONNECTION**

- A. Manufacturer: Badger-Powhatan, Croker, Elkhart Brass, J.W. Moon, Potter-Roemer, and W.D. ALLEN
- B. Wall Mounted, polished chrome plated flush fire pump test connection outlet, three-way outlet body, male snoots, pin-lug caps with chains, removable swivel hose gate valves with 2-1/2" National Standard male hose thread outlets, 6" inlet, chrome plated lettered identification backplate.

2.26. **FIRE DEPARTMENT CONNECTION**

- A. Manufacturer: Badger-Powhatan, Croker, Elkhart Brass, J.W. Moon, Potter-Roemer, and W.D. ALLEN
- B. Polished chrome plated, flush fire department inlet, two-way inlet body, swing clappers, pin-lug swivels and caps with chains, 2-1/2" National Standard female hose thread inlets, 6" outlet, chrome plated lettered identification backplate reading "AUTO SPRINKLER".
- C. Cast aluminum or chrome plated adapter with Storz flush fire department inlet, female NPT outlet, hard coated aluminum Storz cap with attachment cable and screen. Cast brass escutcheon plate with lettering reading "AUTO SPRINKLER".

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION

- A. Contractor performing Division 21 work shall coordinate installation, rough in, wiring, and power requirements of devices/equipment requiring power connections in this specification and indicated on the drawings with Division 26 contractor.
- B. Contractor performing Division 21 work shall coordinate installation, programming, and fire alarm interfacing of all switches referenced in this specification and indicated on the drawings (supervisory/tamper, flow, pressure, etc.) with Division 28 contractor.
- C. Install pipe, fittings, equipment and components according to referenced standards, manufacturers' recommendations, recognized industry practices, and the authority having jurisdiction.
- D. General Coordination: Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of fire protection piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, ceiling grid layout, light fixtures and grilles before installing piping.
- E. Where piping must be embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- F. Do not install piping within exterior walls.
- G. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.
- H. Provide access to valves, equipment and specialties of other Divisions for maintenance.
- I. Provide clearance for access to valve and piping specialties to facilitate maintenance and repair or replacement.
- J. Provide 3/32" min. thickness steel nailing plates behind or on either side of piping where the possibility of penetration from nails or drywall screws exists.
- K. Maintain piping, fittings, and fire protection system components in clean condition internally during construction. Pipe ends shall be kept covered to prevent foreign material from entering. All material shall be kept at proper temperature to assure proper jointing. Pipe and fittings shall be corresponding materials when assembled.
- L. Mitered ells, notched tees, and orange peel reducers are not acceptable. Bushings and reducing couplings are not acceptable.
- M. Pipe shall be hung from building members using concrete inserts or beam clamps. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- N. Install sprinkler piping so that the system can be drained according to NFPA 13. Where possible, slope to main drain valve. Slope dry pipe and pre-action systems at minimum 1/4" in 10' on mains and 1/2" in 10' on branches. Where piping not susceptible to freezing cannot be fully drained, install nipple and cap for drainage of less than 5 gallons or ball valve with hose thread outlet and cap for drainage over 5 gallons. Pipe main drain valve, inspector's tests, and auxiliary drains to grade or to air gap sewer receptor.
- O. Install auxiliary drains at all low points in the system and as required by the referenced standards. The drain shall consist of, as a minimum, a 1-inch ball valve, 1-inch brass nipple with 3/4 -inch male hose threads, and cap. Configure auxiliary drains on dry pipe and preaction systems as drum drips.
- P. Fire Barrier Penetrations: Where pipes pass through fire-rated wall assemblies, partitions, ceilings or floors, the fire rating integrity shall be maintained.

3.2 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.3 COPPER PIPE JOINTS

- A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation and assemble joint to socket stop. Apply flame to fitting until brazing alloy melts when placed at joint. Wipe excess alloy from joint.

3.4 WELDED PIPE JOINTS

- A. Make all welded joints by fusion welding according to ASME Codes, ANSI B31, and State Codes where applicable.
- B. "Weldolets" and "Threadolets" may be used up to following sizes:

Maximum Weldolet/Threadolet Diameter	Main Pipe Diameter
3/4"	1-1/4"
1"	1-1/2"
1-1/4"	2"
1-1/2"	2-1/2"
2"	3"
3"	4"
4"	6"
6"	8"

3.5 THREADED PIPE JOINTS

- A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.6 MECHANICAL GROOVED PIPE CONNECTIONS

- A. Use pipe factory grooved according to the coupling manufacturer's specifications or field grooved pipe according to the same specifications using specially designed tools for the application. Lubricate pipe and coupling gasket, align pipe, and secure joint according to the coupling manufacturer's specifications.

3.7 UNIONS AND FLANGES

- A. Install a union or flanges at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

3.8 FLEXIBLE SPRINKLER DROP FITTINGS

- A. Install according to manufacturer's installation instructions following minimum bend radii, maximum number of bends and bend distance from end requirements.

3.9 UNDERGROUND WATER MAIN FLUSHING

- A. Conduct flushing of the underground water/fire main service as required by NFPA 13 and NFPA 24. The 200 PSI pressure test of the main shall be conducted by the installer of the main. The flushing operation is to be documented on NFPA Underground Contractor's Material and Test Certificate forms.

3.10 PIPING SYSTEM LEAK TESTS

- A. Conduct pressure test with test medium of water. If leaks are found, repair the area with new materials and repeat the test; caulking with not be acceptable.

- B. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints.
- C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
- D. Hydrostatically test system at 200 psi for 2 hours showing no leakage. Where system design is in excess of 150 psig. Test at a pressure 50 psig above system design pressure.
- E. For dry and preaction systems, pneumatically test system at 40 psi for 24 hours showing no leakage in addition to the hydrostatic test.
- F. All pressure tests are to be documented on NFPA Contractor's Material and Test Certificate forms.

3.11 SPRINKLER HEADS

- A. Install sprinkler heads as recommended by manufacturer. Locate sprinkler heads as indicated on approved shop drawings and reflected ceiling plan maintaining minimum clearances from obstructions, ceilings and walls. Install sprinkler heads level in locations not subject to spray pattern interference. When ducts, lights, or other objects are obstructions to sprinkler distribution, additional heads shall be provided beneath the obstruction.
- B. All sprinkler heads installed in finished ceilings shall be fed by a swing joint or return bend arrangement for final positioning in ceiling grid pattern during construction phases.
- C. For areas with finished ceilings, sprinkler head layout shall be based on center-of-tile placement.
- D. Install sprinkler heads level in locations not subject to spray pattern interference.

3.12 GAUGES

- A. Provide a valved pressure gauge in main fire protection riser, at or near each test connection, and at the top of each piping riser. Provide gauge with a connection having a soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gauges to permit removal, and where they will not be subject to freezing.

3.13 SWITCHES

- A. Switches: Locate flow and pressure switches where indicated and where required to obtain specified zoning to isolate floors and major areas of floors. Provide valved test connection for flow switch adjacent to flow switch. Pipe to exterior of building. Test flow switch to verify proper operation.

3.14 VALVES

- A. Properly align piping before installation of valves. Do not support weight of piping system on valve ends. Mount valves in locations which allow access for operation, servicing and replacement. Install all valves with the stem in the upright or horizontal position. Valves installed with the stems down will not be accepted. Provide a riser shutoff valve and a capped hose thread drain valve at the bottom of each riser. Provide capped hose thread drain valves to allow draining of each portion of piping.
- B. Install supervised-open gate valves located to control all sources of water supply except fire department connections. Each building shall have independent control valves for each sprinkler riser.
- C. Provide permanently marked identification signs indicating the portion of the system controlled by each valve.
- D. Provide tamper switch on each shut-off valve.

3.15 SPECIALTY VALVES

- A. Install in vertical position fire protection riser. Install trim recommended by manufacturer including drain and test valves. Pipe drains to exterior where possible, or to hub or floor drains. Test and adjust operation of valves, alarms, pressure maintenance devices, and deluge/preaction controls.

3.16 FIRE DEPARTMENT AND FIRE PUMP TEST HEADER CONNECTIONS

- A. Mount on wall where indicated and/or as required by the local fire department. Coordinate and verify final location with Owner / Architect prior to installation. Support from structure independent of piping. Locate between 2-feet to 3-feet above grade. Fill wall penetration with insulation and seal exterior and interior face of wall opening weathertight.
- B. Provide ½ - inch automatic drip drain on inlet of fire department connection check valve and where indicated.

3.17 DOUBLE CHECK VALVE ASSEMBLY

- A. Double check valve assembly shall be installed in one location to supply water to all sprinkler zones. Install per Wisconsin Administrative Code requirements.

3.18 CONDENSATION TRAPS AND DRAINS

- A. Provide sufficient condensation traps and drains for dry pipe system throughout the building in areas where plumbing drains are available to discharge the condensate. Route these drains to exterior where possible. If condensate drains are required where no plumbing drains are available, notify the Architect/Engineer as soon as possible to provide a means for drainage or to determine if drainage can be accomplished manually with buckets.

3.19 TEST CONNECTIONS

- A. Install test connections sized and located according to NFPA Standards, complete with shut-off valve. Test connections may also serve as drain pipes.
- B. Provide test connections for each flow switch. Test connections shall discharge to appropriate receptacles. Outside discharge shall not be allowed.
- C. When test valves are located remote from the flow switch, the valve shall be identified with a brass tag denoting which flow switch is being tested.

3.20 AIR COMPRESSOR

- A. Install on concrete housekeeping pad, leveled and bolted in place with vibration isolation. Pipe automatic drain discharge piping to floor drain. Install line size ball valve and check valve in discharge line. Install pressure gauge upstream of ball valve.

3.21 NITROGEN GENERATOR

- A. The nitrogen generation system shall be installed as directed by the manufacturer. Interface equipment with the air maintenance piping.
- B. Verify and set the air maintenance devices accordingly for each fire sprinkler zone to the proper setting.
- C. Install Oxygen Purge Vent on each dry and preaction sprinkler riser within the fire protection valve / riser room. Route gas supply tubing from push fitting on the inerting vent to corresponding push fitting on the vent controller. Route all tubing parallel and perpendicular to the building structure. Support gas supply tubing using tubing supports along the wall or zip tie the tubing to the sprinkler main every 3-4 feet to prevent sagging in the tubing supply.
- D. Provide one Protector Handheld Gas Analyzer for each nitrogen generator system. Store the Protector Handheld Gas Analyzer within the nitrogen generator equipment cabinet.
- E. Route ¼" condensate discharge drain to floor drain or install evaporative collection chamber in locations where there are no floor drains.
- F. Start-Up / Commissioning:
 - 1. The Fire Protection Contractor shall determine the operating pressure range for each dry and preaction sprinkler system and set and document the system air maintenance device for each.
 - 2. The Fire Protection Contractor shall document the twenty-four (24) hour leak rate, in psig/hour, of each existing fire sprinkler system and provide documentation as part of the As-Built document submittal. Also, affix a chart with this data within the nitrogen generator control cabinet.

3. The Fire Protection Contractor shall ensure all inerting vents are installed at the locations shown on the approved shop drawings. The isolation ball valve of each device shall be closed during hydrostatic and/or air pressure testing of the existing fire sprinkler systems and then placed in the open position for the commissioning and operation of the system.
4. Complete venting/purging process which may take up to 14-days. Return to the site periodically to ensure venting is complete and nitrogen generator is operating properly.

END OF SECTION 21 10 00

SECTION 21 22 00 – Clean Agent Fire Extinguishing Systems

PART 1 – GENERAL

1.1. SCOPE

- A. This Section includes clean-agent extinguishing systems, associated piping, clean agent, devices, panels, accessories, and connection devices.
- B. This specification outlines the requirements for engineering a “Total Flood” Clean Agent Fire Suppression System with automatic detection and control. The work described in this specification includes all design, engineering, labor, materials, equipment and services necessary and required, to complete and test the fire alarm/suppression system(s). The Clean Agent fire extinguishing system shall be an engineered system for total flooding of each hazard area as indicated on the Drawings.
- C. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances, switches and devices necessary for a sound, secure and complete installation in full compliance with all applicable codes and requirements of the local Authorities Having Jurisdiction (AHJ).
- D. The Clean Agent suppression system devices, components and equipment shall be new, standard products or the manufacturer’s latest design, addressable, and suitable to perform the functions intended.
- E. This specification is intended to provide the design and performance requirements for a Clean Agent fire suppression system. Vendors shall meet all specifications required herein. Any exceptions or proposed alternatives shall be submitted as a complete substitution request per the specifications prior to the bid and be accepted by the Architect/Engineer.
- F. All fees and permits specifically required for the Fire Alarm/Suppression protection work shall be applied for and paid for by the Fire Alarm/Suppression Contractor(s).

1.2. PERFORMANCE REQUIREMENTS

- A. The building shall be provided with a complete addressable fire alarm/suppression system. The specified Fire Alarm / Suppression Control Panel(s) (FACP) shall provide the fire alarm system for the facility, including clean agent and preaction system releasing. Reference the fire protection drawings for locations of preaction system detection and clean agent system devices. Reference the electrical/fire alarm drawings for locations of building fire alarm devices.
- B. Provide Fire Alarm Annunciator Panel(s) (FAAP) for the FACP. One (1) shall be provided at the main entrance, just inside of the entry door, to afford information as to the source of fire alarm, to first responders. If required, additional FAAP(s) shall be provided and indicated on the Drawings.
- C. Design Clean Agent extinguishing system and obtain approval from authorities having jurisdiction. Design system for Class A, B, and C fires as appropriate for areas being protected. Use Clean Agent indicated and in concentration suitable for normally occupied areas.
- D. The system shall be complete in all ways. It shall include all engineering, mechanical and electrical installation, all detection and control equipment, agent storage containers, Clean Agent, nozzles, pipe and fittings, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, HVAC shutdown and alarm interface, caution/advisory signs, functional checkout and testing, training and all other operations necessary for a functional, UL listed and/or FM approved, Clean Agent Fire Extinguishing System.
- E. All fire alarm related wiring shall be in conduit – no exceptions.
- F. The Fire Alarm/Suppression Control System which includes the fire alarm/suppression releasing panel (FACP), photoelectric smoke and heat detection devices, components and equipment shall be by the same manufacturer.
- G. The system shall provide a NOVEC 1230 or FK-5-1-12 agent minimum design concentration of 4.5% by volume or as required by the manufacturer, for Class C hazards, in all areas and/or protected spaces, at the minimum anticipated temperature within the protected areas. Systems design shall not exceed the NOAEL value of 10.0%, adjusted for maximum space temperature anticipated, unless provisions for room evacuation, before agent release, are provided. Complete Clean Agent Discharge shall be within 10

seconds and maintain a minimum 4.5% concentration by volume at the anticipated temperature for a MINIMUM of 10-minute holding time within the protected space or greater as determined by the zone integrity fan testing per Annex C of NFPA-2001. Design concentration may be higher depending on manufacturer's listing and/or approval.

H. Agent, Storage and Distribution:

1. The NOVEC 1230 or FK-5-1-12 agent shall be new agent provided as a brand-new product from the fire equipment manufacturer directly to the authorized distributor.
2. Distributor shall provide evidence of authenticity of the NOVEC 1230 or FK-5-1-12 by submitting documentation from the fire equipment manufacturer attesting to agent authenticity.
3. The use of reclaimed, recycled, pre-owned or re-manufactured NOVEC 1230 or FK-5-1-12 agent is prohibited and unacceptable.
4. Each protected Clean Agent zone shall have its own supply of NOVEC 1230 or FK-5-1-12 agent.
5. The system shall be modular, central storage, or a combination of both design criteria.
6. Systems shall be designed according to the manufacturer's guidelines and the requirements stated herein, for nozzle placement and coordination.
7. Each supply shall be located within the hazard area, or as near as possible, to reduce the amount of pipe and fittings required to install the system.

I. The Clean Agent Suppression System design nozzle placement shall be located in a symmetrical or near symmetrical pattern within the protected area. 180-degree nozzles shall be located on the long wall and shall not be located near or in corners of the protected area. 360-degree nozzles are designed to be located on, or near, the centerline of the protected area, discharging toward the perimeter of the area being covered. The system designers shall layout the nozzles on the floor plan coordinating with all trades and verify the entire area being protected is adequately covered without "Blind Spots" due to nozzle locations. Nozzle placement within the protected space shall follow the manufacturers design guide recommendations as a minimum.

J. The following critical areas as a minimum shall be provided with an approved engineered Clean Agent suppression system for protection of the entire room from structural ceiling to finished floor. If a raised floor is provided, the space below the floor will be protected with Clean Agent suppression system and provided with detection as well. Reference the Drawings for all protected areas.

K. The Clean Agent suppression system shall be actuated by photoelectric smoke detection. Release of the Clean Agent suppression system shall incorporate cross zoning sequential logic, requiring two detectors in alarm to initiate release of the system. Reference the drawings for Fire Protection Schedules, Operations Matrix Schedule for sequence of operations.

L. Monitoring:

1. The building will be supervised and monitored by a UL Listed Central Station, approved by the local fire department. An approved communicator, either a Digital Alarm Communicator Transmitter (DACT) or Subscriber Terminal Unit (STU), compatible with the central station, shall be provided.
2. The DACT or STU will communicate via POTS, alarm or other specified phone lines as required by the communicator. Early coordination with the Architect / Engineer and the Owner to provide these phone lines and location shall be required. These phone lines and verification Central Station is receiving signals are required prior to final with the AHJ.
3. Provide relay contacts for each signal.
4. Reference the Drawings for list of alarm signals required.

5. The following list describes the minimum signals to be sent to Central Station:
 - a. General alarm (smoke detection, heat detections, pull stations).
 - b. System trouble.
 - c. Sprinkler system water flow.
 - d. Supervisory alarms
6. Reference the Drawings for any additional alarm signals required and consult with the local AHJ for their requirements.

1.3. FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.4. RELATED DOCUMENTS

- A. Scope drawings and general provisions of the contract, including General and Supplementary Conditions, and the applicable provisions of Division 1, govern work under this section.
- B. The following technical plumbing specifications sections are directly related to the provisions of this section.

Section 21 05 00 – Common Work Results for Fire Suppression

Section 21 05 29 – Hangers and Supports for Fire Suppression Piping and Equipment

Section 21 10 00 – Water-Based Fire Suppression Systems

Division 26 - Electrical

1.5. CLEAN AGENT SUBMITTALS

1.5.1. GENERAL

- A. Refer to Division 1, General Conditions, "Submittals".
- B. Refer to the General and Supplementary Conditions and the applicable sections of Division 1 for submittal definitions, requirements, and procedures. Submittals of shop drawings and product data will be accepted only when submitted by the contractor. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.
- C. Shop drawing submittals are to be bound, labeled, contain the project manual cover page and a material index list page showing item designation, manufacturer and additional items supplied with the installation. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Include wiring diagrams of electrically powered equipment.
- D. Assemble and deliver O&M materials in electronic format using PDF files. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to the Architect / Engineer. Include each indexed document file in a composite electronic index with the applicable item name. Include a complete electronically linked operation and maintenance directory. Enable inserted reviewer comments on draft submittals.
- E. Scan warranties and bonds and assemble a complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide a bookmarked table of contents at the beginning of the document.

1.5.2. PRODUCT DATA

- A. Submit manufacturer's technical product data as a minimum, but not limited to, for the following:
 - 1. Addressable Fire Alarm/Suppression Control Panel(s).
 - 2. Fire Alarm Annunciator Panel(s).
 - 3. Addressable EWFD devices.
 - 4. Addressable input/output and monitoring devices.
 - 5. Switches.
 - 6. Notification devices and related devices and equipment.
 - 7. Any non-addressable devices such as control relays if needed, etc.
 - 8. Signs and labels for fire alarm equipment and devices.
 - 9. Extinguishing agent containers.
 - 10. Extinguishing agent.
 - 11. Discharge nozzles.
 - 12. Firing modules.
 - 13. Wiring diagrams.
 - 14. Equipment ratings.
 - 15. Pipe hangers and supports.
 - 16. Signs and labels for Clean Agent warning, operation, notification and associated devices.
 - 17. Description of system operation for each product and that the system meets or exceeds specified requirements.

1.5.3. SHOP DRAWINGS

- A. Shall be prepared by persons with the following qualifications:
 - 1. Trained and certified by manufacturer in Clean Agent fire suppression system design.
 - 2. NICET certified special hazards suppression system technician, Level II minimum.
 - 3. NICET certified fire alarm system technician, Level III minimum.
 - 4. If required, licensed and/or certified by the authorities having jurisdiction.
- B. Shop drawing documents must be submitted simultaneously with sprinkler system and the digital, addressable fire alarm system and prior to installation.
- C. Information shall be submitted on 1/8" = 1'-0" scale building floor plans. Reproduction of contract drawing will not be acceptable. The following information shall be included in the Shop Drawings:
 - 1. Occupancy group and use.
 - 2. Number of stories.
 - 3. Indicate Clean Agent Zone information on the Drawings.
 - 4. Indicate Sprinkler Zone information on the Drawings.
 - 5. Indicate whether fire alarm system is required or non-required, and list code sections required by and applicable to.
 - 6. Include brief description of scope of work.
 - 7. One-line diagram showing/indicating number of devices and appliances per zone/circuit.
 - 8. Provide mounting details of fire alarm control panel (s) and power supplies and other boxes to building structure, showing fastener type, sizes, material, and embedded depth where applicable.
 - 9. Plans, elevations, sections, details, and attachments to other work. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
 - 10. The fire alarm contractor shall coordinate with the Owner and Architect / Engineer for final room names and numbers.

11. A separate drawing, showing isometric details of agent storage containers, mounting details, and proposed pipe runs and sizes.
 12. Complete hydraulic flow calculations, from a UL listed computer program, shall be provided for all engineered Clean Agent systems. Calculation sheet(s) must include the manufacturer's name and U.L. listing for verification. The individual sections of pipe and each fitting to be used, as shown on the isometrics, must be identified and included in the calculation. Total agent discharge time must be shown and detailed by zone.
 13. A complete sequence of operation shall be submitted detailing all alarm devices, shutdown functions, remote signaling, damper operation, time delay and agent discharge for each zone or system.
- D. The following Calculations and Wiring Diagrams shall also be included on the Shop Drawings:
1. Power, signal, and control wiring.
 2. Wire sizes and type(s).
 3. Wiring diagrams showing points of connection and terminals used for all electrical connections to the system devices and panels. Indicate on the point-to-point wiring diagrams, interconnecting wiring within the panel between modules, and connecting wiring to the field device terminals.
 4. Provide an internal control panel wiring diagram which shall include power supply requirements and field wiring termination points.
 5. Provide calculations for the battery stand-by power supply taking into consideration the power requirements of all alarms and auxiliary components under full load conditions. Include battery size calculations.
 6. Show system components, including panels and cabinets, locations, quantities, and full schematic of system wiring showing conductor size, routings, quantities and connection details.
 7. Submit for approval prior to installation of wire, a proposed for system conductors to allow rapid identification of circuit types.
 8. All shall be in conduit and all conduit routing must be submitted to, and accepted by, the Architect / Engineer.
 9. All NAC circuits require a minimum of #14AWG – no exceptions.
 10. All fire alarm/suppression wiring shall meet NFPA-72 and NFPA-2001 requirements.
- E. Design Calculations: For weight, volume, and concentration of extinguishing agent required for each hazard area.
- F. HVAC Smoke Detection Systems:
1. Include performance parameters and installation details for detectors used in air handling systems. Provide documentation that the detector is listed for the complete range of air velocity, temperature, and humidity possible when the air handling system is operating.
 2. Include plans, sections, and elevations of AHU's duct work drawn to scale and coordinating installation of duct smoke detectors. Show critical dimensions that relate to placement and support of duct air sampling tubes, detector housing and remote status and alarm indicators. Locate detectors according to manufacturer's written documentation.
- G. Comply with recommendations in NFPA-72, Current Adopted Edition, Fundamentals, Documentation Section.
- H. Permit Approved Drawings: Working plans, prepared according to NFPA-2001, that have been approved by authorities having jurisdiction. Include design calculations.
- I. Warranty information.
- 1.6. DELIVERY, STORAGE, AND HANDLING
- A. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.

- B. Cover pipe to prevent corrosion and deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage or by durable, waterproof, above ground packaging.
 - C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
 - D. Storage and protection methods must allow inspection to verify products.
- 1.7. GUARANTEE
- A. The contractor, by acceptance of this contract, guarantees all labor and materials, provided hereunder and shall at his expense repair, remodel, rebuild, replace and/or rewire and further make good and acceptable all labor and materials found defective within one year from the date of final acceptance or found in violation of applicable Codes or regulations, in force at the time of bidding, within five years from said date.
 - B. Repair, replace, or alter systems or parts of systems found defective at no extra cost to the Owner.
 - C. Guarantee that clean agent system including but not limited to; piping network, nozzle locations, nozzle mounting heights, cylinder fill for specified agent concentration during discharge, are all in compliance with their respective calculations, manufacturer's requirements, and listings (UL and FM).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Steel Pipe: ASTM A-53/A-53M, Type S, Grade B or ASTM A-106, Grade B; Schedule 40, or Schedule 80, seamless pipe. Ordinary cast-iron pipe or steel pipe conforming to ASTM A-120 shall not be used.
- B. Threaded Fittings: Malleable-iron fittings: ASME B16.3, Class 300
- C. Flanges and flanged fittings ASME B16.5, Class 300, unless 600 is indicated.
- D. Grooved-end Fittings: FMG approved and NRTL listed, ASTM A-47/A-47m malleable iron or ASTM A-536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.
- E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.
- F. Reductions in pipe size shall be made with reducing fittings, reducers or swaged nipples. Reducing bushings are not permitted.
- G. Refer to Part 3 piping applications Article retained for applications of pipe, tube, fitting, and joining materials.
- H. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA- 2001, Section "Distribution," for charging pressure of system.

2.3 PIPE, FITTINGS, HANGERS AND SUPPORTS

- A. Reference manufacturer's requirements.
- B. Refer to the Drawings for additional Clean Agent pipe and fittings requirements.
- C. Comply with types and standards listed in NFPA-2001, current edition, Section "Distribution," for charging pressure of system along with relevant sections for piping and fittings.
- D. Beam clamps shall have a restraining strap when used for supporting dead loads. Lock nuts not approved for restraint.
- E. Beam clamps (with or without restraining straps) shall not be used to attach braces to the building structure.
- F. Hanger rods less than 3/8-inch diameter are not permitted.
- G. Powder-driven fasteners or hangers shall not be used.

- H. Piping and nozzles shall be braced at all direction changes and at 10' maximum spacing. Refer to ANSI B31.1 for bracing requirements. Brace piping and nozzles from structure. Nozzles shall be braced at the nozzle for discharge force.
 - I. Mount and secure cylinders per the manufacturer's requirements. Cylinders shall be securely fastened meeting all the seismic requirements of the area.
- 2.4 VALVES
- A. General: Brass; suitable for intended operation.
 - B. Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.
- 2.5 EXTINGUISHING CLEAN AGENT
- A. Clean Agent, no substitutions:
 - 1. NOVEC-1230 by 3M
 - 2. FK-5-1-12 by Fike or Kidde
 - B. Manufacturers, no substitutions:
 - 1. Fike Corporation - Container sizes: 215lb, 375lb, 650lb and 1000lb.
 - 2. Kidde Fire Systems – Container sizes: 250lb, 350lb, 600lb and 900lb.
 - C. The Clean Agent shall be stored in the manufacturer's agent storage containers.
 - D. Container sizes shown are for comparison between manufactures, cylinder sizes shall be based on agent required and volume of area protected. Smaller cylinders may also be needed, but not indicated above.
- 2.6 EXTINGUISHING AGENT CONTAINERS
- A. Steel tanks/containers complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.
 - B. Finish: Manufacturer's standard color, enamel or epoxy paint.
 - C. Agent storage containers shall be new and manufacturer date no older than six months earlier than delivery date.
 - D. No used, recertified, pre-owned or re-manufactured agent containers are acceptable.
 - E. Each container shall have a pressure gauge. The pressure gauge shall be color coded to provide easy visual indication of container pressure.
 - F. Each container shall be fitted with a liquid level device. It shall be possible to determine the container agent quantity without removing the container from its mounting bracket, disconnecting the distribution piping, or removing the Clean Agent system from service.
 - G. Storage Container Brackets: Factory retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement, see storage mounting requirements below.
 - H. Storage Container Mounting: Each container shall be provided with stands as indicated on the Drawings to secure container to floor and building structure. Reference the drawings for additional requirements for tank mounting stands.
- 2.7 DISCHARGE NOZZLES
- A. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, discharge pattern, and capacity required for application.
- 2.8 CLEAN AGENT SYSTEM
- A. General Requirements: The Clean Agent system materials and equipment shall be standard products of the manufacturer's latest design and suitable to perform the functions intended. When one or more pieces of equipment must perform the same functions, they shall be duplicates produced by one manufacturer.
 - B. Manufacturers:
 - 1. All system components of the Clean Agent System including the Addressable Control Panels and Addressable Devices shall be the product of the same manufacturer. Example: Fike FM-200, Clean Agent container, releasing devices, addressable control panel, detection, monitoring, control modules and any or all additional devices for a complete Clean Agent releasing system.

2. Addressable Control Panels shall be UL864 9th Edition listed, no substitutions:
 - a. Fike Model: Cheetah XI
 - b. Kidde Model: Aries MLX
3. Addressable Devices, compatible with addressable control panel, no substitutions:
 - a. Fike
 - b. Kidde
4. All devices and equipment shall be UL Listed and/or FM approved.

2.9 SYSTEM OPERATIONAL DESCRIPTION

- A. Fire alarm signal initiation shall be by one or more of the following devices or systems as a minimum, reference drawing Sequence of Operations for all signals:
 1. Manual pull stations – building or suppression release.
 2. Heat detectors.
 3. Smoke detectors.
 4. Duct smoke detectors – only if required by the AHJ, if acceptable supervisory output only – does NOT roll fire trucks.
 5. Verified automatic alarm operation of a smoke detector.
 6. Automatic sprinkler system water flow.
 7. Smoke or heat detector in elevator shaft.
 8. Clean Agent extinguishing system operation.
- B. Fire alarm signal shall initiate the following actions as a minimum, reference Sequence of Operations for all signals:
 1. Continuously operate alarm notification devices.
 2. Identify alarm at the fire alarm control panel and remote annunciator panels.
 3. Transmit an alarm signal to Central Station.
 4. Send signals to BAS for control of all AHU's and dampers associated with the zone in which the alarm was initiated.
 5. Recall elevators to primary or alternate recall floors.
 6. Record events in the system memory.
 7. Reference the Fire Protection, Mechanical and Electrical Drawings and specifications related to the BAS system for all functions.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions as a minimum, reference drawing Sequence of Operations for all signals:
 1. Sprinkler valve supervisory switch.
 2. Preaction sprinkler low air pressure switch.
 3. Elevator shunt trip supervision.
- D. System trouble signal initiation shall be by one or more of the following devices and actions as a minimum, reference drawing Sequence of Operations for all signals:
 1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm initiating and supervisory signal initiating devices.
 3. Loss of primary power at the fire alarm/suppression control panel.
 4. Ground or single break in the fire alarm/suppression control panel internal circuits.
 5. Abnormal ac voltage at the fire alarm/suppression control panel.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at the fire alarm/suppression control panel or annunciator.
 9. Preaction sprinkler low air pressure switch.

- E. Telecommunication rooms protected by photoelectric smoke detection using Clean Agent Fire Extinguishing Systems shall have an automatic operation of each protected room/space or zone. Reference drawing Sequence of Operations.
- F. Elevator smoke detection and recall operation:
 - 1. Elevator Recall:
 - a. Smoke detectors at the following locations shall initiate automatic elevator recall: Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in the elevator machine room.
 - c. Smoke detector in the elevator hoist way.
 - 2. Elevator lobby detectors located on the designated floor shall be programmed to move the car to the alternate recall floor.
 - 3. Water flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a. Water flow switch associated with the sprinkler in an elevator pit may have a delay to allow elevators to move to the designated floor.

2.10 CONTROL PANELS

- A. Addressable Control Panels:
 - 1. All system components of the Clean Agent System shall be the product of the same manufacturer.
 - 2. All Fire Alarm/Suppression Control Panels shall be UL 864 10th Edition compliant, addressable and listed for releasing of the respected Clean Agent systems being supplied and listed for the activation of the preaction sprinkler solenoid valve.
 - 3. Primary Power:
 - a. 24-V dc obtained from a dedicated 120V ac service and a power supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals and digital alarm communicator transmitters shall be powered by 24-V dc source.
 - b. Alarm current draw of entire fire alarm system shall not exceed 80 percent of the power supply module rating.
 - 4. Secondary Power:
 - a. 24-V dc supply system with batteries per manufacturer's specifications, automatic battery charger and automatic transfer switch.
 - b. The system shall have a minimum of 24 hours battery backup, additional back up time may be required. Refer to the local AHJ requirements that may be imposed.
- B. Enclosure: Manufacturers standard color, enameled-steel cabinet.
 - 1. Mounting: Surface.
- C. Supervised Circuits:
 - 1. Addressable devices assigned to the required number of zones.
 - 2. Manual pull station circuit.
 - 3. Alarm circuit.
 - 4. Release circuit.
 - 5. Abort circuit.
- D. Provide the following control-panel features as a minimum, but not limited to:
 - 1. Reference the Drawings for the contacts required to send signals to the Building Automation System (BAS) and Central Station.
 - 2. Provide individual SLC loops for fire alarm and suppression devices to aid in troubleshooting and maintenance.
 - 3. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.

4. Clean Agent storage container, low-pressure indicator.
 5. Service disconnects to interrupt system operation for maintenance with visual status indication on the annunciator panel.
- E. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- 2.11 REMOTE ANNUNCIATOR
- A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire- alarm control unit, including acknowledging, silencing, resetting, and testing.
1. Mounting: Recessed flush with surface.
 2. When panel is recessed it must meet UL Listing requirements for installation in fire rated partitions.
- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.
- 2.12 DETECTION DEVICES
- A. All detection devices, monitoring modules, control modules, system components, etc. of the Clean Agent System shall be addressable and the product of the same manufacturer unless otherwise indicated in the Clean Agent System, Manufacturers Article above.
- B. Comply with the current editions of NFPA-2001 and NFPA-72.
- C. System Smoke Detectors:
1. Shall be low profile in design.
 2. Shall be addressable photoelectric smoke detectors capable or responding to a broad spectrum of both flaming and smoldering fire conditions.
 3. Capable of a range 0.5% (pre-alarm) - 2.0% (alarm) per foot smoke obscuration.
- D. System Duct Detectors:
1. Shall be addressable photoelectric duct smoke detector.
 2. Provide duct smoke detectors in the supply ducts for all HVAC units with a cfm capacity equal to or greater than 2000 cfm.
 3. Program the duct smoke detector as a supervisory input, unless directed otherwise by the AHJ.
 4. Duct smoke detectors will be programmed as supervisory, not fire alarm devices, except when AHJ requires duct detector to report as alarm.
 5. Provide remote test/annunciator stations for each duct detector, location to be determined and coordinated prior to mounting.
 6. If required by the AHJ duct detectors shall be wired for AHU shutdown, provide necessary relays for shutdown.
 7. If the HVAC unit(s) has duct smoke detectors installed at the factory provide addressable monitoring modules for these detectors.
- E. System Heat Detectors:
1. Shall be low profile in design.
 2. Shall be addressable thermistor-based heat detector.
 3. Combination heat detector type actuated by either a fixed temperature of 135 degrees F or a rate of rise that exceeds 15 degrees F per minute unless otherwise indicated.

2.13 MANUAL STATIONS

- A. Building Fire Alarm:
 - 1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual station status (normal, alarm, or trouble) to the suppression control panel.
- B. Clean Agent Release:
 - 1. Double-action mechanism requiring two actions to initiate a Clean Agent release, pull-lever type; with integral addressable module arranged to communicate release station status (normal, alarm, or trouble) to the suppression control panel.
 - 2. Manual actuation shall cause the system to discharge and shall cause all alarm and functions to operate in the same manner as the system had operated automatically, including necessary time delay to ready the space for agent discharge (closure of dampers, doors, and shutdown of HVAC).
 - 3. Provide with clear plastic hinged cover to prevent accidental manual release. Stopper II by STI, Inc. or equal.
- C. Abort Stations
 - 1. The abort station shall be a mushroom style, large push button dead man type, and shall be located next to each manual release stations. Mount leaving room and taking into account the hinged plastic cover over the manual release station.
 - 2. The abort station shall be supervised and shall indicate a trouble condition at the suppression control panel if depressed.
 - 3. Locking or keyed abort stations will not be permitted.

2.14 SYSTEM INHIBIT SWITCHES

- A. Provide a single Clean Agent Inhibit Switch for each Clean Agent zone. One keyed selector switch shall be provided to disable the automatic release of Clean Agent. The Clean Agent inhibit switch shall function as a maintained abort switch for the Clean Agent system.
- B. The Clean Agent Inhibit switches shall be monitored by the fire alarm control panel and send a supervisory signal when placed in the inhibit position. The open circuit caused by the physical circuit opening shall also generate a trouble signal.
- C. Provide flashing amber strobe located in the zone. The strobe in each zone shall flash until the key switch is restored to normal.
- D. Reference the Drawings for additional switch details.

2.15 AUDIBLE AND VISUAL DEVICES

- A. Building Notification Devices:
 - 1. Approved Manufacturers:
 - a. System Sensor.
 - b. Cooper Wheelock.
 - c. Gentex.
 - 2. Ceiling mounted horn/strobes shall be white.
 - 3. All notification devices shall be multi-candela, field selectable candela settings.
 - 4. Unless indicate otherwise, alternate manufacturers are considered based on an approved substitution request.
- B. Clean Agent Protected Zones:
 - 1. Provide, second alarm, pre-discharge 6-inch bells within each protected space. Bells shall be UL listed for Fire Protective Service, 24-V dc input voltage rated at 92 dba at 10 feet. Provide signs/labels below the bell indicating Clean Agent discharge alarm and evacuation from the protected space.
 - 2. Provide red discharge strobes with white mounting plates for Clean Agent discharge outside each entrance into the protected space.
 - 3. Reference Drawings for additional information and signage requirements.

- C. Provide synchronization modules or separate power supplies to synch building fire alarm devices with clean agent notification devices in clean agent zones.
- 2.16 CLEAN AGENT CAUTION AND ADVISORY SIGNS
- A. Provide all signs as required to comply with NFPA-2001 and the recommendations of the equipment manufacturer. Reference the drawings for additional signage and requirements.
 - 1. Door and Entrance Signs: required at each entrance to a protected space.
 - 2. Manual discharge sign: required at each manual discharge station.
 - 3. Abort station sign: required at each abort station.
 - 4. Notification device signs: required at each light, strobe or bell.
- 2.17 FIRE PROTECTION SYSTEM IDENTIFICATION
- A. Clean Agent Pipe Labeling:
 - 1. Piping, including that concealed in accessible spaces, shall be labeled to designate service. Each label shall include surrounding arrow tape on both ends to indicate flow direction.
 - 2. Piping shall be labeled and arrowed according to the following:
 - a. Each point of entry and exit through walls.
 - b. Each change of direction.
 - c. In congested or hidden areas, at each point required to clarify service or indicate hazard.
 - d. In long straight runs, labels shall be located at a distance visible to each other, but in no case shall the distance between labels exceed 20 feet.
 - 3. Label lettering shall be approximately 1-1/2 to 2 inches high based on outside pipe diameter. Labels shall be legible from the primary service and operating level.
 - 4. Labels shall be made of self-sticking plastic film designed for permanent installation. Labels shall have red letters on white background or white letters on a red background.
 - 5. Label schedule above shall not be construed as defining or limiting the work. All piping systems shall be labeled.
 - B. Device Labeling:
 - 1. All control, alarm, warning, monitoring, and operational devices shall be accompanied with a sign or placard clearly identifies the devices purpose of operation. Signs and placards are to be high quality products made of engraved or stenciled plastic and firmly affixed to their mounting surface adjacent to the device they identify.
 - 2. All addressable devices shall have labels applied to the surface of the device and shall be visible on approach to the device. Apply label so it does not affect the function of the device. Installation on the devices shall be done in a professional manner indicating the SLC loop they are on and the address of the device. This information shall be produced by a labeling machine such as manufactured by brother "p-touch" labeling system using 1/2" black text on clear extra strength tape. Text is to be bold/solid standard type font.
 - 3. Standard writing of the address of the device on the back side or non-visible side is also required. Hand writing on the visible side of the device with a marker is not allowed or acceptable.
- 2.18 ELECTRICAL POWER AND WIRING
- A. Coordinate this Article with Division 26 and 28 Sections and edit to meet project requirements.
 - B. General: All power and distribution shall meet the requirements of the manufacturer, applicable codes and standards, electrical requirements of Division 26.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with hazard area leakage requirements, installation tolerances, and other conditions affecting work performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF MATERIALS AND EQUIPMENT

- A. General: All equipment, distribution piping and fittings shall be installed in strict accordance with the manufacturer's requirements, NFPA-2001 and approved piping standards and guidelines.
- B. All distribution piping and equipment shall be installed by qualified individuals using good, accepted practices and quality workmanship procedures.

3.3 INSTALLATION OF BASIC WIRING SYSTEM MATERIALS

- A. Wiring:
 - 1. Wiring shall be enclosed in conduit in compliance with Division 26. Wiring is to include but is not limited to all wiring routed above ceilings; all wiring associated with interfaces to the Fire Alarm system, and all Clean Agent System communication wiring.
 - 2. All wiring shall be installed in metallic conduit with a minimum size of 3/4". All conduits shall be concealed, except in crawl spaces or tunnels, unfinished spaces and mechanical or electrical rooms. In areas without finished ceilings, route conduit exposed overhead, but conceal conduit drops within the wall construction to devices.
 - 3. Conduit shall be fastened securely at regular intervals and shall be run parallel to the building lines.
 - 4. 24-V dc control wiring shall not share conduit with power wiring.
 - 5. Communication wiring shall not be installed in raceway and enclosures containing Class 1 or other Class 2 wiring.
 - 6. Maximum pulling, tension, and bend radius for cable installation as specified by the cable manufacturer shall not be exceeded during installation.
 - 7. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
 - 8. Communication wiring shall be installed in continuous lengths. Spliced wires are not acceptable.
 - 9. All analog signal and communications wiring between field devices and panel must be "continuous run", no splices shall be permitted. If splice is required, connections, (including shield) must be soldered and taped.
 - 10. Signal integrity of spliced cables must be checked with oscilloscope and appropriate signal generator and lines so tagged.
 - 11. All connections with the panels must be made with spade connectors of appropriate size and design for terminals being applied.
 - 12. All cables must be labeled and identified on corresponding termination Drawings.
 - 13. Final connections between equipment and the system wiring shall be made under the direct supervision of a factory trained representative.

3.4 EQUIPMENT INSTALLATION

- A. Comply with NFPA-72 and according to the manufacturer's written instructions for installation of fire alarm equipment.
- B. Wall Mounted Panels and Devices:
 - 1. Flush mounted where wall construction allows. Where flush mounted in fire rated partitions or walls, shall provide appropriate UL Listed devices for such application. Surface mount wall devices shall require coordination and approval.
- C. Equipment Mounting:
 - 1. Install fire alarm control panel with top of cabinet not more than 72 inches above the finished floor.

- D. Smoke or Heat Detectors:
 - 1. HVAC: Do not locate detectors within 3 feet from air supply diffusers or return air openings or as indicated in manufacturer's literature.
 - 2. Lighting Fixtures: Do not locate detectors within 12 inches from any part of a lighting fixture or as indicated in manufacturer's literature.
 - 3. Reference Drawings for EWFD detection installation, locations and spacing.
- E. Duct Detectors:
 - 1. Comply with NFPA- 72 and NFPA-90A.
 - 2. Install sampling tubes so they extend full width of duct or as required by manufacturer.
- F. Smoke / Heat Detectors in Elevator Shafts:
 - 1. Coordinate temperature rating and location with local AHJ requirements.
 - 2. Locate detectors within 24" of the sprinkler.
- G. Alarm Indicating Devices:
 - 1. Install so that the entire lens is 80 inches above finished floor.
 - 2. At least 6 inches below the ceiling if the ceiling height is insufficient.
- H. Annunciator:
 - 1. Mount top of panel at least 60 inches and not more than 72 inches above finished floor.
- I. Manual Pull Stations, Clean Agent Release and Clean Agent Abort Stations:
 - 1. Install 48 inches, to handle, above finished floor.

3.5 SYSTEM INTERLOCKS AND OPERATION

- A. Fire Alarm/HVAC Interface:
 - 1. Fire Alarm/HVAC Interface:
 - a. The Fire Alarm Contractor shall provide relay contact outputs via form C contacts to allow for fire/smoke damper closure and HVAC shutdown in each clean agent zone.
 - b. The Fire Alarm Contractor shall provide relay contact outputs via form C contacts to allow for equipment shut down where indicated on the drawings. Small HVAC equipment contained within the clean agent zone will not be required to shut down.
 - 2. Wiring and conduit shall be provided per Division 26 from the Fire Alarm Control Panel to the fire alarm relay and mechanical equipment.
 - a. The Fire Alarm Contractor shall be responsible for termination at the Fire Alarm Panel and relay contacts.
 - b. The HVAC or BAS Controls contactor shall be responsible for termination at the mechanical damper or equipment and relay contacts.
 - 3. All system testing shall be coordinated with this Section 212200, Clean Agent Fire Suppression System, Division 23, and controls contractors.

3.6 PIPING APPLICATIONS

- A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.
- B. Fittings Working Pressure: 620 psig minimum.
- C. Flanged Joints: Class 300 minimum.
- D. NPS 2 and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.
- E. NPS 2-1/2 and NPS 3: Schedule 40, steel pipe; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
- F. NPS 4 and Larger: Schedule 40, steel pipe; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.

3.7 CLEAN AGENT EXTINGUISHING PIPING AND CONTAINER INSTALLATION

- A. Install Clean Agent extinguishing piping and other components level and plumb and according to manufacturers' written instructions.
- B. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices.
- C. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.
- D. Install extinguishing agent containers as indicated on the Drawings. Container shall be secured as stated in Article 2.6, Extinguishing Clean Agent and Containers, Storage Container Mounting, and as indicated on the drawings.
 - 1. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA-2001, Section "Distribution," and in ASME B31.1.
 - 2. Install valves designed to prevent entrapment of liquid or install pressure relief devices in valved sections of piping systems.
 - 3. Support piping using supports and methods according to NFPA-13.
 - 4. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA-2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.
 - 5. All piping shall be adequately supported and anchored at each directional change and each nozzle location.
 - 6. Nozzle locations shall be coordinated to avoid obstructions; 3-foot minimum clearance shall be required from ductwork, adjacent walls, cable tray, sprinkler piping, electrical conduits, etc.
 - 7. Clean agent nozzles shall be braced for back-pressure at 180-degree nozzle locations within 12-inches of the nozzle location.
 - 8. 360-degree nozzles shall be braced for discharge pressure per the manufacturer's requirements.

3.8 IDENTIFICATION

- A. Install labeling on piping, extinguishing agent containers, other equipment, and panels according to NFPA-2001. Identify extinguishing agent containers with cylinder number (example: Cylinder 1 of 2) and the zone or room number.
- B. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a Clean Agent fire extinguishing system. Install warning signs within the clean agent zone as well per NFPA-2001.
- C. Install signs at entry doors to advise persons outside the room the meaning of the strobe light(s) outside the protected space and located in the control room.
- D. All control, alarm, warning, monitoring and operational devices shall be accompanied with a sign or placard that clearly identifies the devices purpose and basic mode or purpose of operation.
- E. Install additional labeling as indicated on the Drawings and as stated in these specifications.
- F. Label monitor modules and relays with the device address and the purpose it serves (i.e. tamper switch, damper control, etc.).

3.9 FIELD QUALITY CONTROL

3.9.1 GENERAL

- A. Perform tests and inspections.
- B. The complete system shall be functionally tested, in the presence of Architect / Engineer and/or Owner's Representative, and all functions, including system and equipment interlocks, must be operational at least five (5) days prior to the final acceptance tests.
- C. All tests and inspections required by the referenced Codes and Standards, Fire Department, and the Owner shall be performed by the contractor under this scope of work.

- D. When local code authorities are required to witness tests, the contractor shall be responsible for making all necessary arrangements with the code authorities and coordinating the work with the Owner.
- E. The contractor shall be responsible for obtaining all test documents with necessary approval stamps and signatures of the code authorities. The contractor shall submit one copy of each of these documents to the Owner.

3.9.2 TESTS AND INSPECTIONS

- A. General Testing:
 - 1. Test intelligent analog devices for correct address and sensitivity using test equipment specifically designed for that purpose. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the system address, initials of the installing technician and date.
 - 2. All system and equipment interlocks, such as door release devices, audible and visual devices, equipment shutdowns, local and remote alarms, etc. shall function as required and designed.
 - 3. Each control panel circuit shall be tested for trouble by inducing a trouble condition into the system.
 - 4. All HVAC interfaces and shutdowns shall be tested with the HVAC control contractor per approved HVAC controls operational matrix.
 - a. Fire protection contractor must witness and verify that all required HVAC interlocks and FSD's operate according to the plans.
 - b. Copies of successful test results shall be submitted to the Owner for record.
 - 5. Test wiring runs for continuity, short circuits, and grounds before system is energized. Test and record resistance, current, and voltage readings as work progresses.
 - 6. Field tests shall be performed for all devices and functions of the fire alarm system (100%) prior to the performing a final test to be witnessed and accepted by the local AHJ. All testing shall be coordinated with the Architect / Engineer and the Owner.
- B. Visual Inspection:
 - 1. Conduct visual inspection prior to testing.
 - 2. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA-72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
- C. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA-72; retain the "Initial/Reacceptance" column and list only the installed components.
- D. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA-72.
- E. Test audible appliances for the public operating mode according to manufacturer's written instructions.
- F. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
- G. Test audible appliances for the private operating mode according to manufacturer's written instructions.
- H. Test visible appliances for the public operating mode according to manufacturer's written instructions.
- I. Factory authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA-72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA-72.

- J. The Clean Agent Suppression system shall comply with operating instructions and procedures of NFPA-2001, Section "Approval of Installations." Include the following tests and inspections to demonstrate compliance with requirements:
1. Check mechanical items.
 2. Inspect extinguishing-agent containers and extinguishing agent, and check mountings for adequate anchoring to substrate.
 3. Check electrical systems.
 4. Check enclosure integrity. Comply with NFPA-2001, Section "Enclosure Inspection," and Appendix C, "Enclosure Integrity Procedure."
 5. Prior to performing the tests, fire protection contractor shall conduct a room by room inspection with the contractor.
 6. Discovered deficiencies will be documented by written report by the fire protection contractor and communicated to the contractor.
 7. Fire protection contractor shall schedule room integrity tests only after verification that deficiencies are corrected.
 8. Two (2) Room Integrity Fan pressurization test shall be conducted, in each protected space, to determine the presence of openings, which would affect the agent system concentration levels.
 - a. The first preliminary test is to address leakage issues. The fire protection contractor shall be responsible for coordinating the proper sealing of the protected space(s) by the general contractor or his sub-contractor or agent.
 - b. The contractor shall be responsible for adequately sealing all protected space(s) against agent loss or leakage. The fire protection contractor shall inspect all work to ascertain that the protected space(s) have been adequately and properly sealed.
 - c. The second is to perform the final test for the local AHJ only after the preliminary test has passed and all room integrity issues have been resolved. The test(s) shall be conducted using the Retro-Tec Corp. door fan system, or equivalent, with integrated computer program. If the second room pressurization test is not successful, according to these specifications the contractor shall determine and correct the cause of the test failure and shall provide the necessary repairs, testing and successful passing of all tests is obtained.
 - d. The installing contractor shall conduct additional room pressurization tests (at additional cost; at previously stated and agreed upon price) until a successful test is obtained.
 - e. The contractor shall be responsible for the success of the room integrity tests, NOT the fire protection contractor.
 9. Perform functional pre-discharge test.
 10. Perform system operational test including, abort, and manual release functions.
 11. Check remote monitoring operations.
 12. Check control panel primary power source.
 13. Perform "puff" test on piping system, using nitrogen.

3.10 FIELD TESTS AND INSPECTIONS

- A. Perform the following field tests and inspections and prepare test reports:
1. After installing Clean Agent extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.
 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.
 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
 5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - B. Correct malfunctioning equipment, and then retest to demonstrate compliance. Replace equipment that cannot be corrected or does not perform as specified and indicated, then retest to demonstrate compliance.
 1. Repeat procedure until satisfactory results are obtained.
 - C. Report test results promptly and in writing to Architect / Engineer, the Owner's Representative and Authorities Having Jurisdiction.
- 3.11 ACCEPTANCE TESTS
- A. Prior to final acceptance, the installing contractor shall provide complete operation and maintenance instruction manuals, two hard copies and two electronic versions as stated below for each system, to the Owner's Representative and one hard copy and one electronic copy of each system to the Architect / Engineer. All aspects of system operation and maintenance shall be detailed, including piping isometrics, wiring diagrams of all circuits, a written description of the system design, sequence of operation and drawing(s) illustrating control logic and equipment used in the system. Checklists and procedures for emergency situations, troubleshooting techniques, maintenance operations and procedures shall be included in the manual.
 1. Electronic Documentation:
 - a. Submit thumb drives labeled as Fire Alarm/Suppression System to include date and reference as to project information.
 - b. The thumb drive shall contain all AutoCAD Record Drawings and graphic maps saved in an AutoCAD version 2020 and later format. PDF version of all Record Drawings, graphic maps, fire alarm system program, electronic version of the all documents contained in the Operations and Maintenance Manual as indicated above.
 2. Final Acceptance Test shall begin only when the Preliminary Test Report has been approved.
 3. The fire protection contractor shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system.
 4. As-Built Drawings and previous test results shall be available at the time of testing.
 5. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received.
 - B. Fire Alarm system will be considered defective if it does not pass tests and inspections.
 - C. Prepare test and inspection reports.
 6. Upon completion of a successful test, the fire protection contractor shall so certify the system in writing to Owner's Representative.
 7. Submit copy of test results in duplicate, after signed off by the AHJ, to the Architect/Engineer and the Owner's Representative.
 - D. Upon acceptance by the Architect / Engineer and the Owner's Representative, the completed system(s) shall be placed into service.

END OF SECTION 21 22 00

SECTION 21 30 00 – FIRE PUMPS

PART 1 – GENERAL

1.1. SCOPE

- A. This section includes specifications for supports of all fire suppression pumps, controllers and accessories.

1.2. FEDERAL BIDDING REQUIREMENTS

- A. Buy America:
 - 1. Refer to the Buy America Provision outlined elsewhere in this proposal package and Section 01 60 00 Product Requirements for more information.
- B. Buy America Act Compliance: Based on vendor and manufacturer information, to the best of E/A's knowledge and belief, the products specified for this project meet Buy America requirements. Contractors shall be required to verify all product and material compliance with Buy America prior to bidding.

1.3. REFERENCE

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions, and the applicable provisions of Division 1, govern work under this section.

1.4. RELATED WORK

- A. The following technical fire suppression specifications sections are directly related to the provisions of this section.
 - Section 21 05 00 Common Work Results for Fire Suppression
 - Section 21 05 29 Hangers and Supports for Fire Suppression Piping and Equipment
 - Section 21 10 00 Water-Based Fire Suppression Systems
 - Division 26 Electrical

1.5. REFERENCE STANDARDS

- A. Specific standards referenced in this section are as follows:
 - ASSE 1015 Double Check Valve Backflow Preventers.
 - NFPA 13 Installation of sprinkler systems.
 - NFPA 20 Installation of centrifugal fire pumps.
 - NFPA 71 Installation, maintenance and use of signaling systems for central station service
 - NFPA 72 Installation, maintenance and use of protective signaling systems

1.6. QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.
- B. Conform to NFPA 20 for fire pumps.
- C. Welding Materials and Procedures: Conform to ASME Code.
- D. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.7. SHOP DRAWINGS

- A. Submit fabrication drawings showing pipe sizes, fittings, devices and locations. Submit corresponding hydraulic calculations.
- B. Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights, pump curves, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

1.8. CERTIFICATIONS

- A. Fire protection system components to be UL listed and labeled. All components to be Factory Mutual approved with the exception of sprinkler heads, double check valves and air compressors. All system components shall be in conformance with NFPA rulings.

1.9. DELIVERY, STORAGE, AND HANDLING

- A. Refer to General Conditions and Section 21 05 00.
- B. Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.
- C. Deliver products to site under the applicable provisions of Division 1. Deliver pumps and controllers in the original shipping containers, with labeling in place.
- D. Cover to prevent corrosion and deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage or by durable, waterproof, above ground packaging.
- E. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
- F. Storage and protection methods must allow inspection to verify products.

1.10. DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system, but not less than 175 psig. If system pressure exceeds 175 psig, contractor shall use fittings, valves, and appurtenances rated for system pressure.
- C. Component design, construction and installation to comply with requirements of reference standards.

1.11. ELECTRICAL COORDINATION

- A. All relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the power side of the control of fire protection motors or electrical equipment shall be furnished by the Electrical Contractor, except as specifically noted elsewhere in this division of specifications.
- B. Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this contractor. Should any change in size, horsepower rating or means of control be made to any motor or other electrical equipment after contracts are awarded, contractor is to immediately notify the Electrical Contractor of this change and pay any costs due to this change.
- C. Electrical Contractor shall provide all power wiring and the Fire Suppression Contractor shall provide all control wiring. Control wiring shall conform to Division 26 requirements for Control Wiring.
- D. Furnish wiring diagrams to Electrical Contractor for all equipment and devices furnished by this contractor and indicated to be wired by the Electrical Contractor.

PART 2 – PRODUCTS

2.1. IN LINE CENTRIFUGAL FIRE PUMP

- A. Manufacturer: Aurora, Fairbanks Morse, Grundfos, ITT A-C, Peerless.
- B. Type: In-Line Fire Pump, vertically mounted with electric-motor driver directly mounted to the pump casing.
- C. Pump: Radially split cast-iron casing with suction and discharge flanges machined to ASME B16.1, Class 125 dimensions.
- D. Impeller: Cast bronze, statically and dynamically balanced, and key to shaft.
- E. Wear Rings: Replaceable bronze.
- F. Shaft and Sleeve: Steel shaft with bronze sleeve.
- G. Shaft bearings: Grease lubricated ball bearings in cast iron housing.
- H. Seals: Stuffing box with minimum of four rings of graphic-impregnated braided yarn and bronze packing gland.
- I. Motor: Provide pump with a motor sized for non-overloading over the entire pump curve.
- J. Baseplate: Cast iron or fabricated steel with integral drain rim and grout base.

- K. Accessories: Suction and discharge gauges and gauge cocks, casing relief valve, automatic air release valve, eccentric suction reducer, and concentric discharge increaser (where required).
- L. Type: Vertical direct coupled shaft, multiple stage, inline design, 200 (300) psig maximum working pressure at operating temperature of 225°F. continuous, 250°F. intermittent.
- M. Casing: Cast iron or stainless steel with suction and discharge gauge ports, vent and drain plugs, flanged suction and discharge connections.
- N. Impeller: Bronze or stainless steel, nested configuration, keyed and locked to the shaft, hydraulically and dynamically balanced.
- O. Bearings: Oil or grease lubricated ball or roller bearings.
- P. Shaft: Alloy or stainless steel with copper, bronze, or stainless steel shaft sleeve.
- Q. Seal: Mechanical type shaft seal with carbon steel rings and ceramic seats.
- R. Accessories: Suction and discharge gauges and gauge cocks and relief valve.
- S. Provide pump with a motor sized for non-overloading over the entire pump curve. Motors to be 3450 rpm unless specified otherwise.
- T. Furnish each pump and motor with a nameplate giving the manufacturer's name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current. The manufacturer shall certify all pump ratings.

2.2. HORIZONTAL OR VERTICAL TURBINE PRESSURE BOOSTER PUMP

- A. Manufacturer: Aurora, Pacific (Paco), Roth, or approved equal.
- B. Type: Horizontal direct coupled shaft, base mount design, or vertical design, 300 psig maximum working pressure.
- C. Casing: Cast iron with threaded suction and discharge connections.
- D. Impeller: Bronze turbine with bronze bushing, keyed and locked to the shaft, hydraulically and dynamically balanced.
- E. Shaft: Stainless steel with bronze or stainless steel shaft sleeve.
- F. Seal: Mechanical type shaft seal with carbon steel rings and ceramic seats.
- G. Provide pump with a motor sized for non-overloading over the entire pump curve. Motors to be 1750 rpm unless specified otherwise.
- H. Accessories: Suction and discharge gauges and gauge cocks and relief valve.
- I. Furnish each pump and motor with a nameplate giving the manufacturer's name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current. The manufacturer shall certify all pump ratings.

2.3. FIRE PUMP CONTROLLER

- A. Manufacturer: ITT, Joslyn/Clark, Master Control Systems, or approved equal.
- B. General: Select fire pump controller with electrical characteristics matching pump motor. Factory fabricate and test fire pump controller assembly. Identify assembly with "Fire Pump Controller" label on control panel face. Permanently attach wiring diagrams to inside of cabinet. Provide cabinet and door mounted nameplates identifying each device or switch mounted within cabinet and on door, panel manufacturer and model number.
- C. Enclosure: Floor mounted formed and welded steel, NEMA 12, with hinged and latched door, phosphatized and baked enamel finish.
- D. Motor Starter: Class A, NEMA ICS 2, across-the-line magnetic full voltage starting, non-reversing type. Capable of automatic start initiated by low water pressure switch, remote starting by a normally closed contact and manual starting by front panel mounted control.
- E. Overcurrent Protection: Circuit breakers with test switch and self-contained electronic trip circuit designed and listed for fire pump locked rotor application. Connect directly to HOA switch load side.
- F. Controls: Front panel mounted hand-off-auto switch, 300 psi brass mercoid water pressure switch with low turn on and high turn off adjustable settings and exterior brass bulkhead connection, minimum run timer with manual stop switch, restart time delay. Provide phase reversal relay.

- G. Alarms: Local audible and visual alarm indication as well as remote contacts for loss of power, and phase reversal along with alarm silence switch. Remote contact for fire pump operation (motor current greater than 20% FLA).
 - H. Wiring: Terminations for exterior power and control connections, space in cabinet for terminating incoming and outgoing cables at entry, identification of power and control wiring at terminals and ground bar.
 - I. Transfer Switch: Provide controller with built-in automatic transfer switch.
- 2.4. PRESSURE BOOSTER PUMP CONTROLLER
- A. Manufacturer: ITT, Joslyn/Clark, Master Control Systems, or approved equal.
 - B. General: Select booster pump controller with electrical characteristics matching pump motor. Permanently attach wiring diagrams to inside of cabinet.
 - C. Enclosure: Wall mounted formed and welded steel, NEMA 2, gasketed with driphood, hinged and latched door, phosphatized and baked enamel finish.
 - D. Motor Starter: Class A, NEMA ICS 2, across-the-line magnetic full voltage starting, non-reversing type with overload relays. Capable of automatic start initiated by low water pressure switch and manual starting by front panel mounted control.
 - E. Overcurrent Protection: Fusible disconnect switch with panel face mounted handle.
 - F. Controls: Front panel mounted hand-off-auto switch, 300 psi brass mercoid water pressure switch with low turn on and high turn off adjustable settings and exterior brass bulkhead connection, minimum run timer.
 - G. Alarms: Contacts for remote indication of pressure booster pump running (motor current greater than 20% FLA).
 - H. Wiring: Terminations for exterior power and control connections, space in cabinet for terminating incoming and outgoing cables at entry, identification of power and control wiring at terminals.

PART 3 – EXECUTION

3.1. INSTALLATION

- A. Install fire protection system components according to NFPA rulings, listings and manufacturers recommendations. Locate where accessible for servicing and replacement.
- B. Pumps: Set base mounted pumps on concrete bases, or concrete inertia base, level and bolt down prior to grouting. Fill the entire base with non-shrinking grout when required by the manufacturer's installation instructions.
- C. Align all flexible coupled base-mounted pumps according to the manufacturer's instructions.
- D. Decrease from line size at pump connections with eccentric suction reducer offset with the top of the pipe level. All pump valves and piping specialties must be full line size. Support piping adjacent to pump such that no weight is carried on pump casings. For base mounted pumps, provide supports for elbows on pump suction and discharge piping 4" and over.
- E. Provide automatic air vent, drain valve, relief valve and pressure gauges on pump casings.
- F. Provide drains for bases and seals, piped to and discharging into floor drains.
- G. Provide 1/2" Type L copper pressure sensor line from between pump discharge check valve and shutoff valve to pump controller pressure switch. Provide bronze swing check valve with 3/32" orifice in clapper along with two test valves and intermediate tee with 1/4" test plug at pump and at controller for testing and relieving pressure (NFPA 20, A-7-5.2.1). Each pump, including pressure booster pump, to have its own dedicated sensor line.
- H. Lubricate pumps before startup.
- I. Fire Pump Controller: Install on concrete housekeeping pad, leveled and bolted in place or mount securely to wall. Pipe pressure sensor line to controller. Coordinate wiring with electrical contractor. Startup, test and adjust for proper operation of alarms and operating controls. Adjust pressure switches according to NFPA 20, A-11-4.

- J. Pressure Booster Pump Controller: Mount securely on wall. Pipe pressure sensor line to controller. Coordinate wiring with electrical contractor. Startup, test and adjust for proper operation of alarms and operating controls. Adjust pressure switches according to NFPA, A-11-4.

END OF SECTION 21 30 00

END OF DIVISION 21 – FIRE SUPPRESSION

65. Main Communications Tower, Item SPV.0060.200.

A Description

This special provision describes all work by contractor to provide and install the tower and other associated equipment and materials for the SWEF main communications tower site within the work limits as noted in the drawings as produced by Edge Consulting Engineers, Inc. The work includes the tower, equipment shelter, fence, ice bridge, lightning protection and grounding systems, antennas, coaxial cables, waveguides and other items as noted in the drawings. The work shall be according to the applicable drawings and the following specifications included with this special provision.

Electrical service work including meter installation and conduit/wiring from the meter to exterior conduit stub at the equipment shelter are included in other bid items.

Fiber optic service connections to the equipment shelter including underground conduits, fiber optic cabling, communications vaults, termination, and patch panels are included in other bid items.

Earthwork, grading, geotextile fabrics, surfacing aggregates and concrete pavement for the tower site compound area and access driveway are included in other bid items.

Providing and installing the emergency generator and LP fuel system at the tower site is included in other bid items (SPV.0060.202).

B Materials

Refer to the following specification sections for materials information related to this special provision.

C Construction

Refer to following specification sections for construction and installation information related to this special provision.

D Measurement

The department will measure Main Communications Tower, completed according to the contract and accepted, as a single complete unit of work.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.200	Main Communications Tower	EACH

Payment is full compensation for furnishing all materials and equipment, and for supplying all labor, tools, equipment, and incidentals necessary to complete the work.

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SECTION 03 30 00 – Cast-In-Place Concrete

PART 1 – GENERAL

SCOPE

Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes. The work under this section consists of providing all work, materials, labor equipment and supervision necessary to provide cast in-place concrete as required in these specifications and the drawings.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

33 81 00 – Communication Towers

REFERENCES

Incorporated Guides and References

American Concrete Institute (ACI):

ACI 302.1R – Guide for Concrete Floor and Slab Construction.

ACI 304R – Guide for Measuring, Mixing, Transporting and Placing Concrete.

ACI 304.2R - Placing Concrete by Pumping Methods.

ACI 305R - Hot Weather Concreting.

ACI 309R – Guide for the Consolidation of Concrete.

ACI 347 – Guide to Formwork for Concrete.

ACI SP-66 – ACI Detailing Manual.

Specifications

American Concrete Institute (ACI):

ACI 117 - Specifications for Tolerances for Concrete Construction and Materials.

ACI 301 - Specifications for Structural Concrete.

ACI 306.1 – Specification for Cold Weather Concreting.

ACI 308.1 – Specification for Curing Concrete.

ACI 315 - Details and Detailing of Concrete Reinforcement.

ACI 318 - Building Code Requirements for Structural Concrete and Commentary.

ASTM International (ASTM):

ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

ASTM A704 – Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.

ASTM A706 – Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

ASTM C33 – Standard Specification for Concrete Aggregates.

ASTM C94 – Standard Specification for Ready-Mixed Concrete.

ASTM C150 – Standard Specification for Portland Cement.

ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete.

ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.

ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.

ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Concrete.

ASTM C989 – Standard Specification for Slag Cement for Use in Concrete and Mortars.

ASTM C1059 – Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.

ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete.

ASTM C1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.

ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

ASTM E164 3 – Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.

ASTM E1745 – Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

DEFINITIONS

Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

W/C Ratio: The ratio by weight of water to cementitious materials.

Cured Concrete: The concrete strength at 28 days.

Dry Concrete: The measure of concrete at 80% relative humidity at 40% of the concrete slab-on-grade depth.

Self-Consolidating Concrete (SCC): a highly workable concrete that can flow through densely reinforced or complex structural elements under its own weight and adequately fill voids without segregation or excessive bleeding without the need for vibration.

Passing Ability: The ability of SCC to flow through openings such as the spaces between reinforcing bars without segregation or aggregate blocking.

J-Ring Test: Test used to determine the passing ability of SCC, or the degree to which the passage of concrete through the bars of the J-Ring apparatus is restricted.

J-Ring Flow: The distance of lateral flow of concrete using J-Ring in combination with a slump cone.

Slump Flow: Test method used to measure the unconfined flow and stability of SCC using a slump cone (upright or inverted)

Slump Flow Spread: The numerical value in inches of flow and stability of SCC using a slump cone (upright or inverted).

Slump Flow Spread: The numerical value in inches of flow determined as the average diameter of the circular deposit of SCC at the conclusion of the slump flow test.

T50 Value: Time (in seconds) the edge of the concrete mass takes to reach 50 cm (20 inches) diameter from the time the mold is first raised in the slump flow test.

Stability: The ability of a concrete mixture to resist segregation of the paste from the aggregates.

Static Segregation (Segregation Factor): Segregation of the mortar from the coarse aggregate that occurs after placement while the concrete is still in the plastic state.

Visual Stability Index (VSI) Rating: An assessment of the homogeneity of concrete based on the visual inspection of the concrete sample at the end of the slump flow test.

SUBMITTALS

Product Data: For each type of product.

Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

Material Certificates: For each of the following, signed by manufacturers:

- Cementitious materials.

- Admixtures.

- Form materials and form-release agents.

- Steel reinforcement and accessories.

Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

- Aggregates

QUALITY ASSURANCE

Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

Concrete In-Situ Relative Humidity and pH:

ASTM F2170-11 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs using In-Situ Probes.

ASTM F710-11 – Standard Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring.

Digital "Reader" and calibrated relative humidity sensors

Factory-calibrated "Smart Sensors" using Touch-n-Sense TM technology or similar testing equipment.

National Institute of Standards for Testing (NIST) – traceable factory calibration.

Wide range pH paper, and distilled or de-ionized water.

DELIVERY, STORAGE, AND HANDLING

Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

FIELD CONDITIONS

Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

Hot-Weather Placement: Comply with ACI 301 and as follows:

Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is contractor's option.

Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

FORM-FACING MATERIALS

Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces.

Furnish in largest practicable sizes to minimize number of joints.

Plywood, metal, or other approved panel materials.

Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

High-density overlay, Class 1 or better.

Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.

Structural 1, B-B or better; mill oiled and edge sealed.

B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

Overlaid Finnish birch plywood.

Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

Formulate form-release agent with rust inhibitor for steel form-facing materials.

Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

STEEL REINFORCEMENT

Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.

Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

REINFORCEMENT ACCESSORIES

Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

CONCRETE MATERIALS

Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

Cementitious Materials:

Portland Cement: ASTM C 150/C 150M, Type I gray.

Fly Ash: ASTM C 618, Class C.

Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

Normal-Weight Aggregates: ASTM C 33/C 33M coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

Maximum Coarse-Aggregate Size: 3/4 inch nominal.

Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

ADMIXTURES

Admixtures to be used in the concrete mixture shall be submitted for approval as part of the mixture design. No other admixtures will be allowed except those listed without the Architect's approval.

Air-Entraining Admixture: ASTM C 260/C 260M.

Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

Retarding Admixture: ASTM C 494/C 494M, Type B.

Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

Viscosity-Modifying Admixture: ASTM C 494/C 494M, Type S.

High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

Water: ASTM C 94/C 94M and potable.

VAPOR RETARDERS

Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.

CURING MATERIALS

Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

Water: Potable.

RELATED MATERIALS

Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

CONCRETE MIXTURES, GENERAL

Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

Admixtures: Use admixtures according to manufacturer's written instructions.

Use water-reducing or plasticizing admixture in concrete, as required, for placement and workability.

Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

CONCRETE MIXTURE SCHEDULE

Class	Type of Construction	Min. Comp Strength @ 28 Days (PSI)	Slump		Max. Agg. Size (in.)	Air Water Cement Ratio	Entrainment % +/- 1½%	Notes
			Before addn. of HRWR (in. +/- 1 in.)					
2a	Exterior slab-on-grade	4000	3	0.75	0.44	6.0	(2)(4)	
2b	Exterior Site concrete	4000	3	0.75	0.44	6.0	(2)(4)(6)	
9	Miscellaneous non-scheduled concrete	4000	5	0.75	0.59	6.0	(2)	
10	Utility Concrete	4000	3	0.75	0.48	6.0	(2)(3)	

Notes:

- (1) Use a maximum of 50% replacement of portland cement with ground granulated blast-furnace slag and fly ash at a 1:1 ratio, up to 350 pounds per cubic yard. If fly ash is used alone, limit the maximum re-placement to 25%.
- (2) Use a maximum of 30% replacement of portland cement with ground granulated blast-furnace slag and fly ash at a 1:1 ratio, up to 350 pounds per cubic yard, with a maximum 25% fly ash. If fly ash is used alone, limit the maximum replacement to 25%.
- (3) Use High-Range, Water-Reducing Admixture in mixture.
- (4) High-Range, Water-Reducing Admixture may be used in mixture.
- (5) Maximum equilibrium dry weight of lightweight aggregate mix: 115 pounds per cubic foot, as determined by section 9.5 of ASTM C 567.
- (6) Coordinate with site/civil and landscape concrete elements.

FABRICATING REINFORCEMENT

Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

CONCRETE MIXING

Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.

When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

FORMWORK INSTALLATION

Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

Class A, 1/8 inch for smooth-formed finished surfaces.

Class B, 1/4 inch for rough-formed finished surfaces.

Construct forms tight enough to prevent loss of concrete mortar.

Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

Install keyways, reglets, recesses, and the like, for easy removal.

Do not use rust-stained steel form-facing material.

Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

Chamfer exterior corners and edges of permanently exposed concrete.

Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

EMBEDDED ITEM INSTALLATION

Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

Install dovetail anchor slots in concrete structures as indicated.

REMOVING AND REUSING FORMS

General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

STEEL REINFORCEMENT INSTALLATION

General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

JOINTS

General: Construct joints true to line with faces perpendicular to surface plane of concrete.

Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-Third of concrete thickness as follows:

Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes.

Eliminate groover tool marks on concrete surfaces.

Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

CONCRETE PLACEMENT

Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.

Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

Maintain reinforcement in position on chairs during concrete placement.

Screed slab surfaces with a straightedge and strike off to correct elevations.

Slope surfaces uniformly to drains where required.

Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

FINISHING FORMED SURFACES

Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

Apply to concrete surfaces not exposed to public view.

Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

Apply to concrete surfaces exposed to public view.

Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

FINISHING FLOORS AND SLABS

General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.

Apply float finish to surfaces to receive trowel finish.

Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

Apply a trowel finish to surfaces exposed to view.

Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

MISCELLANEOUS CONCRETE ITEM INSTALLATION

Foundations:

Coordinate sizes and locations of concrete bases with actual equipment provided.

Construct concrete bases 6 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.

Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.

Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

CONCRETE PROTECTING AND CURING

General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

Cure concrete according to ACI 308.1, by one or a combination of the following methods:

Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

Maintain continuity of coating and repair damage during curing period.

CONCRETE SURFACE REPAIRS

Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.

Compact mortar in place and strike off slightly higher than surrounding surface.

Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

After concrete has cured at least 14 days, correct high areas by grinding.

Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

Repair materials and installation not specified above may be used, subject to Architect's approval.

FIELD QUALITY CONTROL

Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof. For tower foundations, obtain sample from the tower legs/piers in addition to the mat.

When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

Compression Test Specimens: ASTM C 31/C 31M.

Cast and field cure two sets of two standard cylinder specimens for each composite sample.

Compressive-Strength Tests: ASTM C 39/C 39M;

Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days, min.

A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

Test results shall be reported in writing to Architect, concrete manufacturer, and contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

Additional testing and inspecting, at contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION 03 30 00

SECTION 13 34 23 – Precast Concrete Communication Shelters

PART 1 – GENERAL

SCOPE

The work under this section includes requirements for the manufacture and installation of prefabricated precast concrete communication shelters as detailed in the plans and specified below.

RELATED WORK AND PROVISIONS

Applicable provisions of Divisions 1 and 26 shall govern all work under this section.

Section 13 30 00 – Communication Tower

Section 13 30 10 – Coax and Waveguides

DESCRIPTION OF SYSTEM

Precast Concrete Communications Shelters are required at one (1) tower site. Shelter sizes (nominal) shall be as follows:

- Wrightstown, Wisconsin: (1) - 12' x 24'

Refer to the drawings for layout and configuration of each shelter.

All shelters shall be produced and constructed by the same manufacturer.

EQUIPMENT AND MATERIALS FURNISHED BY OTHERS

None.

WORK BY OTHERS

Owner will install all equipment racks and radio equipment within the racks.

Owner will make final connection of prepared coax lines within the equipment building to radio equipment.

Owner will install alarm wiring from monitored devices within equipment shelter to R66 block.

SHELTER MANUFACTURER

The equipment shelter manufacturer shall have been engaged in the production of pre-cast concrete shelters for the telecommunications industry for a minimum of ten years.

Pre-approved manufacturers include:

1. Sabre Industries – Alvarado, TX
2. Fibrebond – Minden, LA
3. Old Castle Precast – Hartford City, IN
4. VFP – Roanoke, Virginia
5. Thermo Bond – Elk Point, South Dakota
6. Other manufacturers may be allowed at the discretion of the Owner and A/E.

SHELTER DESCRIPTION

Each communication shelter shall be a prefabricated precast concrete steel reinforced structure. No other type of construction material is permitted. The building exterior shall be the nominal dimensions as noted in the plans with a minimum of 1 ½" roof overhang on all sides. The roof shall be a cap type to provide a drip point for rainwater to drip clear of the shelter wall. The finished inside clear height shall be at least 9'-0".

Roof shall be solid concrete and have a center ridge to provide water runoff with a min. thickness of 5" at the eave and 6" at the ridge.

Walls shall be 4" min. solid concrete with an exposed aggregate exterior finish. Exposed aggregate shall be sealed. No sandwich type construction permitted.

Concrete floor shall support the design loads and specialized equipment.

Shelters shall be sealed and waterproofed at the factory.

Shelters shall be designed to be handled and off-loaded with standard pickups at the base of the shelter. Roof pick points for handling the structure are not permitted.

MINIMUM DESIGN REQUIREMENTS

The building shall be designed to meet the following minimum loading:

1. Roof Live Load 90 PSF
2. Floor Live Load 200 PSF
3. Floor Dead Load 75 PSF
4. Wall Wind Load 150 MPH
5. Earthquake Zone 4
6. Ballistic tested for UL 752 (HPR – 30.06 – Point Blank Range)
7. Roof Ice impact loading 40 lbs at 225'

In addition to the requirements set forth in these specifications, this structure will also meet or exceed, to the extent applicable, but not limited to, the requirement of the latest documents as follows:

1. ANSI/NFPA-70 and NFPA-78
2. MIL-I-45208
3. ASTM-E-84
4. ANSI-58
5. MIL-188-124A
6. PS1-74999
7. All applicable equipment is U.L. listed.

The building, once mounted, shall be able to withstand wind loadings of 120 MPH without moving, turning over or damage.

ELECTRICAL DESIGN AND INSTALLATION

All electrical systems shall be designed and installed according to the National Electric Code (NEC), latest edition and applicable local codes for the jurisdiction in which the shelter is to be installed.

All electrical and grounding systems shall be installed by a state licensed electrician.

Electrical system shall be operational on 120/240VAC, single Phase.

DESIGN CERTIFICATION

Shelters shall be professionally engineered to meet state and local building code requirements for the location in which it is to be delivered. Design calculations signed and sealed by a registered professional engineer stating the building system meets design load requirements shall be available upon request.

Shelters shall be approved, inspected, and labeled by an independent third-party agency. Inspections must be completed, and labels applied prior to delivery to the site.

Shelters shall be designed to meet the requirements of the following:

1. American National Standards (A.N.S.) "Building Code Requirement for Minimum Design Loads in Buildings and Other Structures."
2. American Concrete Institute (A.C.I.-318R-05) "Building Code Requirements for Reinforced Concrete."
3. Concrete Reinforcing Institute "Manual of Standard Practice."
4. State and Local Jurisdiction current Building Codes

SUBMITTALS

Refer also to Section GC - General Conditions of the Contract.

Submit shelter manufacturer's pre-production (shop) drawings of supplied equipment shelters. Shop drawings to include the following:

1. Title sheet with plan index, code summary, design parameters, physical properties and finish schedule
2. Interior and exterior elevations noting all equipment, devices and relevant dimensions.
3. Interior floor and ceiling plans noting all equipment, devices and relevant dimensions.
4. Electrical plan with one line diagram, panel board layouts, lighting layout, motor and lighting fixture schedules, wiring schematics, conduit and receptacle layout and all associated details.
5. Cable tray layout including details for installation
6. Grounding Plan
7. Alarm Schematic
8. Foundation Plan
9. Shelter cross section, construction details and connection details
10. Drawings signed and sealed by a Registered Professional Engineer licensed in the State of shelter delivery. Engineer to certify the building design and construction meets the minimum requirements specified herein along with all requirements of the State Building Code.

Submit manufacturer's cut sheets of devices, equipment and other items installed as part of the equipment shelter package. Minimum items requiring submittal include the following:

1. Electric service disconnects/safety switches
2. Electric panel boards
3. Electrical wiring devices
4. Lights – Interior/Exterior
5. Smoke detectors
6. Surge protection devices (SPDs)
7. HVAC units and controllers
8. Doors and door hardware
9. Cable tray
10. Wave guide entry ports
11. Alarm blocks
12. Ground bars
13. Coaxial Surge Protector Trapeze
14. Grounding halo supports

All submittals must receive approval prior to equipment shelter manufacture.

Provide one (1) electronic (pdf) copy of all submittals.

WARRANTY

Shelters shall be warrantied from water intrusion into the structure for a period of 10 years from the date of project substantial completion.

All shelter electrical, HVAC and mechanical components shall be warrantied for period of one (1) year from the date of project substantial completion.

Warranties shall be full service and include onsite repair work and/or replacement of defective components.

PART 2 - PRODUCTS

MATERIALS

General:

The materials furnished shall include a precast concrete structure, fasteners, anchors, sealants, doors, cable tray, electrical, HVAC, and all other parts/equipment necessary for a complete building system as detailed in the plans and specifications.

Concrete:

Steel-Reinforced (ASTMA615 Grade 60 and ASTMA-185 Welded Wire Fabric), 5,000 PSI minimum, 28 Day Compressive Strength, Air-Entrained (ASTM C260).

Electrical:

Electrical equipment and labor shall comply with the most recent edition of the National Electrical Code, Local Jurisdiction, and applicable Division 26 specifications.

Exterior:

The exterior wall finish shall be an exposed aggregate with an earth tone brown color. The exterior finish shall be sealed with an approved compound designed for this application.

Doors, awnings, ventilation hoods and other exterior steel surfaces shall be primed and painted the same color with rust inhibitor paint.

Roof surface shall be trowel and sealed with a liquid membrane coating. Roof edges are to be smooth without chips or irregular surface.

Interior:

Concrete walls and ceiling shall be covered with White Nu-Poly FRP over 3/8" OSB. Wood framing studs are permitted when 3/4" OSB is used.

Concrete floor shall be rotary trowel to smooth and flat surface. The floor shall be sealed with epoxy built up coating, covered with commercial vinyl floor tile and include vinyl base cove installed around the perimeter.

Fire Resistant:

The exterior and interior walls shall have at least a two (2) hour fireproof rating without affecting the structural properties of the building.

Insulation:

Energy calculations conforming to the International Energy Conservation Code (current revision with state amendments) shall be submitted with the completed design documents. The shelter shall have the following minimum insulation values:

Exterior walls: R-19

Ceiling: R-22

Doors:

Insulated painted 18 GA galvanized steel door and 16 GA painted galvanized steel frame, cast-in.

Hardware to include NRP stainless steel hinges, stepped threshold, door sweep, anti-pick guard, door bumper, drip cap, weather canopy, weather stripping, Door stop T latch and hydraulic door closer.

Size: See plans

Door Hardware:

Electronic pushbutton door lock system with manual key-in-lever override.

Key cores to be removeable/interchangeable.

Finish: Satin Chrome

Make/Model: E-Plex 5000 series as manufactured by dormakaba, or equivalent.

Electrical System:

Utility Power: 120/240 VAC single phase, 60hz, 200Amp

Service Disconnect (SD): 200A Fusible

Automatic Transfer Switch (ATS): See Main Communications Tower Generator, SPV.0060.202

Distribution Panel (PP1): 200A (42) Circuit with 200A main breaker and branch breakers as required

Surge Protection Devices (SPDs):

- a. SPD1:
 - 1) Type 1, 200KA Surge Capacity, EMI/RFI Filtering, Form C Dry Contacts
 - 2) Mersen Surge Trap XT Series, Transtector IMAX Series, or equiv.
- b. SPD2:
 - 1) Type 2, 200KA Surge Capacity, Form C Dry Contacts
 - 2) Mersen Surge Trap XT Series, Transtector IMAX Series, or equiv.
- c. Provide 60A 2P disconnects
- d. Surge protection devices shall include alarm contacts

Receptacles and Circuits: 120V and 240V per drawings

All wiring will be installed in surface mounted conduit or wire ways and will be in full compliance with ANSI/NFPA-70; The National Electric Code, Latest Revision.

All conduit runs shall utilize compression type conduit fittings to maintain ground bond between conduit runs and device boxes.

All receptacles and devices shall be labeled with the circuit/breaker number which controls each device. The label shall be mounted directly adjacent to the receptacle.

Lighting:

Interior: 4ft single bulb LED fixture with wrap around protective lens

- a. 4600 lumens
- b. 4000 CCT
- c. 35-watt
- d. Interior light system to be operational via manual switch and occupancy sensors.

Exterior: LED wall pack

- a. 4000 lumens
- b. 4000 CCT
- c. 30-watt

- d. Motion sensor
- e. Photo-cell
- f. Exterior light system to be operational via manual switch, timer and photocell.

Emergency: Twin bulb LED with battery backup. EXIT sign located over each doorway.

Smoke Detectors:

There shall be a smoke detector installed in each room.

The smoke detectors shall include dry alarm contacts.

The smoke detectors shall be operated on the mains power with battery backup.

Alarms:

Unless otherwise specified, all alarm contacts shall be normally closed, SPST, common ground and wired to the alarm R66 punch blocks located on the alarm panel. The contact closures on the relays shall be capable of sinking 100 ma at -48 volts dc.

Provide (1) punch block

Provide conduits from all devices with dry contacts to R66 punch block even when alarm wiring is completed by others. Devices requiring alarm wiring conduits include:

- Door Alarm contact
- Smoke Alarm
- HVAC Controller
- ATS
- SPDs
- Tower Lighting Controller
- Dehydrator

All alarm contacts requiring wiring shall be wired from each device back to the alarm punch block within conduit. The alarms to be wired to the R66 punch block include the following:

- a. Shelter: None.
- a. Generator: See Main Communications Tower Generator, SPV.0060.202
- b. Automatic Transfer Switch (ATS): See Main Communications Tower Generator, SPV.0060.202

HVAC:

The HVAC system shall include Two (2) lead-lag controlled wall mount air conditioning units

- a. 3.0 Ton (35,200 BTUH)
- b. 230V, 1P, 60 Hz
- c. Efficiency shall provide 11.0 EER minimum cooling ratio
- d. Lead lag controller: Bard MC4002-A
- e. Economizer
- f. Low ambient air kit to allow compressor to run down to 0 degrees F.
- g. 5KW heat strip

Cable Tray:

1. 12", 18", 24" or other size overhead cable ladder per drawings
2. 1 ½" stringers
3. 9" rung spacing
4. Zinc dichromate finish
5. Finished installed height: Per drawings

Wave Guide Entry Port:

16 hole or other size port waveguide/coax entry port panels (see plans). 4" diameter port openings with cushions and caps sized for installed transmission lines.

Grounding:

Interior ground halo: #2 AWG stranded insulated copper conductor installed on all four walls of equipment room located approximately 6-inches below ceiling level. Ground halo shall be mounted on 3-inch standoffs. Maintain gaps in halos as noted in the plans.

Service Entrance Grounding Electrode Conductor: Install #2 AWG stranded insulated conductor from service disconnect (SD) grounding terminal to MGB. Route conductor around shelter interior perimeter near ceiling level and below halo.

Provide (1) #2 AWG stranded insulated copper conductor from the following items to the Master Ground Bar:

- a. Coaxial Surge Protector Trapeze
- b. Cable Tray System
- c. Each Equipment Rack

All metallic items and boxes inside the shelter shall be individually bonded to the halo using #6 AWG stranded insulated copper conductors. All bond wires jumpers shall be oriented with direction flowing toward the MGB.

Provide #6 AWG stranded insulated copper ground bond jumpers between sections of cable tray and cable tray splices.

Ground bond connections shall be mechanical type (unless otherwise noted in the drawings) utilizing 2-hole lugs with stainless steel hardware. Paint shall be scraped from boxes and devices being connected to ensure good electrical continuity. Install anti-oxidant compound between lug and connection point. Use copper anti-oxidant for copper to copper connections.

All conduit runs shall utilize compression type conduit fittings to maintain ground continuity between sections of conduit and connected boxes and devices.

Ground Bars: Provide ground bars as noted in the drawings. All ground bars shall be solid copper.

- a. 24"x4"x1/4" providing (44) forty four (2) two hole grounding lugs, (Site Pro Part No. MG42488K or equivalent).
- b. Interior Master Ground Bar (MGB): Bare Copper
- c. Exterior Ground Bar: Tinned Copper
- d. Use PANI Organization system for ground lead connections to MGB.

Coaxial surge protector trapeze:

12 and 16 Hole Entry Ports: SitePro1 model: ATK306U, Commscope model: AT-K306-U, or equiv.

24 Hole Entry Ports: Commscope model: AT-K-406-U or equiv.

Miscellaneous:

- a. Telco board
- b. Service manual wall pocket
- c. Fire extinguishers: (1) 10lb class BC Carbon Dioxide
- d. First aid kit
- e. Tie down plates and hardware

PART 3 - EXECUTION

EXAMINATION

Confirm access to site is sufficient for shelter delivery and crane operation.

Verify site installed conduits align with shelter penetrations.

PREPARATION

Allow shelter foundation to adequately cure prior to installing shelter. Provide concrete break strength reports to document concrete has achieved design strength requirements prior to installation.

Provide crane of suitable size for lifting and placing shelter.

INSTALLATION

Install shelter per manufacturer's recommendations including shims, canopies and tie downs.

Ground shelter per drawings and specifications.

Connect electrical, communication and other conduits stubs and wiring to shelter.

Field install any other equipment and devices not furnished in the prefabricated structure which are required as part of the project.

Install coax and waveguides from antennas and dishes mounted on towers to interior side of equipment shelter per the drawings and specifications.

CLEANING

Periodically clean shelter throughout construction process.

Perform final cleaning at the time of substantial completion to remove excess construction materials, debris and dirt tracked in from worksite.

END OF SECTION 13 34 23

SECTION 31 23 16.13 – Trenching

PART 1 – GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to complete trenching for utilities and other work, as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

REFERENCE STANDARDS

American Society for Testing and Materials (ASTM):

D422	Standard Test Method for Particle Size Analysis of Soils
D4318	Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
D698	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
D1557	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort
D2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods
D3017	Standard Test Methods for Water Content of Soil and Rock in Place by Nuclear Methods
E329	Standard Specifications for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

QUALITY ASSURANCE

The contractor shall conduct sampling, testing, and analysis as required by this section and elsewhere in the Contract Documents either by retaining the services of an independent construction materials testing consultant or with internal certified testers. The materials testing personnel shall meet the requirements of ASTM E329.

The contractor's construction materials testing personnel shall complete material testing as outlined in Table 31 23 16.13-1:

Table 31 23 16.13-1

Material	Test Required	Test/Sample Frequency
Bedding/Initial Cover	D2922 Standard Test Method for Density of Soil and Soil Aggregate in Place by Nuclear Methods	1 test / 500 lf trench
All Fill	D2922 Standard Test Method for Density of Soil and Soil Aggregate in Place by Nuclear Methods	1 test / 500 lf trench

SUBMITTALS

Provide grainsize analysis for all materials.

Provide manufacturers product information for geotextile fabric.

Provide written plan(s) for Support of Existing Utilities for excavations that will expose multiple large utilities at the same time or expose utility or building structures including tunnels, box conduits, manholes and pits. Show anticipated loads and verification that proposed supports are adequate.

Provide copies of all material field testing reports completed for the project to the AE within 48 hours of completing the individual tests. Along with each individual test result, provide a running spreadsheet of all individual test results.

PERMITS/FEES

Contractor shall be responsible for obtaining all permits necessary to complete trenching work. Contractor shall pay all fees associated with obtaining permits. These include, but are not limited to, permits to work within right-of-way.

PART 2 - PRODUCTS

GEOTEXTILE FABRIC

Woven or non-woven fabric shall meet the requirements of the WisDOT SSSHC Section 645.2.1 and 645.2.2, Geotextile Fabric Type SAS.

CRUSHED STONE CHIPS

Pipe 18" Diameter or Less:

Clean material meeting the requirements of "3/8" Crushed Stone Chips" as defined in Section 8.43.2(a)1 of the SSSWC, except that the gradation shall be as shown herein. If used for pipe bedding, Crushed Stone Chips shall also be used for cover material.

<u>Sieve Sizes</u>	<u>Percent Passing by Weight</u>
1/2 inch	100%
3/8 inch	85 – 100%
No. 4	10 – 30%
No. 8	0 – 10%
No. 16	0 – 5%

Pipe Over 18" Diameter:

Clean material meeting the requirements of "3/4" Crushed Stone Chips" as defined in Section 8.43.2(a)2 of the SSSWC, except that the gradation shall be as shown herein. If used for pipe bedding, Crushed Stone Chips shall also be used for cover material.

<u>Sieve Sizes</u>	<u>Percent Passing by Weight</u>
1 inch	100%
3/4 inch	90 – 100%
3/8 inch	20 – 55%
No. 4	0 – 10%
No. 8	0 – 5%

CRUSHED STONE SCREENINGS

Crushed stone shall be free of organic material, concrete, asphalt and other debris. Material shall meet the requirements of "Crushed Stone Screenings" as defined in Section 8.43.2(b) of the SSSWC. If used for pipe bedding, Crushed Stone Screenings shall also be used for cover material.

Sieve Sizes	Percent Passing by Weight
1/2 inch	100%
No. 4	75 – 100%
No. 100	10 – 25%

BEDDING SAND

Sand shall meet the requirements of “Bedding Sand” as defined in Section 8.43.2(c) of the SSSWC. If used for pipe bedding, Bedding Sand shall also be used for cover material.

<u>Sieve Sizes</u>	<u>Percent Passing by Weight</u>
1 inch	100%
No. 16	45 – 80%
Material finer Than No. 200	2 – 10%

UTILITY BEDDING SAND

Sand shall meet the requirements of “Bedding Sand” as defined in Section 8.43.2(c) of the SSSWC. If used for pipe bedding, Bedding Sand shall also be used for cover material.

<u>Sieve Sizes</u>	<u>Percent Passing by Weight</u>
No. 8	100%
No. 16	80-95%
No. 30	50-80%
No. 50	20-50%
No. 100	10-20%
Material finer than Than No. 200	1-10%

CRUSHED STONE

When crushed stone is required to affect soil stability or drainage it shall meet the gradation requirement below.

<u>Sieve Sizes</u>	<u>Percent Passing by Weight</u>
2-1/2 inch	100%
2-inch	90-100%
1-1/2 inch	35-70%
1-inch	0 – 15%
½ inch	0 – 5%

UTILITY COVER MATERIAL

Material that is to be used around and over the pipe and above the pipe bedding shall be termed utility cover material. The utility cover material for pipe shall be the same as the bedding material.

CONTROLLED BACKFILL

Granular material, meeting the following above all direct buried utilities:

<u>Sieve Size</u>	<u>Percent Passing by Weight</u>
1 inch	100
3/4 inch	85 - 100
3/8 inch	50 - 80
No. 4	35 - 60
No. 10	25 - 50
No. 40	15 - 30
No. 200	5 - 15

EARTH BACKFILL

Sand/gravel non-cohesive non-expansive, free of vegetable matter, clay, rubbish, rock larger than 2 inches, boulders, concrete, paving, masonry debris, waste, frozen materials, other inorganic and deleterious materials. Existing material meeting these requirements can be reused.

PART 3 - EXECUTION

PREPARATION

General Contractor shall excavate and backfill the following utilities according to this section:

- Direct buried power and signal conduits
- Building services for underground utilities listed above.

Review drawings and prepare work plan and schedule. Coordinate any necessary interruptions in utility service with Construction Representative, according to other specification sections.

Test pits, potholes or other means used to verify the location of existing underground facilities that are shown on the plans are considered incidental to utility installation.

Remove topsoil from work area. Saw cut and remove pavement from the work area. Remove excavated materials throughout the day. Deliver imported materials as needed throughout the day. Locate bedding, backfill and spoil piles according to all governing safety requirements, and do not interfere with public travel, adjacent landowners or other construction activities.

The same trench may not obstruct more than one street at one time without an approved traffic control plan and posted detour.

CONNECTIONS TO EXISTING UTILITIES

Connect to existing utilities according to the requirements of other pertinent specification sections.

DRAINAGE PROTECTION

Prevent surface drainage from entering utility excavations and trenches. Shape area to direct water away from excavation or trench with diversions such as berms, or ditches. If drainage must cross the excavation or trench, use culverts or other structure to minimize water entering the excavation or trench.

EXCAVATION

Excavate to elevations and dimensions necessary to complete construction. Excavations shall be sufficiently deep to provide for bedding beneath pipes and structures and as otherwise required to complete the work as shown. Excavations shall be sufficiently wide to provide for compaction equipment along the side of the pipe and the sidewall of trench or inside wall of trench box, shield or shoring.

The contractor shall provide all trench soil retention, trench boxes, sheeting and/or bracing needed to protect the work, existing property, utilities, pavement, and existing improvements, and to provide safe working conditions in the trench. Removal of any trench soil retention, sheeting and/or bracing from the trench shall not disturb pipe bedding and cover on new or existing utilities. Sheeting and bracing shall be removed unless specific permission to leave it in place is given by the Project Representative.

Contractor shall not excavate soil or impact the area of influence for structure foundations or footings. Notify Project Representative and A/E immediately if foundations or footings are undermined, cracked, damaged or appear unstable.

Unless noted on the drawings, the contractor shall remove all vegetation along the full width of the trench before beginning excavation. Vegetation and soil containing organic material, rock or boulders larger than 6 inches in diameter shall not be used for trench backfill. Unless otherwise specified, surplus material shall be the property of the contractor, and shall be disposed of at contractor's cost.

Trench excavation shall be backfilled when the contractor is not working in the trench. If trench cannot be backfilled due to progression of work, fence shall be installed and extend the full length of open trench on all sides.

UNSTABLE TRENCH BOTTOM

Notify Construction Representative if trench bottom consists of unstable soil, organic material, debris or other undesirable material. When this condition arises, the excavation shall be carried to such depth as directed by the A/E. Undercut backfill shall be installed and mechanically compacted to replace the excavated materials to trench bottom subgrade.

SUPPORT OF EXISTING UTILITIES

Contractor shall support all tunnels, conduits, sewers, structures, piping, wiring and cables that are exposed due to trenching and excavations. Support systems shall maintain current horizontal alignment, prevent vertical deflection and stabilize exposed piping, tunnel, duct package or conduit crossing the trench or running lengthwise in or along the trench.

INSULATION FOR EXISTING UTILITIES

Contractor shall provide temporary insulation over exposed utilities to prevent damage/corrosion, wasted energy and or freezing.

BEDDING AND UTILITY COVER MATERIAL

Excavate trench to depth and alignment of proposed utility lines and grades, allowing for required amount of bedding material. Excavation shall be reasonably free of water prior to placement of bedding material. Bedding material shall be shaped to conform to bell of pipe, fittings and structures.

If unstable soils are adjacent to bedding and cover material in trench wrap bedding and utility cover material in geotextile fabric. Where sheet piling/shoring is abandoned between unstable soil and trench wall geotextile fabric may be omitted.

Bed pipes and place utility cover material for the utility and pipe type being installed according to detail drawings and the depth and compaction requirements specified in table 31 23 16.13-2 . After placing pipe, support during placement and compaction of initial utility cover material.

Compaction of utility cover material for pipe and fittings shall be accomplished using hand tools and vibratory plate or tamping type walk behind compactors.

BACKFILL AND COMPACTION

Backfilling shall not begin until excavation is cleaned of trash and debris.

After initial cover material is placed and compacted, backfill and compact trenches using the material specified in Table 31 23 16.13 – 2. Take care to minimize settlement and avoid damage to new and existing structures, pipes, utility lines and other features during backfill placement and compaction. Place

backfill simultaneously on all sides of structures. Moisture condition backfill material as necessary to achieve density required for given use. Do not place material on frozen surfaces or use frozen material.

Backfill trenches from the top of utility cover material to subgrade below pavements, base course, and topsoil as required by the drawings. Where final restoration will be delayed backfill trench to match existing grade and maintain surface drainage patterns. Wedge around structures that extend above existing grade with compacted soil or pavement to match the existing surface.

It is the responsibility of the contractor to provide all necessary compaction equipment and other grading equipment that may be required to obtain the specified density. Vibratory plate or tamping type walk behind compactors will be required whenever backfill is placed adjacent to structures, pipes, utility lines and other features.

Flooding or jetting of backfill material for compaction purposes is not allowed.

Table 31 23 16.13-2

Location	Required Material	Maximum Compacted Lift Thickness	Minimum Proctor Compaction	Minimum Relative Density (a)
Bedding Material Beneath Utility Structures	Crushed Stone Chips or Crushed Stone	12"	95% Modified	70%
Bedding Materials Beneath Utilities	Crushed Stone Chips, Crushed Stone Screenings, or Bedding Sand(as required in Division 33)	6"	95% Modified	70%
Utility Cover – Areas Over Bedding Materials to 12" Over Utilities	Crushed Stone Chips, Crushed Stone Screenings, or Bedding Sand (as required in Division 33)	6"	95% Modified	70%
Areas Between Topsoil and Utility Cover	Earth Backfill	12"	90% Modified	50%
Areas Between Utility Cover and Crushed Aggregate Base Course Beneath Existing or Proposed Pavement (Roads, Drives, Walks)	Controlled Backfill	12"	95% Modified	60%
Areas with 10' of an Existing or Proposed Building or Structure Footing or Slab	Controlled Backfill	12"	95% Modified	60%
Turf Areas	Earth Backfill	12"	88% Modified	50%

(a) Minimum relative density as determined by ASTM D-4253-00 for coarse-grained soils with less than 15% by mass passing the No. 200 sieve. Applicable only when minimum proctor compaction cannot be achieved.

GRADING

Grade areas disturbed during trench excavation and backfilling and adjacent areas as necessary to establish new grades shown on plans as soon as practicable after backfilling. If new grades are not shown on plans, grade areas to tie into the surrounding area without abrupt changes in elevations or slopes and provide drainage away from structures.

New grades are designed to produce desired configuration of site and do not represent a balance between cut and fill.

Grades for earthwork shall not deviate more than 1 inch from plan elevations unless otherwise directed by Construction Representative.

GRADING AROUND TREES

Limit excavation, fill or grading near trees or other vegetation to the extent possible. No excavation, trenching or backfilling shall occur within the fenced tree protection zone of existing trees without authorization from DFD Project Representative. If tree roots are encountered during trenching cut roots cleanly and squarely.

CLEAN UP

Remove excess bedding, backfill and spoil material from the site as soon as possible after backfilling is complete, but no later than 1 calendar day after backfilling is complete.

Thoroughly clean all drainage ways, roads, parking lots sidewalks and paved surfaces and remove and dispose all debris and mud.

END OF SECTION 31 23.16.13

SECTION 32 31 13 – Chain Link Fences and Gates

PART 1 – GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide a fully functioning fence and gate installation as provided for in these specifications and on the drawings.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

REFERENCE

Unless otherwise specified in these specifications or otherwise shown on the drawings, conform all work under this section to Section 616 of the Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, current edition.

OWNER FURNISHED MATERIALS

None.

PROVISIONS FOR FUTURE WORK

None.

RECORD DRAWINGS

Maintain record drawings of all fencing installations and points of connection made as part of this project and for future connection on original drawings prepared by the installing contractor/subcontractor. Include copies of record drawings with the Operating and Maintenance instructions.

PART 2 - PRODUCTS

GENERAL

All materials furnished shall be new materials unless otherwise specified. Salvaged materials may be used only when specified.

FENCE HEIGHT

The height of the fence shall be as shown on the drawings. The designated height of the fence shall be the fabric height.

REQUIRED ARMS, RAILS, AND TENSION WIRES

Provide rampart arm, top rail/tension wire, intermediate rail, and bottom rail/tension wire according to the drawings.

REQUIRED COATINGS

All steel items used shall be galvanized, aluminum or zinc aluminum alloy coated.

FABRIC

Provide 9 gauge galvanized coated, two (2) inch mesh fabric, with barbed selvage on bottom and knuckled salvage on top, conforming to ASTM A-392 Class 1.

FABRIC FASTENERS

Provide fabric fasteners of steel wire clips and tie wires galvanized according to ASTM A-641, Class III, or aluminum coated in conformance with fence fabric specifications.

Provide fasteners for posts, top and intermediate rails, bottom rails, top tension wires and braces of 9 gauge steel or 0.179 inch diameter aluminum tie wires.

Provide fasteners for bottom tension wire of not smaller than 12 gauge or 0.149 inch diameter aluminum tie wires.

POST, RAIL AND FRAMING MATERIALS

Framing (Steel): ASTM F1083 Schedule 40 galvanized steel pipe, welded construction, minimum yield strength of 25 ksi; coating conforming to ASTM F1043 Type A on pipe exterior and interior.

Line Posts: 2 1/2 inch OD Sch 40 galvanized steel pipe.

Corner and Terminal Posts: 3 inch OD Sch 40 galvanized steel pipe.

Gate Posts: 4 inch OD Sch 40 galvanized steel pipe.

Top and Brace Rail: 1 5/8 inch OD Sch 40 galvanized steel pipe, plain end, sleeve coupled.

Gate Frame: 2 inch OD Sch 40 galvanized steel pipe for welded fittings and truss rod fabrication.

GATES

Provide additional horizontal and vertical members as necessary to assure proper gate operation and attachment to fabric and hardware.

Provide diagonal braces made of crossed adjustable length three-eighths inch diameter truss rods on non-welded gate frames and on welded frames where corner rigidity is not sufficient to prevent sag.

Gate frames shall be covered with the same fabric as the fence.

Weld or assemble gate frames with malleable or pressed steel fittings and rivets to provide rigid connections. Install fabric with stretcher bars at vertical edges. Attach to frame at fifteen (15) inches o.c. all sides. Provide caps for all gate frame work ends.

GATE HARDWARE

Provide heavy duty hinges of malleable iron, pressed or forged steel, non-lift-off type, adjusted to permit 180 degree gate opening. Provide two (2) hinges for each leaf.

Provide heavy duty forked type or plunger bar type latches for all single leaf gates. Provide center stop and keeper for all double leaf gates. Provide spring latch for all sliding gates. Provide padlock eye as an integral part of all latches.

Provide multi-user lock system for each gate. Lock system to be Tayhope 5-User system. Owner to provide locks.

POST TOPS

Provide cast or malleable iron ornamental tops on all posts except 3.5" x 3.5" roll formed sections. Tops shall have an opening for the top rail to pass through.

Post tops shall be fitted with a 45 degree extension arm for supporting three strands of barbed wire and with an opening for the top rail or tension wire. Extension arms shall be capable of supporting a 200 pound downward pull at the outermost end of the arm.

BARBED WIRE

Provide three (3) strand 12 1/2 gauge minimum galvanized steel barbed wire with 14 gauge minimum four (4) point barbs.

Galvanized wire shall conform to ASTM A-121, Class III.

TENSION WIRE

Provide 7 gauge tension wire conforming to the fence fabric used, complete with end clamps.

STRETCHER BARS

Provide stretcher bars of one piece lengths equal to the full fabric height with a minimum cross section of 3/16" x 3/4". Provide one stretcher bar for each gate and end post and two for each corner and pull post, except roll form posts with integral loops.

GROUND RODS

Provide ground rods according to plans.

PART 3 - EXECUTION

SITE WORK

Prior to fence construction remove and dispose of all trees, brush, logs, stumps and other debris for a width of at least 12 inches each side of the proposed fence alignment.

CONCRETE FOOTINGS

Excavate holes for footings to neat dimensions in firm ground to ensure the post will be centered. Remove rock or other obstructions encountered to the required depth. Use forms in unstable soil and allow them to remain in place for at least 24 hours after concrete is poured. Backfill, after forms are removed, with suitable material thoroughly compacted in place in layers to prevent settlement.

Fence post footings shall be of the size and type as shown on the drawings.

Line posts may be driven posts. All other posts must be set in concrete.

POSTS AND BRACES

Set posts in a vertical position at the required location and alignment. Set tops at the required elevation to provide a smooth profile at the top rail or tension wire without abrupt changes and in conformity with the general contour and which meets the approval of the engineer.

Place an end post at each end of each run of fence. Place a corner post whenever a break of 30 degrees or more occurs in the horizontal alignment. Set an intersection post in line with an intersecting chain link fence and brace it to the adjacent posts of the intersecting fence.

Place an intermediate braced post where the vertical alignment changes by more than 5 degrees, or a change in fence grade of more than nine (9) percent occurs.

Place an intermediate braced post at 660' intervals for fence with a top rail and at 1,000' intervals for fence with a top tension wire on all long runs of fence. Set an intermediate brace post at the approximate midpoint when runs of fence are less than 1,320' but more than 660' for fence with top rail, or less than 2,000' but more than 1,000' for fence with top tension wire.

POST BRACING ASSEMBLY

Post bracing assemblies consist of one or more brace rails and a 3/8 inch truss rod as hereafter specified. Provide brace rails the same size as the top rail. Provide truss rods with an adjustable take-up adapter.

Install a single bracing assembly at each gate and end post location.

Install a double bracing assembly at each corner post and all intermediate braced posts.

Provide the bracing assembly with one horizontal brace rail and one diagonal truss rod on all fences which have a top rail. Locate the horizontal brace rail according to the manufacturer's specifications.

Provide the bracing assembly with one horizontal brace rail and one diagonal brace rail and one diagonal truss rod on all fences which do not have a top rail. Locate the horizontal rail according to the manufacturer's specifications.

STRETCHER BARS

Provide one stretcher bar for each gate and end post and two for each corner and pull post, except roll form posts with integral loops. Attach to posts with heavy duty pressed steel or malleable iron bands spaced at 15 inches o.c.

GROUND RODS

Install ground rods as specified on drawings.

FABRIC

Install, stretch, and anchor tension wires to each end, corner, gate and brace post and properly attach to each line post before the fabric is placed. Pass top tension wire through the post top rail opening. Install top, intermediate and bottom rails at proper locations.

Attach the end of the fabric to the end, corner, gate or brace posts (except roll form posts with integral loops) by means of a stretcher bar threaded through the end loops of the fabric and stretched to remove all slack with proper stretching equipment. Secure the stretched fabric to posts, rails and tension wires with specified fabric fasteners. Install fabric fasteners on all posts at not greater than 14 inches o.c. and on rails and bottom tension wires at not more than 24 inches o.c. Where a top tension wire is installed, fasten to the fabric at not more than 18 inches o.c.

Repeat stretching operations at approximately every 100' for each run of fence.

Make splices in fabric by interweaving a wire picket through each end loop of each piece of fabric. Each splice shall be subject to the engineer's approval.

GRADE CLEARANCE

For line and property fences provide a clearance of 3 inches.

GATES

Install gates plumb and level and adjust for smooth operation as intended, without binding or hanging up.

BARBED WIRE

Install barbed wire properly fastened to the rampart arms.

CLEANUP

After chain link fence construction is completed clean up all storage and work areas. Replace or repair as required all landscape features damaged or disturbed under this contract.

END OF SECTION 32 31 13

SECTION 33 79 00 – Tower Grounding and Lightning Protection

PART 1 – GENERAL

SCOPE

The work under this section shall consist of providing and installing grounding and lightning protection for communication towers, antennas, coaxial cables, waveguides and tower site compound as detailed in the plans and specified below.

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

Section 31 23 16.13 - Trenching

Section 33 81 00 – Communication Towers

Section 33 82 00 – Coax and Waveguides

Section 33 83 00 – Antennas

REFERENCES

NFPA 70, National Electric Code

NFPA 780, Standard for the Installation of Lightning Protection Systems.

UL 96A, Installation Requirements for Lightning Protection Systems.

Motorola R56 Standard – Standards and Guidelines for Communication Sites

IEEE Std. 1692-2011, Guide for the Protection of Communication Installations from Lightning Effects

IEEE Std. 1100, IEEE Recommended Practice for Powering and Grounding Electronic Equipment.

DESIGN INTENT AND MINIMUM REQUIREMENTS

All grounding and lightning protection systems installed shall meet or exceed the requirements of the Motorola R56 Standards, latest revision. In cases where these plans and specifications exceed the requirements of the R56 standards, these plans and specifications shall be followed. In cases where these plans and specifications are in conflict with the R56 standard, contact engineer for desired resolution.

PERFORMANCE REQUIREMENTS

Tower Site Grounding System Resistance: 3 ohms maximum at tower ground test well.

Use suitable test instrument to measure resistance to ground of system. Perform testing according to test instrument manufacturer's recommendations. Perform fall-of-potential test according to ANSI/ IEEE 81 on tower ground test well.

Testing of grounding system resistance is to be witnessed by the Construction Representative.

Provide test report of grounding system overall resistance in final O&M manuals and noted on record documents.

EQUIPMENT AND MATERIALS FURNISHED BY OTHERS

None.

WORK BY OTHERS

None.

SUBMITTALS

Submit manufacturer's cut sheets for all grounding and lightning protection system materials to be used on the project to the engineer for approval prior to installation.

Items requiring submittal include:

- Grounding conductors
- Air Terminals
- Ground rods

- Chemical ground rods/plates
- Ground bars
- Coax and waveguide ground kits
- Deterrent wire grounding clamps
- Gate jumpers

Submit test reports of ground system performance to engineer prior to backfilling of site ground system.

PROJECT RECORD DOCUMENTS

Record locations of all electrical and telecommunications grounding electrodes, busbars and grounding conductors as installed including recorded ground resistance test results.

Contractor to take digital photos of all installed below grade connections. Provide photos with record drawings.

PART 2 - PRODUCTS

GROUNDING CONDUCTORS

Ground system conductors shall be stranded or solid, tinned or untinned, copper conductors of the size and type noted on the drawings. Aluminum conductors are not permitted.

AIR TERMINALS

Air terminals shall be constructed of copper clad steel and shall extend a minimum of two feet above the highest appurtenance on the tower.

Air terminals shall be directly connected to mast pipes or bonded to tower steel with a #2 stranded insulated copper conductor using UL approved mechanical connectors

Air terminals may be mounted on mast pipes to reach required height. Mast pipes (when used) shall be directly connected to tower steel or bonded to tower steel with a #2 stranded insulated copper conductor using UL approved mechanical connectors.

ANTENNA GROUND BARS

Copper bus bars shall be sized appropriately to accommodate the number of connecting lines. Minimum copper bar size shall be 1/4" x 4" x 6" providing (9) ten two-hole grounding lugs, (Site Pro Part No. MG40609 or equivalent).

Provide a #2 AWG stranded insulated ground lead which connects the ground bar to tower steel using a UL listed mechanical connector as detailed in the drawings.

LOWER TOWER GROUND BAR

Tinned copper bus bar shall be sized appropriately to accommodate the number of connecting lines. Minimum copper bar size shall be 1/4" x 4" x 24" providing 44 two-hole grounding lugs, (Site Pro Part No. MG42488K or equivalent).

Provide non-conductive insulators between bus bar and tower structure.

INTERIOR/EXTERIOR SHELTER GROUND BARS

Copper bus bar shall be sized appropriately to accommodate the number of connecting lines. Minimum copper bar size shall be 1/4" x 4" x 24" providing 44 two-hole grounding lugs, (Site Pro Part No. MG42488K or equivalent).

Exterior ground bars shall be tinned.

Provide non-conductive insulators between bus bar and tower/building structure.

COAX AND WAVEGUIDE GROUND KITS

Copper strap type ground with integral #6 ground lead with 3/8-inch two-hole lug, butyl wrap and electrical tape specially fabricated for use for coax and waveguide grounding (Site Pro Series SGT, UGT or equivalent).

GROUND RODS

Ground Rods: Refer to drawings for requirements.

Rods shall be driven to depth noted in the drawings. Connect each ground rod to the below grade ground system using #2 AWG solid tinned copper ground conductors. Utilize exothermic connections between ground rod and conductor.

Provide the number of rods and space as indicated on the drawings, generally no greater than 20 feet on center along path of ground ring.

GROUND PLATES

Provide 18"x18" square x 0.032-inch thick solid copper grounding plates as noted on drawings.

ENHANCED GROUNDING TRENCH

Provide Ground Enhancement Material (GEM) within grounding trench as required by drawings.

GEM to be non-corrosive and have a resistivity of less than 2 ohm.

CHEMICAL ENHANCED GROUND RODS

Provide chemical enhanced ground rod (as manufactured by Harger, or equivalent) composed of a copper tube that contains specialized hygroscopic electrolytic salts that help lower soil resistivity.

Chemical enhanced ground rods shall be UL Listed and designed to last in excess of 35 years.

Chemical enhanced ground rods shall be of the length and orientation noted in the plans and be provided with test well cover and #2 solid tinned conductor for connection to site grounding system.

Install chemical enhanced ground rod per manufacturer's recommendations with 4-inch minimum cover of ultra-low resistance carbon based (Ultra-fill) material on all sides.

MECHANICAL GROUNDING CONNECTORS

Mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lockwashers shall be made of stainless steel and supplied as a part of the connector body and shall be of the two bolt type.

Paint and other non-conductive finishes shall be removed from items being connected to in order to provide a metal to metal connection.

Install anti-oxidant compound between mechanical connector body and connection point. Use copper anti-oxidant for copper to copper connections.

The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

COMPRESSION GROUNDING CONNECTORS

Compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall be no less than 99% by IACS standards.

The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.

The installation of the connectors shall be made with a compression, tool and die system, as recommended by the manufacturer of the connectors.

The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required compression tool settings.

Each connector shall be factory filled with an oxide-inhibiting compound.

EXOTHERMIC GROUNDING CONNECTORS

Exothermic welding system connection specifically used for in making electrical connections of copper to copper, copper to steel or copper to cast iron or copper to brass/bronze for grounding and cathodic applications as manufactured by Cadweld, or equivalent.

Exothermic welding system shall meet the applicable requirements of IEEE Std. 80 and IEEE Std. 837. Independent test data showing conformance to shall be readily available.

Electronic igniter must meet applicable requirements for electromagnetic compatibility. An independent test report including results of radiated emission, electrostatic discharge and radiated immunity shall be readily available.

Manufacturer shall be ISO9001:2000 certified.

PART 3 - EXECUTION

PREPARATION

Coordinate work with Electrical Contractor.

Coordinate fence ground lead locations with fencing contractor.

Verify that final backfill and compaction has been completed before driving rod electrodes

GENERAL

Install Products according to the plans, details and manufacturer's instructions.

Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed over mechanical ground connections.

Ground connection surfaces shall be properly cleaned and prepared to provide metal to metal contact. All connections shall be made so that it is impossible to move.

TOWER FOUNDATION REINFORCING STEEL GROUNDING

Connect tower reinforcing steel to tower ground ring with one #2 solid bare tinned copper conductor(s) as detailed in the drawings.

BELOW GRADE TOWER SITE GROUND SYSTEM

Excavate ground trenches at the locations and required depths as noted in the plans.

Install ground rods, ground plates, conductors and other below grade devices as detailed in the plans.

Connect all devices using exothermic type connections to below grade ground system.

Measure site ground system performance prior to backfilling and prior to interconnection to utility power ground system using Fall of Potential testing procedure. Report results to engineer.

Notify engineer for inspection of ground system and connections prior to backfilling. Provide 72 hour minimum advanced notice.

Record locations of all below grade connections.

Record digital photos of all completed below grade connections.

Backfill and compact trenches per the plans and specifications.

Install inspection/test wells per the plans and specifications.

Grounding plates shall be utilized in lieu of ground rods at locations where ground rods cannot be installed (i.e., over tower foundation or bedrock). Install ground plates at standard ground trench depth.

ENHANCED GROUNDING TRENCH

Install Ground Enhancement Material (GEM) within grounding trench at a thickness required by manufacturer specifications.

GROUND BARS

Install ground bars at the locations shown and as detailed in the plans.

GROUND KITS

Install ground kits on all coax and waveguide at the locations shown and as detailed in the plans.

Ground kits shall be installed on each coax/waveguide a minimum of three times (antenna level, base of the tower and building coax port entry). For coax/waveguide runs above a tower height of 200 feet, an additional ground kit shall be installed at the mid-point of the coax/waveguide line run.

ABOVE GRADE TOWER SITE GROUND SYSTEM

Connect fence posts, fence fabric, gates, ice bridge posts, tower and ground bar leads to the below grade ground system as detailed in the plans.

QUALITY CONTROL

Inspect grounding and bonding system conductors and connections for tightness and proper installation.

Use suitable test instrument to measure resistance to ground of overall system prior to backfilling.

Perform testing according to test instrument manufacturer's recommendations using the fall-of-potential method. Resistance shall meet or exceed a 3 ohm maximum resistance plateau. Provide written results of resistance measurements to the engineer.

END OF SECTION 33 79 00

SECTION 33 81 00 – Communication Towers

PART 1 – GENERAL

SCOPE

The work under this section shall consist of providing and erecting communication towers, antenna mounts and transmission line ice bridges as detailed in the plans and specified below.

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

Section 03 30 00 – Cast-In-Place Concrete

Section 33 79 00 – Tower Grounding and Lightning Protection

Section 33 82 00 – Coax and Waveguides

Section 33 83 00 – Antennas

REFERENCES

Abbreviations of standards or organizations referenced in this specification are as follows:

ACI	American Concrete Institute
AISC	Manual of the American Institute of Steel Construction
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CS	Commercial Standards, Products Standards Sections, Office of Eng. Standards Service, NBS
EPA	Environmental Protection Agency
EIA	Electronic Industries Association
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FS	Federal Specifications, Superintendent of Documents, U.S. Government Printing Office
UL	Underwriters Laboratories Inc.
IEEE	Institute of Electrical and Electronics Engineers
NBS	National Bureau of Standards
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
SSPC	Steel Structures Painting Council
TIA	Telecommunications Industry Association

DESCRIPTION OF SYSTEM

Communication Towers are required at two location(s). Tower heights and types shall be as follows:

1. Main Tower - Wrightstown, Wisconsin: (1) – 400 feet tall self-support
2. Auxiliary Tower - Wrightstown, Wisconsin: (1) – 70 feet tall self-support

Refer to the drawings for layout, configuration and loading of each tower.

All towers shall be produced and constructed by the same manufacturer.

DESIGN

The tower shall be designed, fabricated and erected according to TIA-222- Revision G Standards, including latest revisions. Wind speeds and ice thicknesses shall follow ASCE 7-16 Standards as allowed per TIA Committee. The tower shall comply with EIA Specifications for twist and sway as they relate to the tower and antenna support brackets.

The following design parameters shall be used for each tower location as follows:

Wrightstown, Wisconsin:

- Structure Classification "Class 3"
- Exposure Category "C"
- Topographic Category "1" (Flat/Rolling)
- 113 mph basic wind speed with 0" of radial ice
- 50 mph basic wind speed with 1.50-inch radial ice (0.75-inch Rev G equiv.)
- 60 mph basic wind speed for deflection calculations

The loading criteria to be used for tower and foundation design is as follows:

Tower Structure, Mounts and Accessories:

1. Antennas: Quantity, size, location and orientation as specified in the drawings
2. Coax, Waveguides and Transmission Line Ladders: Placement on the tower as specified in the drawings
3. Climbing Ladder: Placement on the tower as specified in the drawings
4. Other appurtenances: As specified in the drawings
5. All mounts shall be designed to remain vertical under design wind conditions. Design of antenna mounts is the responsibility of the supplier. The mount design shall meet general dimensions as noted in the drawings.
6. All mounts shall be designed to support servicing of antennas by tower climbers (up to 200 lbs) under prescribed antenna loads using service wind conditions.
7. Tower structure shall be designed such that no member is stressed to more than **80%** of its design capacity under the modeled loading criteria for the limiting design case (basic wind, radial ice, deflection) and to account for future loading.
8. Tower structure shall be designed such that all specified antenna mounts and other appurtenances (proposed and future) properly connect to the tower structure without issue and do not cause excessive deflection or failure of the tower member being connected to.

Tower Foundation:

1. The tower base reactions calculated for the modeled loading criteria for the limiting design case shall be increased by a minimum of **25%** to account for future loading.
-
2. Tower anchor bolts shall be designed such that grout is not required below tower base plates and around anchor bolts. This requirement is to allow drainage and air flow beneath the base plates.
3. The tower foundations shall be designed based on the soil conditions and recommendations provided in the subsurface soil exploration report for the project. The soil design parameters specified in Section 7.0 "High Mast Lighting, Sign Structure & Tower Foundation Recommendations" for boring HM-1 shall be utilized in foundation design (conservative approach).

The design, fabrication and erection shall conform to the requirements of the Federal Communications Commission, Federal Aviation Administration, the National Electrical Code, International Building Code and State Building Code. Any known conflicts between these specifications or drawings, and codes, as well as any suspected error in these specifications or plans shall be brought to the attention of the engineer.

Tower Design, Tower Foundation design, and Fabrication and Erection drawings shall be certified by a Registered Professional Engineer licensed in the state of tower construction.

The contractor is responsible for ensuring the proposed tower design is compatible with the site layout and general parameters specified in the bid documents. Any proposed changes to layout shall be pre-approved by the engineer prior to implementing. All costs associated with such changes shall be the responsibility of the contractor.

QUALITY ASSURANCE

Where equipment, accessories, or materials are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated in the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed.

All ground and aerial work shall be performed by persons equipped and qualified to do so. The contractor shall furnish, upon contract award, evidence of adequate bonding and insurance to hold the State harmless in completion of the contract issued for this work.

The contractor shall be experienced in the installation and alignment of microwave parabolic antennas. Contractor shall furnish, upon request, a list of at least three references where microwave parabolic antennas were successfully installed and aligned.

The contractor shall visit the tower site to verify the site specific data and drawings. Any expense and delay due to lack of information shall be the contractor's responsibility.

QUALIFICATIONS

Tower and Tower Accessory Manufacturer: Company specializing in manufacturing Products specified in this section with minimum 10 years documented experience.

Tower Erector: Company specializing in performing work of this section with minimum of 5 years documented experience.

PROTECTION OF EXISTING WORK AND FACILITIES

Verify the locations of, and protect, any signs, paved surfaces, buildings, structures, landscaping, streetlights, utilities and all other such facilities that may be encountered or interfered with during the progress of the work. Take all measures necessary to safeguard all existing work and facilities which are outside the limits of the work or items which are within the construction limits but are intended to remain.

CONSTRUCTION LIMITS

Construction Limits are indicated on the drawings. In the absence of such a designation on the drawings, confine work to the minimum area reasonably necessary to undertake the work. All area disturbed by excavation and grading, plus such additional areas as are disturbed by construction related activities including construction access and storage and installation of materials shall be considered the "Construction Area."

EQUIPMENT AND MATERIALS FURNISHED BY OTHERS

None.

WORK BY OTHERS

Owner will install alarm wiring from tower lighting controller to punch block within contractor provided conduits.

SUBMITTALS

Refer also to Section GC - General Conditions of the Contract.

Tower and Tower Foundation Design:

1. Submit engineering design and structural analysis package for tower and tower foundations.
2. Design and analysis shall be completed using structural analysis software generally accepted by the tower industry.
3. The design and analysis shall be according to the Design requirements of this specification.

4. Submitted package shall include sufficient information and detail to allow a third-party engineer to accurately model the tower and foundation system to verify the design and for future changes in loading per TIA-222-Revision G requirements as a "Rigorous Analysis". This includes providing all member sizes, material types, connection details, weld information, bolt size and material strengths, geometry configuration, loading input parameters, factors of safety, design assumptions, calculations and results of each loading condition.
5. This package shall include a scaled drawing which shows the layout of the tower geometry, location of each appurtenance load applied to it and feed line placement on the tower.

Fabrication and Erection Drawings:

1. Submit fabrication and erection drawing package of all fabricated items associated with the tower package.
2. All submittals must receive full approval of the engineer prior to tower manufacture and erection.
3. Submitted package shall include engineering shop drawings for the fabrication, assembly and erection of all items. The drawings at a minimum shall include:
 - a. Cover sheet showing project name, tower height, manufacturer's name and model number
 - b. Bill of materials for the tower and each attached component.
 - c. Elevation and plan view showing tower orientation. Precise antenna/dish location and azimuths, light levels as required, waveguide and coax routing, plus any pertinent construction or erection notes.
 - d. Tower section drawings showing all tower members, splice plates, ladder mounting details, antenna supports, entry/exit ports, hand holes and any other information needed to identify each portion of the tower. Show dimensions of all tower members including the location and size of each bolt and hole, materials types and other information to model the tower.
 - e. Tower base foundation and associated concrete reinforcement details, plan and elevation views. Drawing shall include such information as reinforcement bar size, quantity and position, cubic yards of concrete, concrete placement of finishing requirements and other pertinent site specific information.
 - f. Drawings of tower base plate details, anchor bolts, anchor bolt templates and associated hardware.
 - g. Drawings of transmission line ice bridge assemblies and associated supports.
 - h. Drawings of each antenna mount, climbing ladder, vertical transmission line ladder and other assemblies.
 - i. Lighting system schematic drawing and material list, if applicable.
 - j. Fall Radius Design Certification, if applicable.

WARRANTY

The tower and components supplied under this specification shall be warranted to be free of defects for a minimum period of 5 years from the date of substantial completion. In addition, all workmanship provided under this specification, shall be warranted to be free of defects for a minimum period of 5 years from the date of substantial completion. Defects in materials or workmanship during the warranty period and any materials and/or equipment damage because of defects, shall be repaired or replaced at no cost to the Owner.

This warranty shall not be void by the Owner's use of other competent contractors to install antennas or transmission lines or perform other maintenance on the tower when the work is consistent with the initial design and intent.

Warranty service shall be provided and repairs completed within 24 hours following notification of contractor by Owner that a failure covered by the warranty provisions has occurred. Contractor shall furnish Owner with a telephone number at which contractor, or his representative, may be reached 24 hours a day, seven days a week, notification of in-warranty failures.

OPERATING AND MAINTENANCE INSTRUCTIONS

Assemble material in an operating and maintenance manual, using and index at the front of each volume and tabs for each system or type of equipment installed. In addition to the data indicated in the General Requirements, include the following information:

Copies of all approved shop drawings

1. Manufacturer's wiring diagrams for electrically powered equipment
2. Records of tests performed to certify compliance with system requirements
3. Parts lists for manufactured equipment
4. Warranties and/or guarantees
5. Additional information as indicated in the technical specification sections

RECORD DRAWINGS

Maintain record drawings of all as-built system installations and points of connection made as part of this project. Include copies of record drawings with the Operating and Maintenance instructions.

PART 2 - PRODUCTS

MATERIALS - GENERAL

All structural materials, fabricated parts and associated assemblies shall be galvanized according to ASTM A-123 (Hot-Dip).

All mounting hardware shall be either galvanized or stainless steel.

Tower structure and appurtenances shall be designed and fabricated so that erection may be accomplished using bolt connections with no field welding required.

SELF-SUPPORT TOWERS

Self-support towers shall be a free standing three leg tapered towers constructed of galvanized steel.

Tower sections shall utilize bolted connections, no field welding is permitted.

Each base section tower leg shall be provided with a grounding tab for connection of ground leads.

TOWER FOUNDATIONS

Self-support tower foundations shall be either a spread footing (mat) type, individual pad and pier at each tower leg, or drilled pier (caisson) foundation at each tower leg consisting of reinforced concrete.

CLIMBING LADDER/SAFETY CLIMBS

Self-support towers shall be equipped with a permanent continuous exterior climbing ladder from the base of the tower to the top and/or step bolts. Refer to drawings for location of exterior climbing ladders.

Self-support towers shall also be equipped with construction step bolts on each tower leg from the base of the tower to a point where the tower face width is less than 15 feet wide.

Tower shall be equipped with a continuous permanent safety climb cable device coordinated with the climbing ladder which meets OSHA and ANSI requirements for a climbing safety device.

Provide one compatible climbing harness along with safety climb device for each tower.

VERTICAL TRANSMISSION LINE LADDERS

Provide vertical transmission line (coax/waveguide) ladders of the size, quantity and style as noted in the drawings.

ANTENNA MOUNTS

All antenna mounts shall connect to tower with mechanical compression type brackets as detailed in the plans. The use of chain mounts is not acceptable.

Mounts shall include brackets to orient the assembly vertically when mounted on tapered sections of the tower.

Each mount shall be designed and adequately braced back to tower structure to minimize deflections of the antenna such that pole type antenna assemblies do not strike one another or the tower structure under the design wind conditions. In addition, antennas shall return to vertical after experiencing design wind conditions. Design of antenna mounts is the responsibility of the manufacturer. The mount design shall meet general dimensions noted in the plans. If determined that a suitable design is not achievable per the general dimensions, the engineer shall be notified prior to manufacture and installation.

1. Dish Mounts
 - a. Dish mounts shall be leg type mounts and be adequately connected or otherwise braced to prevent dish movement.
 - b. Provide vertical separation distances suitable for each dish to be installed.
 - c. Dish mounts shall be provided with mast pipes for mounting of dish antennas
2. Stand-off Mounts
 - a. Stand-off mounts shall utilize truss style extension and be adequately connected or otherwise braced with tieback arms to prevent antenna movement.
 - b. Provide horizontal stand-off separation distances as noted in the plans.
 - c. Stand-off mounts shall be designed for connection of one antenna on each mount.
 - d. Stand-off mounts shall be provided with mast pipes for mounting of antennas, when necessary.
3. V-Arm Truss Frame Mounts
 - a. V-Arm Truss Frame mounts shall include (2) truss type elements that connect to (1) tower leg and a face portion for mounting of antennas.
 - b. Face portion of mount shall be of the size indicated in the plans (6' typ.)
 - c. Mounts shall provide required stand-off distance from the tower as indicated in the drawings (6' typ.).
 - d. Mounts shall include a mast pipes for connection of antennas.
 - e. Mounts shall include a min. of (2) stiff arm supports for to prevent movement of the mount assembly.

ICE SHIELDS

Microwave dish antennas shall be provided with ice shields of appropriate size when required in the drawings. Ice shields shall connect to tower with mechanical compression type brackets as detailed in the drawings.

TRANSMISSION LINE ICE BRIDGE

Provide self-supporting transmission line ice bridge(s) supported by galvanized steel pipes between tower and building coax port entries as detailed in the plans.

All of the vertical pipe supports shall be schedule 40 galvanized steel pipe of the diameter specified in the drawings. Extend vertical supports above the top of transmission line ice fall protection as detailed in the plans. Provide pipe cap on top of vertical supports.

Ice bridge shall be 24-inch-wide grip strut type bridge with vertical extended double T-line hanging brackets. Transmission line support system shall provide 30 holes of line capacity using double stack snap-in clips. Install support brackets 3 feet on-center, or as recommended by the manufacturer.

TOWER GROUNDING

Self-Support Tower: Provide a minimum of three (2 inch x 2 inch x ¼ inch thick) steel ground tabs (one on each leg) welded to the tower base legs for use in attachment of ground conductors.

Ground tower according to the plans and specification section 33 79 00 Site Grounding and Lightning Protection.

OBSTRUCTION LIGHTING

All tower lighting equipment shall be furnished according to current FAA and FCC standards. Specifically, lighting systems shall be according to FAA Federal Aviation Advisory Circular 70/7460-1 L, Obstruction Marking and Lighting including subsequent revisions and updates.

The 70 foot Auxillary Tower shall not include a tower lighting system.

The 400 foot Main Tower shall be lighted with "E"-Series lighting kit (E-2+1). Lighting system to include two L-864/L-865 Flashing Dual Red/White Medium Intensity Beacons (Top) and two L-864/L-865 Flashing Dual Red/White Medium Intensity Beacons (Mid height) configured to flash in sync with L-864 at 30 fpm.

The lighting system shall be specifically manufactured to work in a communication RF environment. The lighting system shall not radiate, nor conduct through power lines, electromagnetic energy which will interfere with Owner's broadcast or point-to-point radio equipment.

Lighting systems to be completely LED based. LED lights shall include in-fared emitters as required by current FAA standards.

Acceptable manufacturers/products include: International Tower Lighting, LLC (ITL), Model: ILS-3600-0IR – No substitutes.

Warranty: The lighting system shall carry a 5-year manufacturer's warranty on all components comprising the system.

Dual Strobe/Beacon Lights:

1. Strobe lights shall be medium intensity dual red/white FAA type L-864/L-865 with LED light engine(s)/Flash Head(s).
2. Beacon Lights shall be LED RED FAA type L-864 with LED light engine(s).
3. Light to be housed in a cast aluminum- powder coated housing.
4. The light shall be a single-level design utilizing a single level containing both red and white LED's.
5. The light lens shall be a polycarbonate material coated with Red Spot #UTV200V3 to preclude yellowing of the lens after exposure to UV rays from the sun.
6. Power supply cable shall interface with color coded DIN terminal blocks in the light engine and control enclosure.
7. Each light engine mounted shall be installed on a leg mounted beacon mounting bracket. The contractor shall verify the light engine is mounted in such a way that a good electrical ground connection is made between the powder coated light engine and the tower structure. If not provided by the tower manufacturer, hot dipped galvanized brackets shall be specified and provided by the lighting system distributor.

Wiring, Interconnection Cable and Conduit:

1. All tower light wiring shall comply with national, state and local electrical codes.
2. The beacon power supply/controller to light engine multi-conductor cable and obstruction light power cable shall be manufactured to fully comply with the above referenced FAA standards and manufacturers requirements including full FAA temperature ratings.

Integrated Beacon Power Supply/Light System Controller:

1. All interconnections shall be provided by the distributor. The installer shall only need to provide power wiring, flash head wiring, PEC wiring and alarm wiring to the preassembled system. The complete system shall be fully tested prior to shipment- including all alarm functions.
2. The lighting system controller shall include a photocell equipped with manual override and alarm conditions for the following:
 - a. Beacon failure
 - b. Strobe failure switch to night mode

- c. AC power failure
 - e. Photocell failure
 - f. Controller Failure
3. The system shall provide for remote site monitoring of alarms by dry contacts. Ethernet connection capabilities shall be available as an option. If Ethernet connection is desired, all software and hardware shall be included. No third party payments for monthly use shall be required.
 4. The system shall also provide an indication dry contact to indicate when the system is in day and night modes.
 5. A component failure in one lighting instrument shall affect only that instrument and shall not result in failure of other instruments in the system.

Temporary Lighting During Construction: Provide temporary lighting system during construction when each lighting level is reached. If practical, permanent lights shall be installed and operated at each level as construction progresses.

Service Manuals: Provide two service manuals (in addition to operation/user manuals) for lighting system. Manuals shall provide sufficient detail to facilitate component level troubleshooting and repair.

PART 3 - EXECUTION

EXAMINATION

Verify existing conditions before starting work.

PREPARATION

Call Local Utility Line Information service at not less than three working days before performing Work. Request underground utilities to be located and marked within and surrounding construction areas.

Confirm that the Owner has a valid FAA construction permit, if applicable, before commencing construction. Coordinate with Owner for notification to FAA concerning construction schedule.

TOWER FOUNDATION

Install tower foundation according to tower manufacturer foundation design requirements and these specifications. Concrete, rebar and other material testing and quality assurance items shall conform to the respective sections of these specifications.

Ground foundation reinforcing steel per the drawings.

Tower foundation excavations, rebar placement and grounding shall be inspected by the engineer prior to concrete installation.

Anchor bolts shall be installed per design requirements including minimum thread protrusion.

TOWER ERECTION

Provide concrete compressive strength test results to the engineer which indicate conformance with the design requirements prior to tower erection.

Erect tower according to tower manufacturer design requirements and these specifications.

The tower shall be erected using bolted connections. No field welding is allowed.

All bolts shall have a minimum of two threads protruding beyond the nut and torque tested to meets installation requirements.

Install vertical transmission line ladders, antenna mounts, safety climb, air terminal and all other appurtenances according to tower manufacturer design requirements and these specifications.

Notify Owner within 24 hours of tower construction reaching full height so Owner can notify FAA regarding completed construction.

CLIMBING LADDER/SAFETY CLIMB

Install climbing ladder and safety climb device according to the manufacturers' requirements at the location on the tower noted in the drawings.

Confirm climbing harness is compatible with the provided system.

ANTENNA MOUNTS

Install antenna mounts according to manufacturer requirements, plans and these specifications.

ICE SHIELDS

Install ice shields according to manufacturer requirements, plans and these specifications.

ANTENNAS

Install antennas according to the plans and Section 33 83 00 - Antennas

VERTICAL TRANSMISSION LINE LADDERS

Place vertical transmission line ladders on the tower at the locations noted in the drawings.

Attach line ladder to the tower at 20 foot maximum spacing or as required by the manufacturer using J-bolt connectors. All coax and waveguide shall connect to transmission ladders with 3/4-inch snap in hangers.

TRANSMISSION LINE ICE BRIDGE INSTALLATION

Install self-supporting transmission line ice bridge(s) between tower and building coax port entries according to the manufacturer requirements, drawings and these specifications.

COAX AND WAVEGUIDE

Install and test coax and waveguide between antennas and equipment building according to the plans and Section 33 82 00 – Coax and Waveguides

TOWER, ANTENNA AND WAVEGUIDE GROUNDING

Ground tower, antennas and waveguide and install lightning protection systems according to the plans and Section 33 79 00 – Site Grounding and Lightning Protection.

OBSTRUCTION LIGHTING

Install tower lighting according to the manufacturer's recommendations, FAA requirements and these specifications.

Wall mount lighting controller with equipment shelter at location noted in the drawings.

Connect lighting controller to dedicated electric circuit.

Route and install lighting cables and photo-cell as noted in the drawings.

Route lighting cables up tower along vertical transmission line ladder. Secure to lighting cable to vertical member of ladder using 2-3-4 tape method.

Provide a minimum of three service loops of excess cable at each junction box and light fixture. Secure service loops to underside of tower members using 2-3-4 tape method.

Route lighting cable from vertical transmission line ladder to light fixtures at tower legs along bottom side of tower members. Provide slack in cable to maintain clearance from tower member joints and other sharp edges. Utilize 2-3-4 tape method to secure lighting cable to tower members.

Ensure top tower light extends above all antennas and appurtenances of 7/8-inch diameter or more when only one top tower light is provided.

CORRECTION OF PUNCH LIST INSPECTION ITEMS

Following tower erection and antenna and line installation, A/E will perform a tower climb and punch list inspection of installed items. An inspection report will be issued with items to be addressed by contractor.

Contractor shall promptly correct all deficient items and provide photos of each item prior to and after correction. Photo documentation shall be sufficient and clear enough to allow the Owner and A/E to see that all items have been adequately addressed. Photos shall be appropriately labeled to reference each punch list item being addressed.

CLEAN UP

The contractor shall be responsible for cleanup of the site of all refuse associated with this Contract. Contractor to remove all crates, reels and other refuse associated with the antennas and line shipping.

END OF SECTION 33 81 00

SECTION 33 82 00 – Coax and Waveguides

PART 1 – GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to install coax and waveguides.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related Sections:

Section 33 79 00 – Tower Grounding and Lightning Protection

Section 33 81 00 – Communication Towers

Section 33 83 23 – Antennas

EQUIPMENT AND MATERIALS FURNISHED BY OTHERS

Owner shall furnish all new coax and waveguide. Contractor shall be responsible to install these items as well as to provide and install all other required mounts, mounting hardware and accessories necessary to complete the project per the plans and specifications.

WORK BY OTHERS

Owner will make final connection of prepared coax lines to radio equipment within the equipment building.

SUBMITTALS

Submit product data for each type of coax and waveguide supplied.

Submit transmission line frequency return loss test reports for each installed coax/waveguide.

Submit written key for installed identification markings of each coax/waveguide.

QUALITY ASSURANCE

All installed coax and waveguides shall be “sweep” tested using frequency return loss testing, or other Owner approved method, after complete installation to ensure the integrity of each line. Contractor shall submit, to engineer, reports of the test results for each line documenting each line passed testing.

PART 2 - PRODUCTS

COAX AND WAVEGUIDE

Provide coax and waveguide as listed in the drawings.

Provide associated hoist grips, snap-in supports, jumpers and connectors for complete installation from antenna to termination point inside of building.

1. Hoist grips: galvanized
2. Snap In Hangers: Stainless Steel
3. Fasteners: Use corrosion resistant fasteners which are manufactured for outdoor use specifically for the intended application.

PART 3 - EXECUTION

COAX AND WAVEGUIDE

Install coax lines and waveguides from antennas and dishes mounted on tower to interior side of equipment buildings according to the manufacturer's recommendations, drawings and these specifications.

Connection of coax and waveguide to antennas and dishes shall be by the contractor.

All coax and waveguide runs shall be continuous from each antenna to equipment building. No splicing of lines is allowed.

Secure and adequately support coax and waveguides as necessary to prevent movement and contact with sharp edges of tower structure, mounts and other appurtenances.

Clearly mark all lines at each end with the termination elevation, azimuth, description, color code and/or as otherwise directed by Owner.

All lines shall route up the tower structure on vertical transmission line ladders utilizing appropriately sized snap-in style mounting clips and cushions. Place lines on ladders in configuration shown on the drawings.

Provide and install hoist grips and hoist grip hangers for each transmission line.

Install ground kits on each transmission line at the locations identified in the drawings and grounding specifications. All ground kits shall be properly weatherproofed.

Route coax and waveguide along ice bridge hanger brackets. Secure to ice bridge hangers with appropriately sized snap-in style mounting clips and cushions per manufacturers recommendations.

Provide drip loop in line at base of the tower and prior to entry into shelter coax entry port.

Bends in coax and waveguide runs shall not exceed manufacturer's specifications.

Route lines through building coax entry port. Provide and install weather proof boots and cushions for each port opening on exterior.

Install surge protection device on each line within the equipment building and terminate as directed by Owner. Install ground leads from surge protection device to interior Master Ground Bar.

Perform Quality Assurance "sweep tests" of all installed coax and waveguides. Provide documented results.

END OF SECTION 33 82 00

SECTION 33 83 00 – Antennas

PART 1 – GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to install antennas and microwave dishes.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

Section 33 81 00 – Communication Towers

Section 33 82 00 – Coax and Waveguides

Section 33 79 00 – Tower Grounding and Lightning Protection

EQUIPMENT AND MATERIALS FURNISHED BY OTHERS

Owner shall furnish all antennas and dishes for the project delivered to the site. Contractor shall be responsible to install these items as well as to provide and install all other required mounts, mounting hardware and accessories necessary to complete the project per the plans and specifications.

WORK BY OTHERS

None.

REMOTE DISH INSTALLATION

Remote microwave dish installation is required at two (2) locations to complete the microwave path links from the tower site. The following remote microwave dishes shall be installed:

WDOT Chilton Tower:

Tower coordinates: 44.029127, -88.286575

Tower Height and Type: 385' Self-Support

Dish: (1) HX 10-6W (10' dia.) – Owner provided.

Install Centerline Height: ~380' (TBD)

Azimuth: 11.3 degrees

Mount: Leg Mount – Contractor to provide.

Ice Shield: Required - Contractor to provide.

Waveguide: (1) EW63 – Owner provided.

Accessories: Stiff arm, waveguide snap-ins, jumpers, ground kits, entry port boots – Owner provided.

WDOT DePere Tower:

Tower coordinates: 44.347639, -87.928333

Tower Height and Type: 302.5' Guyed

Dish: (1) HX 10-6W (10' dia.) – Owner provided.

Install Centerline Height: ~280' (TBD)

Azimuth: 267.8 degrees

Mount: Leg Mount – Contractor to provide.

Ice Shield: Required - Contractor to provide.

Waveguide: (1) EW63 – Owner provided.

Accessories: Stiff arm, waveguide snap-ins, jumpers, ground kits, entry port boots – Owner provided.

SUBMITTALS

Submit product data for each antenna supplied to engineer for approval prior to ordering.

PART 2 - PRODUCTS

ANTENNAS

Provide antennas as listed in the Drawings.

Provide all associated antenna mounts, mounting and bracing hardware and fasteners for secure installation and proper alignment.

PART 3 - EXECUTION

ANTENNAS

Install all antennas and microwave dishes on tower mounts installed at elevations and orientation noted on the drawings with required mounting hardware as required or recommended by the antenna manufacturer.

Microwave dish installation shall include installation and alignment of remote site dishes when required.

Secure and properly brace each antenna and microwave dish. Orient to azimuth and down tilt noted on the drawings.

Install coax and waveguides per Section 33 82 00 Coax and Waveguides.

Connect coax and waveguide runs to each antenna and microwave dish with required jumpers and connectors. Weatherproof each connection.

Record as-built location of each installed antenna and microwave dish.

Allow Owner sufficient time to install radio equipment.

Re-mobilize to site to perform final alignment of antennas and/or microwave dishes at both send and receive locations. Contractor shall furnish personnel for each end of microwave path under alignment. Alignment shall be done once new equipment is installed and "online" at both locations and peaked up to the highest level. Coordinate alignment procedures with Owner's personnel.

Notify engineer when complete for inspection of installation. Provide 72 hour minimum advance notice.

END OF SECTION 33 83 00

66. Auxiliary Communications Tower, Item SPV.0060.201.

A Description

This special provision describes all work by contractor to provide and install the tower and other associated equipment and materials for the SWEF auxiliary communications tower site within the work limits as noted in the drawings as produced by Edge Consulting Engineers, Inc. The work includes the tower, fence, ice bridge, lightning protection and grounding systems, antennas, coaxial cables, waveguides, SWEF building cable entry and other items as noted in the drawings. The work shall be according to the applicable drawings and the following specifications included with this special provision.

Earthwork, grading, geotextile fabrics and surfacing aggregates for the tower site compound area and access driveway are included in other bid items.

B Materials

Refer to special provision Main Communications Tower (SPV.0060.200) specification sections for materials information related to this special provision.

C Construction

Refer to special provision Main Communications Tower (SPV.0060.200) specification sections for construction and installation information related to this special provision.

D Measurement

The department will measure Auxiliary Communications Tower, completed according to the contract and accepted, as a single complete unit of work.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.201	Auxiliary Communications Tower	EACH

Payment is full compensation for furnishing all materials and equipment, and for supplying all labor, tools, equipment, and incidentals necessary to complete the work.

67. Main Communications Tower Generator, Item SPV.0060.202.

A Description

This special provision describes all work by contractor to provide and install a complete factory assembled packaged engine generator system including Automatic Transfer Switch, LP fuel system, concrete pads, conduits, fuel piping, controls, wiring and associated equipment and materials for the SWEF main communications tower site within the work limits as noted in the drawings as produced by Edge Consulting Engineers, Inc. The generator is intended to provide electrical power for critical building operations for the SWEF communications main tower site during power outages. The work shall be according to the applicable drawings and the following specifications included with this special provision.

Providing and installing the equipment shelter is included in another bid item (SPV.0060.200).

Installation of the automatic transfer switch and LP fuel monitoring system within the equipment shelter is covered under this bid item.

Installation of conduits and wiring between generator, LP tank and equipment shelter is covered under this bid item.

B Materials

Refer to following specification sections for materials information related to this special provision. The department desires that the generator for the Communications Tower be of the same manufacturer as the generator for the SWEF building.

C Construction

Refer to following specification sections for construction and installation information related to this special provision.

D Measurement

The department will measure the Main Communications Tower Generator bid item as each individual installation, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.202	Main Communications Tower Generator	EACH

Payment is full compensation for Main Communications Tower Generator, measured as provided above will be paid for at the contract lump sum price, which price shall be full compensation for furnishing the generator and installing all equipment, all utility hook-ups, and for furnishing all labor, supervision, equipment, calibrating and testing, warranties, training, tools and incidentals items for installing and supplying the Main Communications Tower Generator.

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Section 26 32 00 – Packaged Generator Assemblies

PART 1 – GENERAL

SCOPE

The work under this section includes providing a complete factory assembled packaged engine generator system with controls and startup testing. Included are the following topics:

RELATED WORK

Applicable provisions of Division 01 govern work under this section.

Section 26 36 23 - Transfer Switches.

REFERENCES

NFPA110 – Emergency and Standby Power Systems.

ANSI/NEMA MG 1 - Motors and Generators.

UL2200 – Stationary Engine Generator Assemblies.

PERMITS

The contractor shall be responsible for obtaining all necessary permits for the complete installation of the generator fuel system and related equipment.

SUBMITTALS

Submit shop drawings showing plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical ratings and diagrams including schematic and interconnection diagrams.

Submit manufacturer's installation instructions.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

QUALITY ASSURANCE

Manufacturer: Company specializing in packaged engine generator systems with minimum 10 years documented experience.

Supplier: Authorized distributor of engine generator manufacturer with service facilities within 100 miles of project site.

WARRANTY AND PREVENTATIVE MAINTENANCE SERVICE

Warranty: Provide five-year comprehensive warranty. Warranty shall include complete coverage for the package generator system, including one automatic transfer switch of same manufacturer.

Preventative Maintenance Service: Provide all manufacturers' scheduled preventative maintenance service on the package generator system, including one automatic transfer switch of same manufacturer for a period of one year from the date of substantial completion.

EXTRA MATERIAL

Provide two additional sets of each fuel, oil, and air filter elements required for the engine generator system and one additional set of all required belts.

PART 2-PRODUCTS

SYSTEM RATINGS

Generator Set Rating: 50 KW, 50 KVA, 0.8pf, 240/120 VAC, 1 phase, 3 wire, 12 wire re-connectable, 60 Hz at 1,800 rpm. Standby power rated.

Motor starting KVA shall be 50 KVA based on a sustained RMS voltage drop of no more than 35% of no-load voltage with the specified KVA load at near zero power factor applied to the engine-generator set.

The generator set manufacturer shall verify the engine as capable of driving the generator with all accessories in place and operating at the nameplate rating after de-rating for the range of temperature expected in service and the altitude of the installation.

The engine-generator set shall be capable of picking up 100% of nameplate kW, less applicable derating factors, in one step with the engine-generator set at operating temperature.

Voltage regulation shall be $\pm 1.0\%$ of rated voltage for any constant load between no load and rated load. Random voltage variation with any steady state load from no load to full load shall not exceed $\pm 1.0\%$ of rated voltage.

Frequency regulation shall be $\pm 0.5\%$ from steady state no load to steady state rated load.

Harmonic distortion shall not exceed 5% total harmonic distortion at full linear load and no single harmonic shall exceed 3% of rated voltage.

ENGINE AND ENGINE EQUIPMENT

Engine Type: Water-cooled, turbo-charged, four cycle, internal combustion engine.

Fuel Type: LP.

Governor: Isochronous electronic type to maintain engine speed within 0.5 percent, steady state, and 1 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes.

Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine over crank. Limits as selected by manufacturer.

Include remote starting control circuit, with RUN-OFF-AUTO selector switch on engine generator control panel.

Engine Accessories: Include intake air filter, fuel filter, fuel priming pump, automatic electric fuel shutoff, fuel/water separator, gear-driven water pump, positive displacement mechanical full pressure lubrication oil pump, full flow lubrication oil filters with replaceable elements, dipstick oil level indicator, and oil drain valve with hose extension. Include engine mounted battery charging alternator with solid state voltage regulator. Include fuel pressure gauge, water temperature gauge, and lube oil pressure gauge on engine-generator control panel.

Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F (32 degrees C). Heater voltage shall be served from integral Branch Circuit Panelboard.

Cooling System: Unit mounted radiator using glycol coolant, with blower type fan, coolant pump and thermostat temperature control sized to maintain safe engine temperature in ambient temperature of 105 degrees F. The equipment supplier shall provide 50% ethylene glycol antifreeze solution to fill engine cooling system.

Exhaust System:

- Provide critical grade silencer, with muffler companion flanges and flexible stainless steel exhaust fitting, suitable for horizontal orientation, sized according to engine manufacturer's instructions. Contractor shall mount muffler, so its weight is not supported by the engine.
- Flexible exhaust connections shall be provided as required for connection between engine exhaust manifold and exhaust line, in compliance with applicable codes and regulations.
- Provide an exhaust condensation trap with manual drain valve to trap and drain off exhaust condensation and to prevent condensation from entering the engine. Provide drain line to drip pan.

- Provide a suitable rain cap at the stack outlet. Provide all necessary flanges and special fittings for proper installation.

Fuel System:

- The generator shall be capable of accepting liquid propane (LP) fuel. LP fuel will be the primary source of fuel.
- Provide flexible supply and return line fittings and all connections for connecting fuel system to the engine in compliance with applicable codes and regulations. All fuel piping shall be pressure tested for minimum 2 hours.

Batteries:

- Heavy duty, diesel starting type, lead-acid storage batteries. Provide a DC volt system with number of batteries and battery capacity as sized by the manufacturer adequate for four 30 second cranking periods (total of 2 minutes) along with all additional loads being run on the DC system.

Mounting: Provide unit with suitable spring-type vibration isolators and mount on structural steel base.

ALTERNATOR

Insulation: ANSI/NEMA MG 1, Class H.

Alternator Speed: 1,800 rpm

The unit shall be single bearing, self-aligning 4-pole, brushless, synchronous type, revolving field windings, and direct driven centrifugal blower for proper cooling and minimum noise. No brushes will be allowed.

The unit shall be 1-phase, broad-range, re-connectable and shall have 12 leads brought out to allow connection by user to obtain any of the available voltages for the unit. Leads shall terminate in NEMA 1 connection enclosure. A fully rated, isolated neutral connection shall be included by manufacturer.

The alternator shall meet temperature rise standards of UL2200 (120 degrees C). The insulation system material shall be class "H".

The regulator design shall include torque-matching characteristics to allow the engine to use its fullest power producing capacity (without exceeding it or over compensating) at speeds lower than rated, to optimize motor starting capability and provide the fastest possible recovery from transient speed dips. Regulators which use a fixed volt per hertz characteristic are not acceptable.

The alternator shall include a permanent magnet generator (PMG) exciter and electronic voltage regulator, and shall be self-ventilated drip-proof construction built according to NEMA, AIEE and ANSI standards.

The alternator shall be protected against overloads and short circuits by electronic control panel protective functions. Functions shall be implemented electronically in the control panel. The generator design shall be of the self-protecting type as demonstrated by the prototype short circuit test. Systems utilizing 3-wire, solid state control elements rotating in the rotor, will not be acceptable.

OVER CURRENT PROTECTIVE DEVICE

Circuit breaker required: Provide a mainline molded case circuit breaker(s), 80% thermal magnetic, 200 Amp, on generator output with adjustable long time and short time delay and instantaneous trip; complying with NEMA AB 1 and UL489. Trip settings shall be factory set to generator thermal damage curve.

ACCESSORIES

Provide the following accessories with the engine generator set.

Silencer: Outdoor enclosure mounted: Critical grade, minimum 30 dB reduction. Silencer shall be located inside enclosure.

Enclosure: Standard Weather protective housing with the following features:

- Vandal-resistant.
- Rodent-proof.
- Galvanized steel body.

- Lifting points on base frame.
- Stainless steel flush fitting latches and hinges.
- Stainless-steel fasteners.
- Sheet steel components pre-treated with zinc phosphate prior to polyester powder coating.
- Lockable wide door on each side installed to allow 180 degree opening rotation.
- Radiator fill access door with lockable cover.
- Lube oil and coolant drains piped to the exterior of the enclosure skid base.
- Lockable fuel fill cap.
- Battery can only be reached through lockable doors.
- UL listed base tank sized as indicated elsewhere in these specifications.

Load Center - Enclosure: Integral load center 30/2 amps to serve accessories including, but not limited to, the battery charger, engine heater, enclosure lighting, and convenience receptacle.

Load center style panelboard: plug-on circuit breaker type, fully rated, Type 3R enclosure, 3-3/4" D, 14.25" W, code gauge steel, surface mounted with ground bar and lock kit. Copper bus, minimum system (i.e., individual component) short circuit rating: 10,000A. Provide with typed circuit identification directory label.

Load center shall be independently supported to equipment pad or unit frame on frame side of engine isolation to avoid load center vibration.

Electrical Devices - Enclosure: GFCI WP receptacle. Devices and associated circuitry shall be field installed by the Electrical Contractor.

Electrical Lighting - Enclosure: Manual switch inside access door and LED lighting fixture(s). Lighting fixture, switch and associated circuitry shall be field installed by the Electrical Contractor.

Battery Heater: Thermostatically controlled battery blanket heater, 120VAC.

Battery Tray: Plastic coated metal tray treated for electrolyte resistance, constructed to contain spillage of electrolyte.

Battery Charger: A 10-ampere voltage regulated battery charger shall be provided for the engine-generator set. Charger shall be equipped with float, taper and equalize charge settings. Charger shall include overload protection, voltage surge suppressor, DC voltmeter and fused AC input. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30 VDC for remote indication of:

- Loss of AC power-red light (no relay contact).
- Low battery voltage-red light.
- High battery voltage-red light (no relay contact).
- Chargers fail-red light.

Engine-Generator Digital Control Panel - Unit mounted: Provide a control panel with the top not more than six (6) feet above finished floor (this may require remote mounting). NFPA – 110, NEMA Type 1 generator mounted control panel enclosure with engine and generator controls and indicators containing the following:

- Automatic remote start capability
- "Run-Off-Auto" switch
- Shut downs as required by NFPA 110 5.6.5.2(3)
- Alarms as required by NFPA 110 5.6.5.2(4)
- Individual alarm indication as required by NFPA 110.5.6.5.2(4) and table 5.6.5.2
- Controls as required by NFPA 110 5.6.5.2(5)

Include remote starting control circuit, with RUN-OFF-AUTO selector switch on engine generator control panel.

Fuel pressure, water temperature, and lube oil pressure shall be monitored by the engine-generator controller.

The control shall include surge suppression for protection of solid state components. A front control panel illumination lamp with On/Off switch shall be provided. The engine-generator set starting batteries shall power the monitor.

Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.

Remote Alarm Contacts: Pre-wire form C contacts to terminal strip for remote alarm functions required by ANSI/NFPA 110.

Remote Mounted Annunciator Panel (Equipment Shelter): Surface Mounted. Digital. Annunciator panel shall be powered from unit storage battery and located within the equipment shelter. A remote, audible alarm shall be provided per NFPA110-5.6.5.2(4).

The annunciator shall have provisions for spare relay based inputs for audible/ visual alarms to meet the requirements of these specifications. Refer to Generator Source Alarm Annunciation/ Indication.

The annunciation alarm shall be capable of being silenced and the panel shall include repetitive alarm circuitry so that after the audible alarm has been silenced, it re-activates after the fault condition has been cleared.

Provide all wiring and raceway systems as required.

Remote Emergency Stop "Mushroom" Switch: Provide remote emergency shut off switch on the exterior of the generator enclosure or exterior of shelter.

Devices installed outdoors shall be installed in approved wet location wiring method.

Shut off switch: Red button with two N.O. and two N.C. contact block. Switch shall be capable of lockout and tagout.

Provide label with "Emergency Shut Down"- White letters on Red background.

Provide all wiring, raceways and mounting systems as required.

Generator Feeder: The ampacity of the conductors from the generator terminals to the first distribution device containing overcurrent protection shall not be less than 115% of the nameplate current rating of the generator.

Alarm Contact Wiring: Provide two alarm wiring cables (Cat 5, color: red) from generator unit to punch block within shelter. Provide services loops in cable at each end.

Remote Access and Control System: Generator system shall be provided with an Ethernet connection (TCP/IP) for remote monitoring and control of generator system functions. Provide all hardware and software to enable customer to remotely view and control generator and transfer switch via the Ethernet ModBus Connection. The software shall allow for viewing, control and set-up of the generator and transfer switch through a personal computer operating on a Microsoft operating system.

PART 3 - EXECUTION

EXAMINATION

Verify that required utilities are available in proper location and ready for use.

INSTALLATION

Install according to manufacturer's instructions.

Generator set shall be anchored to the concrete pad.

Interior and exterior Generator installations shall be provided with battery powered emergency lighting to illuminate area surrounding generator/ generator enclosure.

Generator Emergency Shutdown switch shall be located within the generator enclosure.

Outdoor Generator Enclosure Accessory Panelboard: The accessory source panel and all related branch circuitry shall be furnished and installed by the Electrical Contractor. This includes, but is not limited to, the circuiting for the battery charger, engine heater, enclosure lighting, and convenience receptacle.

Feeders: Feeder wiring serving emergency loads shall be installed per NEC 700.10(D)(1) through (D)(3).

Control Conductors:

All generator control conductors installed between transfer equipment and the emergency generator serving Emergency, Legally Required Standby and Optional Standby systems shall be kept entirely independent of each other and all other wiring. This shall require a dedicated conduit system between each transfer switch and the emergency generator.

All Emergency branch control conductors installed between transfer equipment and the emergency generator shall be installed per NEC 700.10(D)(1) through (D)(3).

Grounding: When 3-pole transfer switches are utilized, the generator shall be installed and connected as an equipment connection (not a separately derived system) and the factory installed generator ground/neutral bonding strap shall be removed.

FIELD QUALITY CONTROL

Operational testing of complete emergency electrical system shall be conducted prior to scheduling the required full load test to ensure complete system operation.

Provide full load testing utilizing a portable test bank for four hours continuous, minimum. During the first two hours, step increase the load from 0% to 100% in at least six equal steps. At the end of two hours, continue running test at 100% load. Record the following in 20-minute intervals throughout the four-hour test: kilowatts, amperes, voltage, coolant temperature, room temperature, generator frequency (Hz), oil pressure, fuel consumption.

Full load testing utilizing a portable test bank shall be conducted with minimum outside temperature of 32 degrees F.

After the generator has cooled down from the four-hour test, shut it down and then simulate a power failure including operation of the transfer switch, automatic cycle, and automatic shutdown and return to normal.

AGENCY TRAINING

Provide on-site factory training to Owner by manufacturer trained technicians (minimum of 2 hours).

END OF SECTION 26 32 00

SECTION 26 36 23 – Automatic Transfer Switches

PART 1 – GENERAL

SCOPE

The work under this section includes transfer switches (less than 600V) for standby generator systems.

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

Section 26 32 00- Packaged Generator Assemblies.

QUALITY ASSURANCE

Manufacturer: Company specializing in automatic transfer equipment with five years documented experience.

SUBMITTALS

Submit product data showing overall dimensions, electrical connections, electrical ratings, all specified accessories, interlock methods, and environmental requirements.

Submit manufacturer's installation instructions.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

In addition to the general content specified under GENERAL REQUIREMENTS, include instructions for operating equipment under test and emergency conditions.

PART 2 - PRODUCTS

AUTOMATIC TRANSFER SWITCHES

Open Transition Type: Furnish and install Open Transition Automatic Transfer Switch (ATS) with number of poles, ampere rating, voltage, and withstand ratings as indicated on drawings. Each automatic transfer switch shall consist of a double throw power transfer switch mechanism and microprocessor controller to provide automatic operation. Where multiple switches are required, all shall be by same manufacturer.

Description: NEMA ICS 2; automatic transfer switch.

Configuration: The transfer switch shall be electrically operated and mechanically held. The electrical operation shall be by a solenoid mechanism operating from the same source to which the load is being transferred.

The switch shall be rated for continuous duty and be mechanically interlocked to be in either the normal or the emergency position.

The switch shall be controlled by a single built-in microprocessor with serial communications module. Controller shall be connected to the transfer switch by plug type with associated interconnected wiring harness. Relays shall be industrial grade with dust covers, mounted separate from the transfer switch.

All customer wiring connections shall be to a common terminal block for ease of field wiring. The switch shall be designed and built so that it can be manually operated under no-load conditions from behind a barrier partition or with the door closed. The enclosure shall allow for inspection of the internal operation of the switch through a full sequence of the transfer cycle with the door open and the switch de-energized.

In applications where the switch serves as the service entrance disconnect, the switch shall be rated as suitable for use as a service disconnecting means.

RATINGS

Ratings: As scheduled on drawings.

SEQUENCE OF OPERATION

Controller keypad and display: Provide minimum 4 line, multi character LCD display and keypad controller for viewing all available data and settings operational parameters. Provide serial communications input port.

The following parameters shall be adjustable via DIP switches: Nominal line voltage and frequency, single or three phase sensing.

Voltage, frequency and phase rotation sensing: Continuously monitor voltage and frequency on both normal and alternate sources with pickup, drop out and trip setting capabilities.

Voltage and frequency settings shall be field adjustable in 1% increments via keypad or serial communications port.

The controller shall sense the phase rotation of both sources.

Source information shall be indicated on data screen for normal and alternate sources to provide readout of voltage on all phases, frequency and phase rotation.

Time delay settings shall be adjustable utilizing LCD display and keypad or serial communications port.

TIME DELAYS

Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.

Time Delay to Start Alternate Source Engine Generator: 0 to 10 seconds, adjustable.

Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.

Time Delay Before Transfer to Alternate Power Source: 0 to 60 seconds, adjustable.

Initiate Re-transfer Load to Normal Source: Upon permission by normal source monitor.

Time Delay Before Transfer to Normal Power: 0 to 30 minutes adjustable.

Time Delay Before Engine Shut Down: 0 to 30 minutes, adjustable, unloaded operation.

Operating transfer time of the switch in either direction shall not be greater than 1/6 of a second.

ACCESSORIES

Engine Exerciser: Digital control, start engine every 7 to 31 days adjustable; run for 0 to 120 minutes adjustable, before shutting down. Bypass exerciser control if normal source fails during exercising period.

Manual Operator: Provide manual operator to allow switch to be operated under no-load conditions from behind a barrier partition or with the door closed.

Provide three position momentary test switch for the test/ automatic/ reset. The test position will simulate a normal source failure. The reset switch shall bypass the time delays on either transfer to alternate source or retransfer to normal.

Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source.

Indicating Lights: LED type. Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, SWITCH POSITION.

Transfer Switch Auxiliary Contacts: Minimum 2 normally open; 2 normally closed, rated 10 amps. Minimum one shall be closed when ATS is connected to the normal source and one closed when ATS is connected to the alternate source.

Normal Source Monitor: Monitor each line of normal source voltage; adjustable set points; initiate transfer when voltage drops below 85 percent.

Alternate Source Monitor: Monitor alternate source voltage and frequency; adjustable set points; inhibit transfer when voltage is below 85 percent or frequency varies more than 3 Hertz from rated nominal voltage.

In phase monitor shall control transfer so the motor load inrush currents do not exceed normal starting currents and shall not require external control of power sources.

The switch shall contain an in-phase monitor or adjustable time delay transition to inhibit closing of the switch into high levels of motor residual voltage.

A factory installed equipment ground bar shall be provided in each switch enclosure.

Three-pole transfer switches shall contain a factory installed fully rated solid neutral lug assembly.

Provide digital metering on all transfer switches. Metering shall provide, at a minimum, measurement of voltage, frequency, current and power, energy and power factor on the load side of the switch.

PART 3 - EXECUTION

INSTALLATION

Install according to manufacturer's instructions.

Starting contacts for all transfer switches shall be wired in parallel to the generator starting circuit so that any transfer switch that senses a loss of normal power will start the generator. This control wiring is not shown on the plans but is required to be provided by the electrical contractor.

FIELD ADJUSTMENTS

The contractor shall field adjust all timing and voltage settings of the transfer switch as necessary for proper operation of the switch, related loads and sources.

TESTING

Maintenance and operational testing shall be per NFPA 110-8.3.

Operational inspection and testing shall be per NFPA 110-8.4.

AGENCY TRAINING

Provide on-site factory training to Owner by manufacturer trained technicians (minimum of 2 hours).

END OF SECTION 26 36 23

SECTION 33 50 00 – LP Fuel Systems

PART 1 – GENERAL

SCOPE

The work under this section shall consist of providing and installing LP fuel tanks, remote LP fuel monitor systems and LP fuel piping systems.

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

Section 26 32 00 – Packaged Generator Assemblies

Section 31 23 16.13 - Trenching

REFERENCES

Abbreviations of standards and organizations referenced in other sections are as follows:

ANSI B16.3	Malleable Iron Threaded Fittings
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
ASTM A234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
AGA	American Gas Association
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CGA	Compressed Gas Association
EPA	Environmental Protection Agency
GAMA	Gas Appliance Manufacturers Association
MCA	Mechanical Contractors Association
MSS	Manufacturer's Standard Society of the Valve and Fitting Industry
NBS	National Bureau of Standards
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
UL	Underwriters Laboratories Inc.

SUBMITTALS

Refer to Division 1, General Conditions, Submittals.

Submit shop drawings and production information for the following items: LP tank, LP fuel gas piping, remote LP gas monitor system and LP fuel regulators.

Submit test report of installed LP fuel piping system.

For all equipment and systems as indicated in the respective sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number as indicated in the contract documents.

OPERATION AND MAINTENANCE INSTRUCTIONS

All operations and maintenance instructions shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

QUALITY ASSURANCE

Supplier: Authorized supplier of LP fuel systems and fuel supply with service facilities within 100 miles of project site.

Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and according to the appropriate ASTM specification.

Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

DELIVERY, STORAGE AND HANDLING

Promptly inspect shipments to ensure that the material is undamaged and complies with specifications.

Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place.

Offsite storage agreements will not relieve the contractor from using proper storage techniques.

Storage and protection methods must allow inspection to verify products.

RECORD DRAWINGS

Refer to Division 1, General Requirements, Record Drawings.

Record as-built drawing locations of all installed below grade piping.

PART 2 - PRODUCTS

LP FUEL TANK

Provide a new LP fuel storage tank of the size as indicated on the drawings. LP tank shall become the property of the State of Wisconsin and shall not be on lease/fill agreement with fuel supplier.

Tank shall be an above ground steel type with lockable cover all which are primed and painted suitable for outdoor environments.

Tank shall include direct read gauge to monitor fuel level.

REMOTE LP FUEL MONITOR SYSTEM

System shall be a hard wired local stationary tank monitor system with remote read out located within the equipment building. System shall include:

1. Remote monitor with field programmable high/low set points
2. RS232 interface to PC for programming/saving parameters
3. Alarm relay form "C", 10A dry contacts
4. 120VAC power supply
5. Remote sensor at the tank with volume readout.

The system shall be a LevelCon Model#: STM94442A, or equivalent.

LP FUEL PIPING

All LP fuel piping components shall be specifically manufactured for use in LP fuel applications.

Below grade fuel piping shall be direct buried polyethylene tubing of the size indicated in the plans. Below grade tubing shall include tracer wire.

Provide anodeless meter risers at each end where LP fuel piping stubs up to generator and LP fuel tank. Anodeless meter risers shall include epoxy coated steel casing and be rated for 125 psig.

Above grade hard piping at generator and LP tank shall be steel gas rated piping which is primed and painted for outdoor environments.

Above grade piping at LP fuel tank from LP tank to anodeless meter riser shall be flexible LP fuel gas tubing rated for outdoor environments.

LP FUEL PRESSURE REGULATORS

Cast iron body, aluminum spring and diaphragm, Nitrile diaphragm, threaded ends, 150psi W.O.G., -20°F to 150°F.

Regulators shall be specifically manufactured for use in LP fuel applications. Size regulators as appropriate for piping sizes and anticipated pressure drops as noted on the plans.

SHUT-OFF VALVES

2- inch or smaller: Ball valve, bronze body, threaded ends, stainless steel or chrome plated ball, full or conventional port, Teflon seat, blowout-proof system, two-piece construction, suitable for 150psig working pressure, U.L. listed for use as LP gas shut-off.

PART 3 - EXECUTION

LP FUEL TANK

Verify size of concrete foundation is suitable for tank to be installed. Install concrete foundation slab per the plans and specifications.

Mount tank on slab concrete slab and secure legs to slab with galvanized anchor bolts.

Connect tank leg(s) to site grounding system according to the plans and specifications. Grind paint on tank legs to ensure good ground continuity. Touch up paint connections to prevent rust or corrosion.

Install LP gas monitor system per these specifications.

Purge and fill tank to 80% of capacity with LP fuel. Fuel used during project construction is responsibility of the contractor. The tank shall be re-filled by contractor just prior to Owner taking occupancy of the equipment building. After occupancy, fuel use will then become the responsibility of the Owner.

REMOTE LP FUEL MONITOR SYSTEM

Trench and install conduit between LP tank and equipment building for hard wire leads as detailed in the plans. Install tracer wire. Support conduit above grade at LP tank per drawings.

Install remote LP gas monitor system per manufacturer's instructions.

Mount remote monitor unit within the equipment building at the location as indicated in the drawings.

Seal conduits containing hard wire leads between LP tank and equipment building at both ends per drawings.

LP FUEL PIPING

Trench and install LP fuel piping between LP tank and generator as detailed in the drawings.

Install AGA approved ball shut-off valve at the generator.

Install LP fuel pressure regulators per manufacturers requirements at the locations noted in the drawings.

Provide fuel line support as noted in the drawings.

Provide sediment trap/dirt leg in hard piping at generator.

Install flexible LP fuel gas tubing between hard piping and generator for vibration isolation.

Air test fuel piping to ensure no leaks. Air test shall be at 100 psig for 24 hours. Repair as necessary. Document test results on attached form and submit results to A/E.

PIPING SYSTEM TEST REPORT

Date Submitted: _____

Project Name: _____

Location: _____ Project No: _____

Contractor: _____

☐ HVAC

☐ Refrigeration

☐ Controls

☐ Power Plant

☐ Plumbing

☐ Sprinkler

Test Medium: ☐ Air ☐ Water ☐ Other _____

Test performed per specification section No. _____

Specified Test Duration _____ Hours Specified Test Pressure _____ PSIG

System Identification: _____

Describe Location: _____

Test Date: _____

Start Test Time: _____

Initial Pressure: _____ PSIG

Stop Test Time: _____

Final Pressure: _____ PSIG

Tested By: _____

Witnessed By: _____

Title: _____

Title: _____

Signed: _____

Signed: _____

Date: _____

Date: _____

Comments: _____

END OF SECTION 33 50 00

68. Main Communication Tower Electrical Service, Item SPV.0060.203.

A Description

This work consists of all coordination, materials, and work by contractor as required to provide electric service to the Main Communication tower site, according to the plans and as hereinafter provided.

B (Vacant)

C Construction

Contractor makes all arrangements and coordinates electric utility service work with Kaukauna Utilities.

Utility provides and installs transformer and transformer pad; wire; and provides service lateral to customer supplied meter socket.

The electric utility company (Kaukauna Utilities) charges will be paid for separately by the department.

Main Communication Tower Electrical Service includes all other work not completed by Kaukauna Utilities or included in the tower plan but necessary for complete installation.

D Measurement

The department will measure Main Communications Tower Electrical Service as each individual unit, in place and acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.203	Main Communications Tower Electrical Service	EACH

Payment is full compensation for providing and or coordinating overhead and/or underground electric service to the site at the proposed transformer locations and from the transformers to the Main Communications Tower electric service location, for transformer pads, meters; cabinets, disconnects all required equipment to facilitate the electric service lateral installation and all associated coordination, permits, fees, labor, material, equipment, tools, and incidentals necessary to complete the work.

**69. Concrete Curb and Gutter 24-Inch Type A, Item SPV.0090.001;
Concrete Curb and Gutter 24-Inch Type D, Item SPV.0090.002.**

A Description

This special provision describes constructing curb and gutter at the locations shown in the plans, or as directed by the engineer.

B Materials

Furnish concrete that conforms to the requirements for concrete curb and gutter according to standard spec 601. Provide QMP for class II ancillary concrete as specified in standard spec 716.

C Construction

Construct according to the requirements of standard spec 601.

D Measurement

The department will measure Concrete Curb and Gutter 24-Inch (type) by the linear foot, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.001	Concrete Curb and Gutter 24-Inch Type A	LF
SPV.0090.002	Concrete Curb and Gutter 24-Inch Type D	LF

Payment is full compensation according to standard spec 601.

70. 12-CT Fiber Optic Cable, Item SPV.0090.003.

A Description

Work under this item shall consist of providing, installing, and testing 12-CT Fiber Optic Cable as shown in the plans and described in these specifications.

B Materials

The 12-CT Fiber Optic Cable shall meet the following requirements:

- Meets or exceeds the Fiber Optic Communications Cable performance characteristics and test methods as defined in the Department of Agriculture Rural Utilities Service (RUS) 7 CFR 1755.900 (PE-90)
- Meets or exceeds the requirements of ANSI/ICEA Standard for Fiber Optic Outside Plant Communications Cable, ANSI/ICEA S-87-640-2006
- Meets or exceeds the requirements of ITU-T G.652 (Categories A, B, C and D)
- Complies with IEC Specification 60793-2-50 Type B1.3 "Low Water Peak" single mode fiber
- Complies with TIA 492CAAB / OS2 "Low Water Peak" single mode fiber
- Complies with Telcordia GR-20-CORE, issue 2
- Color coding shall meet TIA/EIA-598B, "Color Coding of Fiber Optic Cables"
- Meets or exceeds applicable National Electrical Safety Code Specifications.

The central anti-buckling member shall consist of a glass reinforced plastic rod. The purpose of the central member is to prevent buckling of the cable.

The cable core shall contain a water-blocking material. The water blocking material shall be non-nutritive to fungus, electrically non-conductive, and homogenous. It shall also be free from dirt and foreign matter and shall be readily removable with conventional (nontoxic) solvents.

Binders shall be applied with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking, and dielectric with low shrinkage. The cable shall contain at least one ripcord under the sheath for easy sheath removal. Tensile strength shall be provided by a combination of high tensile strength dielectric yarns. The high tensile strength dielectric yarns shall be helically stranded evenly around the cable core.

The single cable jacket or sheath shall be free of holes, splits, and blisters. The single cable jacket shall contain no metal elements and shall be of a consistent thickness. Single cable jackets shall be marked with:

Manufacturer's Name, Optical Cable-Year or as specified - Description (as required by Section 350G of the National Electrical Safety Code).

- Where the Description conforms to the following depending on cable type:
 - Single-Mode Cable: XXF SMF28E
 - XX denotes the fiber count

The cable length shall also be marked every two feet. The actual length of the cable shall be within – 0/+1% of the length markings. Cable marking shall be in contrasting color to the cable jacket.

The shipping, storage, and operating temperature range of the cable shall be -40° C to +70° C. The installation temperature range of the cable shall be -30° C to +70° C.

Tracer wire installed with 12-CT Fiber Optic Cable shall be single conductor, 12 AWG solid copper, XLP insulated with orange color, USE rated.

C Construction

Install cable as per standard spec 678.3.

Install a tracer wire in each run of conduit which contains fiber optic cable. The wire shall be approximately 5 feet longer than the run of conduit and shall be doubled back at least 2 feet at each raceway access point. The tracer wire shall be anchored at each access point in a manner acceptable to the engineer. At each access point, the wires from all conduits entering shall be twisted and joined using an appropriately sized wire nut. Test the tracer wire following installation.

Testing

The contractor shall provide the date, time, and location of any tests required by this specification at least 24 hours before performing the test.

Upon completion of the cable installation, splicing, and termination, the contractor shall test all fibers for continuity, events above 0.10 dB, and total attenuation of the cable. The test procedure is as follows:

A Certified Fiber Optics Technician utilizing an Optical Time Domain Reflectometer (OTDR) and Optical Source/Power Meter must conduct the installation test. The Technician is directed to conduct the test using the Standard Operating Procedure as defined by the manufacturer of the test equipment.

The method of connectivity between the OTDR and the cable shall be a factory patch cord of a length equal to the "dead zone" of the OTDR. Optionally, the technician can use factory fiber box of 100 meters minimum with no splices within the box. The tests shall be conducted at 1310 and 1550 nm for all cable.

At the completion of the test, the contractor shall provide the test results in tabular form to the engineer in a standard, readable, electronic format (e.g., Excel or Adobe PDF). If this is not possible, the bidder must provide the engineer with the appropriate software to enable the engineer to read the results electronically. The test documentation shall include the following:

- Cable and Fiber Identification
 - Cable– ID
 - Cable Location - begin and end point
 - Fiber ID, including tube and fiber color
 - Operator Name
 - Date and Time
 - Setup Parameters
 - Wavelength
 - Pulse width (OTDR)
 - Refractory index (OTDR)
 - Range (OTDR)
 - Scale (OTDR)
 - Test Results
- OTDR Test
 - Total Fiber Trace
 - Splice Loss/Gain
 - Events greater than 0.10 dB
 - Measured Length (Cable Marking)
 - Total Length (OTDR)
- Optical Source/Power Meter
 - Total Attenuation
 - Attenuation (dB/km)

The following shall be the criteria for the acceptance of the cable:

- The test results shall demonstrate that the dB/km loss does not exceed +3% of the factory test or 1% of the cable's published production loss. The error rate for the test equipment will be considered.
- No event shall exceed 0.10 dB. If any event is detected above 0.10 dB, the contractor must replace or repair that event point.
- The total dB loss of the cable, less events, shall not exceed the manufacturer's production specifications as follows: 0.10 dB/km at both 1310 and 1550 nm.
- If the total loss exceeds these specifications, the contractor shall replace or repair that cable run at the contractor's expense, both labor and materials. Elevated attenuation due to exceeding the pulling tension during installation will require the replacement of the cable run at the contractor's expense, both labor and materials.

Test tracer wire using a Megger to perform ground resistance testing. Ensure that all wire tests, read infinity to ground. Provide results to the department for each run. Replace tracer not meeting requirements at no expense to the department.

D Measurement

The department will measure 12-CT Fiber Optic Cable, complete in place and accepted, by the linear foot of cable installed, including all incidentals required.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.003	12-CT Fiber Optic Cable	LF

Payment is full compensation for providing, installing, and testing the cable with tracer wire; including all, permits, OTDR testing and results documentation, troubleshooting, acceptance, and incidentals necessary to complete the work.

71. Aluminum Landscape Edging, Item SPV.0090.004.

A Description

This special provision describes supplying and installing Aluminum Landscape Edging.

B Materials

Furnish 7/32" aluminum landscape edging, 4" tall, silver in color.

Furnish spikes/ stakes as necessary for installation.

Edging shall have interlocking ends.

C Construction

Install using manufacturer's recommendation where the plans show or where the engineer directs so the top of the edging is ½" above top of granite chips height.

Installation of spikes/ stakes shall follow manufacturer's recommendation as far as depth, frequency, and installation angle.

D Measurement

The department will measure Aluminum Landscape Edging by the linear foot in place, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.004	Aluminum Landscape Edging	LF

Payment is full compensation for all materials related to the edging, excavation of adjacent soil, and installation.

72. Sanitary Sewer Main 8-inch, Item SPV.0090.021.

A Description

This special provision describes furnishing and installing new sanitary sewer main piping all as shown on the plans and provided by these specifications. The work shall be performed according to the Standard Specifications for Sewer and Water Construction in Wisconsin, 6th Edition and as hereinafter provided.

B Materials

Pipes shall conform to the following, with all related materials provided from the same manufacturer:

Description	Class or Type	Specification	Joint
PVC Sewer Pipe 8-inch	SDR 35	ASTM D3034	Elastomeric Gasket Conform with F477

When any portion of a section of PVC sewer between manholes has a bury depth equal to or greater than 25 feet, SDR-26 pipe shall be installed. When the entire section of PVC sewer between manholes is less than 25 feet of bury depth, SDR-35 may be installed.

Insulation board shall be extruded polystyrene conforming with ASTM C578 with a minimum thickness of 1-inch.

C Construction

C.1 General

Maintain flow in sanitary sewers on a continuous basis while construction is underway. If required plug sewers with inflatable plug and provide pumps, portable generators, hoses, and related items to maintain flow. During the unloading process, all pipe and accessories shall be inspected by the contractor. Notify the engineer of all material found defective. The engineer shall inspect the material and have the right to reject any materials found unsatisfactory. Promptly remove all rejected material from the job site.

If excessive flow is entering pipe segment being inspected from outside source, contractor shall coordinate with source owner to stop or reduce flow to acceptable levels and/or reschedule inspection of pipe segment to when flows are at acceptable levels. Coordination, scheduling, equipment, notifications, monitoring, and any damage occurring from stopping or bypassing sewage flows shall be the responsibility of the contractor.

Removal of existing facilities, trench excavation and backfill and restoration shall be according to the provisions of these specifications.

Lay and maintain all pipe to the lines and grades shown on the plans. Set pipe grades with a pipe laser. Water mains crossing beneath sanitary or storm sewer mains or services shall be laid to provide a minimum separation of 18 inches between the top of the water main and the bottom of the sewer.

When water mains pass above a sewer a minimum separation of 6 inches shall be provided. Separate sewers and manholes at least 8 feet horizontally from any water main.

When connecting to existing sewers, give the Municipal Utilities department 48 hour notice prior to taking a sewer out of service. The contractor shall have approval from the utility and engineer prior to taking the sewer out of service. Disruption of service shall be during the time of day when the least inconvenience will be caused to the owner and kept to a minimum amount of time.

No pipe shall be laid in water or when the trench conditions are unsuitable for such work. Removal and disposal of existing sanitary sewer, regardless of size or pipe material, shall be considered incidental to the new installations. Clay pipe may be crushed in place if remaining pieces are smaller than 3 inches. Keep clay pipe pieces away from new pipe.

Before lowering pipe into the trench and while suspended, the pipe shall be inspected for defects. Any defective, damaged, or unsound pipe shall be rejected and removed from the site. Installation of pipe shall conform to ASTM D 2321. Adequate manhole water stops must be provided to prevent infiltration into the sewer system. There shall be no mixing of different manufacturer's pipe or fittings on a project.

Remove all foreign matter from the inside of the pipe before lowered into its position in the trench. Keep pipe clean by approved means during and after laying. Provide temporary plug in the end of incomplete piping at the end of day and when work stops. Pipe laying shall proceed from the lowest end of the grade and bell ends of the pipe shall face upgrade.

Provide watertight plugs at end of stubs installed for future connections. Maximum deviation from staked or plan grade shall be no more than 0.30 feet horizontal and grade slope variation of 0.02 percent.

Pipe shall be laid on solid subgrade material shaped to the contour of the pipe. All pipes shall be laid with ends abutting and true to line and grade. Pipe, which has in any way been disturbed or does not conform to said line and grade before final acceptance, shall be removed and re-laid by the contractor at the contractor's expense. Pipe bedding shall be according to the standard details shown on the drawings.

Pipes shall be fitted together and matched so when laid they will form a sewer with a smooth and uniform invert.

Installation shall conform to ASTM D2321. Compact haunching area to specified density required by ASTM D2321.

Install gaskets and forms according to manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.

Maintain sanitary sewer flow at all times during construction. Maintaining sanitary sewer flow shall be considered incidental.

Trench Excavation Requirements:

Alignment and Grade:

- Excavate trench to alignment and grade as staked.
- Excavate no more than 100 feet in advance of pipe laying operation.

Trench Width at Pipe Zone:

- Center trench on pipe alignment.
- Minimum Width: Pipe O.D. plus 12 inches.
- Maximum Width: Pipe O.D. plus 24 inches (except rock excavation).

Excavated Materials:

- Use stable material for backfill.
- Waste unstable material as directed.
- Do not place materials on sidewalk, driveways, or drainageways.

Drainage:

Provide drainage excavations when required. Drain trench water into natural channels or storm sewer. Do not drain trench water into sanitary sewer.

Rock Excavation:

- Blasting shall conform to all local and state ordinances.
- Submit blasting schedule for approval.
- Minimum trench width: 36 inches.
- Provide minimum 6-inch vertical clearance between pipe and rock trench bottom.
- Provide minimum 12-inch horizontal clearance between pipe and rock trench walls.
- Provide pipe foundation material for pipe in rock trenches.

Pipe Foundations:

- Engineer to determine stability of the trench bottom.
- Stable trench bottom:
- Shape trench bottom to conform to bottom half of pipe.
- Excavate bell holes to permit proper jointing.
- Unstable trench bottom:
- Excavate below pipe grade to specified depth.

Trench Backfill Requirements:

- Use native or specified foundation material free of rocks and other unsuitable debris.
- Deposit material uniformly on both sides of pipe throughout entire trench width.
- Place compacted fill in horizontal layers not exceeding 8 inches in thickness.

Use native materials free of debris and rock, concrete or clay lumps with a size greater than 3 inches. (Stones larger than 3 inches and up to 6 inches may be used provided a min. of 24 inches of cover material is provided over pipelines).

- Provide specified compaction through entire lift thickness by mechanical compaction. Compaction with a backhoe bucket is not acceptable.
- Maintain moisture content within ± 3 percent of the optimum moisture content, as determined by the Modified proctor (ASTM D1557) method to attain required compaction.

Compaction requirements for all fill soils unless specified elsewhere shall be as follows:

Class 1 - Fills supporting structures.

- Subgrade under pavements or floors.
- Backfill under piping and conduits.
- Trench backfill over pipelines.
- Trenches within existing or proposed roadways, sidewalks, driveways, shoulders, and other hard surfaces

Class 2 – Fills which do not support structures.

COMPACTION REQUIREMENTS FOR VARIOUS SOIL CLASSES
Required Compaction (%) of Modified Proctor Density

Soil Class	Class 1	Class 2
B-3 through B-4	95	90
C-1 through C-6	95	90
D-1 through D-3, and G-1 and G-2	95	90
E-1	95	90

Field Quality Control:

- Density tests on backfill materials will be as directed by the engineer.
- Contractor to recompact all areas represented by failed density tests.
- Costs for initial test and first retest will be considered incidental.
- Costs of subsequent retests to be deducted from contractor's payment. All trench excavation and backfilling, including backfill material, compaction, and minor dewatering shall be considered incidental. All work shall be done by open trench excavation. All dewatering of trenches as described in the special provisions for dewatering will be incidental to the construction.

C.2 Testing

Deflection Test

Deflection tests shall be performed on all sanitary sewer pipe. The test shall be conducted after the final backfill has been in place at least 30 days. Deflection testing should follow standards according to the Standard Specifications for Sewer and Water Construction in Wisconsin, 6th Edition.

Infiltration and Air Test

Infiltration and air testing should follow standards according to the Standard Specifications for Sewer and Water Construction in Wisconsin, 6th Edition.

The contractor shall receive no additional compensation for tests or corrective work necessary to reduce results below the amount allowed by the specifications, correction of excess deflections, or correction of failing air test.

Record the location, size, length, and number of bends on services on a record drawing. Measure service locations from the closest downstream manhole. Submit sanitary record drawings to Village of Wrightstown Utilities upon completion of the sanitary portion of the project. Reconnect services to the existing sewer and adjusting service without damage to the pipe. Proper watertight joints must be made.

C.3 Televising

All designated sewer sections shall be visually inspected by means of closed-circuit color television. The television camera used for the inspection shall be one specifically designed and constructed for such inspection. The camera shall be capable of radial view for inspection of the top, bottom, and sides of pipe and for looking up lateral connections.

The television camera shall be moved through the line in either direction at a uniform rate, stopping when necessary to ensure proper documentation of the sewer's condition but in no case will the television camera be pulled at a speed greater than 30 feet per minute.

The logs shall be typed or computer printed and acceptable to the Owner. Printed location records shall be kept by the contractor and will clearly show the location, in relation to adjacent manholes, of each infiltration point discovered by the television camera. An estimate of the flow rate of observed infiltration points shall be made and recorded. In addition, other points of significance W:\1200\1269\1269-073\21-01\SPEC\33 01 30.16 Sewer Cleaning & Televising.docx(Rev. 09252020) 33 01 30.16-3 SEWER

CLEANING & TELEVISIONING such as locations of building sewer laterals, joints, unusual conditions, roots, storm sewer connections, collapsed sections, presence of scale and corrosion, and other discernible features will be recorded and two copies of such records shall be supplied to the Owner. The purpose of tape recording shall be to supply a visual and audio record of the condition of the lines that may be replayed both daily and at future presentations.

Television inspection logs shall include, but are not limited to, the following:

- a. Date, time, city, street, basin, sewer section, reference manhole number, name of operator, inspector, and weather conditions.
- b. Pipe diameter, pipe material, section length, depth of pipe, length between joints, and corresponding DVD/Flash Drive identification.
- c. Location of each point of leakage.
- d. Location of each service connection.
- e. Location of any damaged sections, nature of damage, and location with respect to pipe axis.
- f. Deflection in alignment of grade of pipe.

Acceptance of televising shall be made upon the successful completion of the project and shall be to the satisfaction of the Owner. If the recordings show the inspection to be unsatisfactory, the contractor shall be required to re-inspect the sewer line.

Payment for television inspection of the sewer lines shall be incidental to the appropriate bid item.

D Measurement

The department will measure Sanitary Sewer Main (size) by length in linear feet from center manhole to center of manhole or connection, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.021	Sanitary Sewer Main 8-inch	LF

Payment is full compensation for backfill material, excavation, compaction, removal and disposal of existing pipe, disposal of excess material, tracer wire, bypass pumping, testing, and other items required conduits to transfer sewage flows from upstream side of the plug to a downstream manhole, around the pipe segment during the inspection.

73. Sanitary Sewer Service PVC 6-inch, Item SPV.0090.022.

A Description

This special provision describes furnishing and installing new sanitary sewer sanitary service and riser pipe all as shown on the plans and provided by these specifications. The work shall be performed according to the Standard Specifications for Sewer and Water Construction in Wisconsin, 6th Edition and as hereinafter provided.

B Materials

All sanitary sewer service pipe shall meet the same material specifications as the main sewer line.

All fittings shall be the product of one manufacturer and shall be the same type and class as the sewer service pipe.

Elastomeric gaskets shall conform with F477.

Tracer wire shall be No. 10 AWG, solid copper, or No. 12 AWG stranded stainless steel, with HWPE insulation rated for direct burial service. Tracer wire signal connection box shall be three-piece, 5¼-inch cast iron valve box with top marked, "Water" or "Sewer" as required, and as manufactured by Clow, Tyler, or equal.

C Construction

The location and size of sanitary sewer services as shown on the plans are approximate. Actual locations and size may vary from what is shown.

During the unloading process, all pipe and accessories shall be inspected by the contractor. Notify the engineer of all material found defective. The engineer shall inspect the material and have the right to reject any materials found unsatisfactory. Promptly remove all rejected material from the job site. Remove all foreign matter from the inside of the pipe before lowered into its position in the trench. Keep pipe clean by approved means during and after laying.

Removal of existing facilities, trench excavation and backfill and restoration shall be according to the provisions of these specifications. Lay and maintain all pipe to the lines and grades shown on the plans. Install service pipe at a minimum of 1 percent to a maximum of 2 percent grade. No pipe shall be laid in water or when the trench conditions are unsuitable for such work, except by permission of the engineer. Place watertight plug at end of service pipe.

Mark end of service pipe with a 4 by 4 timber set below grade. Riser pipes shall be extended from the service wye connection at 45-degrees above horizontal to an elevation as required to serve the surrounding property as directed by the engineer. Install riser pipe against undisturbed trench wall.

Removal and disposal of existing sanitary sewer service materials, regardless of size or pipe material, shall be considered incidental to the work.

Services shall conform with all plumbing codes for depths and installation. Service depth shall be 12 feet deep at the property line, or as deep as sewer main allows, or as shown on plans.

Installation of pipe shall conform to ASTM D 2321. Wyes shall be oriented at a ten (10) or two (2) o'clock position from the main. There shall be no mixing of different manufacturer's pipe or fittings on a project. Compact haunching area to specified density required by ASTM D2321. Install tracer wire along entire length of service riser and pipe, from wye to service end and up to access box, taped to top center. Avoid splices and underground connections. If splices are required, provide UL-listed moisture proof connectors, self-sealing compression or heat shrink type. Allow at least 2 feet excess tracer wire to remain coiled beneath test box. Locate test box at property line or as directed by engineer or owner. Mark location with steel fence post or as directed by engineer or owner. Pipe laying shall proceed from the lowest end of the grade and bell ends of the pipe shall face upgrade. Pipe, which has in any way been disturbed or does not conform to said line and grade before final acceptance, shall be removed and re-laid by the contractor at the contractor's expense. Pipes shall be fitted together and matched so when laid they will form a sewer with a smooth and uniform invert.

Install gaskets and forms according to manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.

Trench Excavation Requirements shall conform to specifications listed within Sanitary Sewer Main 8-inch special provisions.

All trench excavation and backfilling, including backfill material, compaction, and dewatering shall be considered incidental. All work shall be done by open trench excavation.

Record the location, size, length, and number of bends on services on a record drawing. Measure service locations from the closest downstream manhole. Submit sanitary record drawings to the engineer and Utility upon completion of the sanitary portion of the project.

Reconnect services to the existing sewer and adjusting service without damage to the pipe. Proper watertight joints must be made.

Televising

All designated sewer sections shall be visually inspected by means of closed-circuit color television. The television camera used for the inspection shall be one specifically designed and constructed for such inspection. The camera shall be capable of radial view for inspection of the top, bottom, and sides of pipe and for looking up lateral connections.

The television camera shall be moved through the line in either direction at a uniform rate, stopping when necessary to ensure proper documentation of the sewer's condition but in no case will the television camera be pulled at a speed greater than 30 feet per minute.

The logs shall be typed or computer printed and acceptable to the Owner. Printed location records shall be kept by the contractor and will clearly show the location, in relation to adjacent manholes, of each infiltration point discovered by the television camera. An estimate of the flow rate of observed infiltration points shall be made and recorded. In addition, other points of significance such as locations of building sewer laterals, joints, unusual conditions, roots, storm sewer connections, collapsed sections, presence of scale and corrosion, and other discernible features will be recorded and two copies of such records

shall be supplied to the Owner. The purpose of tape recording shall be to supply a visual and audio record of the condition of the lines that may be replayed both daily and at future presentations.

Television inspection logs shall include, but are not limited to, the following:

- a. Date, time, city, street, basin, sewer section, reference manhole number, name of operator, inspector, and weather conditions.
- b. Pipe diameter, pipe material, section length, depth of pipe, length between joints, and corresponding DVD/Flash Drive identification.
- c. Location of each point of leakage.
- d. Location of each service connection.
- e. Location of any damaged sections, nature of damage, and location with respect to pipe axis.
- f. Deflection in alignment of grade of pipe.

Acceptance of televising shall be made upon the successful completion of the project and shall be to the satisfaction of the Owner. If the recordings show the inspection to be unsatisfactory, the contractor shall be required to re-inspect the sewer line.

D Measurement

The department will measure Sanitary Sewer Service (size) PVC by length in linear feet from the center of the main to the end of the service complete in place with no deduction for bends or cleanouts, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.022	Sanitary Sewer Service PVC 6-inch	LF

Payment is full compensation for excavation, backfilling, backfill material, compaction, removal and disposal of excess or unsuitable material, bends, tracer wire, tracer wire box, adjustments, removal of existing service materials, televising and other items required for a complete installation.

74. Sanitary Sewer Lateral, 4-Inch, Item SPV.0090.023.

A Description

This special provision describes furnishing and installing new sanitary sewer laterals as shown on the drawings and according to the Standard Specifications for Sewer and Water Construction in Wisconsin and as hereinafter provided.

B Materials

All sanitary sewer lateral pipe shall meet the same material specifications as the main sewer line.

Fittings for laterals shall be of the same material as the lateral pipe unless special fittings are needed for transition between material types or sizes or standard fittings are not manufactured. Where the laterals are of dissimilar materials, provide a transition coupling for the connection.

Tracer wire shall be No. 10 AWG, solid copper, or No. 12 AWG stranded stainless steel, with HWPE insulation rated for direct burial service. Tracer wire signal connection box shall be three-piece, 5¼-inch cast iron valve box with top marked, "Water" or "Sewer" as required, and as manufactured by Clow, Tyler, or equal.

Refer to Trench Backfill Requirements in Sanitary Sewer Main 8-inch of these special provisions.

C Construction

Furnish and install sanitary sewer laterals as shown on the drawings or requested by engineer. Under normal circumstances, service laterals will be installed within the right-of-way or easement to serve all existing building and all platted lots. In certain cases, only wye or tee branches will be installed to vacant lots. Service laterals shall consist of a branch fitting at the main and extension of the specified lateral pipe to the end of lateral as called for on the drawings and requested. All necessary fittings shall be furnished and installed to complete the installation as shown on the drawings.

Refer to Sanitary Sewer Main 8-inch of these special provisions for additional construction requirements.

Each service lateral shall have a tracer wire installed from the main to the location of the connection to the existing service. The tracer wire shall be 10 gauge solid copper with no splices. The wire shall be secured to the pipe with duct tape at a minimum of 5-foot intervals. The ends of the tracer wire shall be brought to the ground surface and stored in a tracer wire access box according to the drawing details. Eighteen inches of additional wire shall be coiled at the location of the terminal box. Each tracer wire shall be tested by the contractor to confirm it accurately provides the location and depth of the sewer lateral.

A complete and accurate tabulation of length, depth, and location of all branches, risers, and laterals shall be kept by the contractor on cards available from engineer. Measurements shall be made from the nearest downstream manhole. Lateral installation shall meet these specifications and field conditions. Problems occurring because of failure to provide proper installation or proper records shall be corrected by contractor at its expense.

No installed lateral shall be backfilled until engineer has been notified that the lateral is complete and reasonable time is allowed for observation of the work.

D Measurement

The department will measure Sanitary Sewer Lateral (size) in length by the linear foot, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.023	Sanitary Sewer Lateral, 4-Inch	LF

Payment is full compensation for all bends, couplings, tracer wire installations, tracer wire access boxes; service lateral; and for preparing and providing all records; for providing bedding, granular backfill material and backfilling, compaction, televising, and disposal of excess material.

75. Water Main C900 6-inch, Item SPV.0090.031; Water Main C900 8-inch, Item SPV.0090.032.

A Description

This special provision describes furnishing and installing new water main piping all as shown on the plans and provided by these specifications. The work shall be performed according to the Standard Specifications for Sewer and Water Construction in Wisconsin, 6th Edition and as hereinafter provided.

B Materials

Water main shall be polyvinyl chloride pipe conforming to AWWA C900, thickness class DR-18, Pressure Class 235 and shall be the product of one manufacturer. Where necessary for connections, short segments, hydrant leads, or fittings, water main may be ductile iron Class 52 with approval from the engineer. Any ductile iron pipe used shall be paid at the PVC unit price. Pipe Joints - Joints shall be push-on type with elastomeric gaskets conforming to the requirements of ASTM F477. The wall thickness of the bell section shall conform to ASTM D3139.

Refer to Trench Backfill Requirements in Sanitary Sewer Main 8-inch of these special provisions.

Tracer wire shall be No. 10 AWG, solid copper, or No. 12 AWG stranded stainless steel, with HWPE insulation rated for direct burial service. Tracer wire signal connection box shall be three-piece, 5¼-inch cast iron valve box with top marked, "Water" or "Sewer" as required, and as manufactured by Clow, Tyler, or equal.

The water main fittings shall conform to AWWA C153 and be the product of one manufacturer. Fittings interior lining shall be standard thickness of cement-mortar conforming with AWWA C104. Fittings exterior lining shall be asphaltic coating with minimum of 1-mil thickness.

Joining pipe of different material or outside diameter. Mechanical pipe couplings shall be Dresser Style 162, Romac 501 or equal.

Mechanical joints shall be Class 52 and use corrosion resistant bolts and nuts with a rated pressure of 350 psi. Rods shall be 0.75-Inch diameter, Type 304, or 316 Stainless Steel. Underground clamps shall be 0.5-Inch x 2 inches flat bar stock clamps, Astral Corp., or equal and include a retainer washer. T-bolts shall be Type 304 or 316 stainless steel and stainless steel threads shall be coated with nickel based

anti-seize compound prior to assembly. In lieu of anti-seize compound, a green fluoropolymer coated stainless steel nut may be substituted.

Megalugs, by EBAA iron, Sigma "One-Lok", Ford, or equal may be used for joint restraint.

Thrust blocks shall be constructed of concrete having a minimum 28-day compressive strength of 2,000 psi. Hardwood blocking may be used, if approved by the engineer. The minimum cement content shall be 4½ bags of cement per cubic yard of concrete. The allowable slump shall be 4 to 5 inches.

Polyethylene encasement shall conform to AWWA C105 and a minimum thickness of 8 mils. Polyethylene encasement shall be Class C Black, Type 1 and Grade E-1.

Restrain all joints within the Restrained Length shown on the table, below, with restrained mechanical fittings consisting of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C101/A21.10, and have a working pressure of 350 psi. All mechanical joint restraints shall be manufactured in the United States and include a cast identification number consisting of year, day, plant, and shift, referenced to material traceability records related to strength, chemical and nodularity tests performed on during production. Acceptable manufacturer is Certanteed Certa-Lok C900/RJ PVC pipe or equal.

Pipe Size (In)	<u>Restrained Length (feet)</u>		Tee, Hydrant or Dead End
	45° Bend	90° Bend	
6	11	20	14
8	19	34	24

C Construction

Manipulation of existing valves required in order to construct work shall be performed by the Village of Wrightstown unless permission has been given on a case-by-case basis. Contact the Village of Wrightstown at least 48 hours in advance to coordinate and schedule any required valve manipulation. Removal and disposal of existing water main shall be considered incidental to the work. Inspect water main for defects before placing in trench. Lay pipe to the required alignment and grade. Locate hydrants, valves, and fittings according to plans. Remove all foreign matter from the inside of the pipe before installation.

Provide trench excavation, foundations, and backfill according to the requirements as described under the item for sanitary sewer.

All trench excavation and backfilling, including backfill material, compaction, and minor dewatering shall be considered incidental.

Provide a minimum of 8 feet of cover over the pipe. Greater depths of cover over pipe may be necessary to clear other utilities or provide for future finished grade above pipe. Laying pipe at greater depths than 8 feet shall be considered incidental.

Construct the pipe under the conflicting sewer, where water pipe is in direct conflict with sewers. Provide a minimum 18-inch space when the water main crosses beneath the sewer. Provide a minimum 6-inch space when the water main crosses above the sewer.

Water Main paralleling sanitary sewers shall be laid at least 8 feet horizontally from a sanitary sewer. Connecting to existing water main: Only representatives of the owner are permitted to operate valves on existing system. Give the owner at least 48-hour notice when it is necessary to take an existing water main out of service. Disruption of water service shall be during a low usage period or when it is the least inconvenient to the user. Have all proper materials and equipment immediately on hand when a water main is taken out of service for connection.

No pipe shall be laid in water or on unsuitable foundation bedding except by permission of the engineer. Perform the following test upon completion of the water main construction and prior to any external service connections.

Lay pipe to line and depth shown on plans. Unless otherwise stated, pipe shall be laid with the bell ends facing the direction of laying. When grade exceeds two feet per hundred feet, the bells shall face upgrade. Keep pipe, fittings, and hydrants free of debris and foreign matter. The interior of all pipes shall be clean before being installed. The contractor shall provide the necessary means to wipe, brush, swab, or air blast to remove foreign matter. Assemble all joints according to manufacturer's recommendations. Full lengths of pipe shall be utilized at the connection to 45° and 90° bends.

Water Main Fittings shall be mechanical type. Joint conductivity shall be provided by means of external copper jumpers across all fitting connections, including mechanical restrained joints. Each joint shall be capable of carrying 500 amps for an extended period. Tracer wire shall be used in lieu of copper jumpers if C900 water main is specified.

Anchorage of Bends, Tee's, Plugs, and Valves: Place concrete blocking at all plugs, bends, and tees and between the fitting and the undisturbed trench wall. Blocking shall be a minimum of 12 inches thick and the minimum area in square feet as follows:

Tee Pipe	Or Plug Sq Ft	1/4 Bend Sq Ft	1/8 Bend Sq Ft	1/32 1/16 Bend Sq Ft
6"	2.9	3.1	1.6	0.8
8"	3.7	5.3	2.9	1.4

Provide thrust blocking or restraints at the following locations:

1. Bend deflecting 11½ degrees or more.
2. Hydrants.
3. Valves and tees.
4. Plugs and caps.

Size blocking based on larger main at junctions. Ductile Iron Retainer Glands shall be placed on all fittings. Place on joints of all dead ends 6 inches through 12 inches commencing with the branch fitting.

Where specified or required, pipes of different material or outside diameter shall be joined with mechanical pipe couplings. Couplings shall be suitable for the intended service and shall be installed according to the manufacturer's instructions. The contractor shall submit details of proposed coupling for engineer's review.

Wrap all below ground metal with polyethylene encasement according to AWWA C105 including:

1. Ductile iron pipe.
2. Fittings, valves, and valve boxes.
3. Corporations, curb stops, and curb boxes - their entire length.
4. All portions of hydrants below grade.
5. Copper water services.
6. All metal restraining devices.

Run tracer wire along pipe when PVC or polyethylene pipe is used from hydrant to hydrant. Terminate tracer wire at each hydrant utilizing the specified access point connector and/or at tracer wire signal boxes as shown on the plans. A maximum of one splice will be allowed between each hydrant. Tracer wire shall be tested for continuity prior to acceptance of project.

Where specified or required, pipes of different material or outside diameter shall be joined with mechanical pipe couplings. Couplings shall be suitable for the intended service and shall be installed according to the manufacturer's instructions. The contractor shall submit details of proposed coupling for engineer's review.

C.2 Testing

Perform a pressure and leakage testing according to the Standard Specifications for Sewer and Water Construction in Wisconsin, 6th Edition.

Test Pressure: 150 psi. Test Duration: 2 hours.

Test with valves open to include all stubs and C900 service laterals. Contractor is responsible for removal of air from dead ends by installing taps or corporation stops at locations as approved by engineer and Owner. Upon completion of testing, corporation stops shall be removed and plugged or left in place at the direction of engineer and owner.

Pressure Test Services: Service pipes may be tested at the time of the foregoing test, if installed, at the contractor's option. However, testing of service pipes may be completed as a separate operation from main testing and, if so, the test pressure shall be 100 psi. Service pipe testing, if done separately, shall be done with the corporation stop open.

Perform Electrical Conductivity Test on Iron Pipe water mains:

Perform a conductivity test within one week after completion of pressure testing of the main on all iron pipe water mains to establish that locating the new main and services may be carried out in the future. Bacteriological Tests and Disinfection of New Water Mains and Water Services:

C.3 Disinfection

All water distribution system or extension to existing system or any valved section of such extension, or replacement, shall be disinfected prior to placing same in service. Disinfection of water main shall be done according to AWWA Standard C651.

Disinfection shall be by tablet or continuous feed method. Hold chlorine in pipe for a minimum period of 24 hours, with an initial dosage of 50 ppm minimum. Residual dosage after hold period shall be 10 ppm. Flush system within 24 hours after disinfection is completed.

Village of Wrightstown shall draw water samples with accommodations made by contractor. Provide 36-hour notice of time when samples are to be taken. After final flushing, obtain two sets of samples taken a minimum of 24 hours apart.

More samples may be required due to staging and installation methods. Any stubs or C900 services which will be tapped in order to release air from the system for pressure testing, shall be made available for testing. The Village of Wrightstown will have the option of requiring safe water samples at these taps.

Ensure that one sample is obtained from each branch of main. A minimum of two samples are required. Perform coliform tests on each sample. Two consecutive safe samples are required from each sample location.

Re-chlorinate if any sample tests positive for coliform.

D Measurement

The department will measure Water Main for each size by the linear foot, acceptably completed.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.031	Water Main C900 6-inch	LF
SPV.0090.032	Water Main C900 8-inch	LF

Payment is full compensation for all excavating, backfilling, dewatering, sheeting, shoring, removing existing water main, for furnishing and installing water mains, pipe joints, fittings, tracer wire, bedding material, initial backfill, all test procedures, and other items required for a complete installation.

76. Topsoil Stripping, Item SPV.0180.001.

A Description

This section describes removing topsoil from the site of proposed roadway excavations and embankments, stockpiling and removing excess as directed by the engineer.

B Materials

Salvaged topsoil consists of the loam, sandy loam, silt loam, silty clay loam or clay loam humus-bearing soils available from overlying portions of areas to be occupied by the completed roadway.

C Construction

Mow topsoil procurement areas to a height of approximately 6 inches. Remove litter such as brush, rock, and other materials that will interfere with subsequent vegetation establishment. Strip off the humus-bearing soil. Take care to minimize removing the underlying sterile soil. Stockpile the topsoil on the right-of-way as plans show, excess topsoil becomes property of the contractor and must be hauled off site.

D Measurement

The department will measure Topsoil Stripping by the square yard of area where topsoil was removed. The quantity measured for payment will equal the actual number of square yards of area stripped to the depth specified within the limits of construction designated on the plans or in the contract, or as the engineer directs. Areas not designated as topsoil stripping are incidental to the Salvaged Topsoil bid item.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0180.001	Topsoil Stripping	SY

Payment is full compensation for performing the work described above.

77. Weed Barrier Fabric, Item SPV.0180.002.

A Description

This work shall consist of furnishing and installing the Weed Barrier Fabric in areas as shown on the plans.

B Materials

Landscape fabric shall be black polypropylene polyester blend, 28 mills, 3.33 ounces/sq. yard, Mullen burst strength: 250 lbs. Permeability is 28 gals/s.f./min. per fallen head method.

C Construction

The contractor shall finish grade the planting beds prior to installing the Weed Barrier Fabric.

Weed barrier Fabric shall be installed per manufacturer's specifications as called out on the plans. Overlap of the fabric shall be a minimum of 6" or the manufacturer's recommendations, whichever is greater.

The contractor can install the weed barrier before or after planting. If installed prior to planting, cut the Weed Barrier Fabric with appropriately sized "x"s to allow for the planting holes per the standard details and will be folded back during planting operations and folded to the stem/ trunk upon completion. If the Weed Barrier Fabric is installed after the plantings, all waste material shall be fully removed prior to installation. The edges of the Weed Barrier Fabric shall be within 4" of the stem/trunk of the plant material on all sides.

The practice of cutting the Weed Barrier Fabric the full size of the planting areas and then installing remnant patching will not be allowed.

Weed Barrier Fabric shall not be visible under covering material. All loose ends shall be cut off, tucked under, or otherwise covered at depth specified in plan.

D Measurement

The department will measure Weed Barrier Fabric by the square yard, acceptably completed. The department will not make allowance for fabric that must be entrenched in the soil for any end or junction slot, or for required overlaps.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0180.002	Weed Barrier Fabric	SY

Payment is full compensation for furnishing and installing the Weed Barrier Fabric.

78. Construct Outside Drop, 6-Inch, Item SPV.0200.020; Construct Inside Drop, 8-Inch, Item SPV.0200.021.

A Description

This special provision describes constructing inside and outside drop structures on sanitary sewer access structures where shown in the drawings, or as directed by the Village of Wrightstown. Drops are required if the elevation difference between the flow line of the incoming pipe and the spring line of the outgoing

pipe is greater than 2 feet. The work shall be performed according to the Standard Specifications for Sewer and Water Construction in Wisconsin, 6th Edition and as hereinafter provided.

See Sanitary Manhole 8-Inch Core SPV.0060.23 item for 8-Inch inside drop connection on an existing sanitary manhole.

B Materials

Provide all materials associated with this item according to Standard Detail Drawing.

Pipe and fitting shall be of the same material as the sewer main.

Saddle blocks shall be 4 inches in thickness and made of Type 2 HDPE Perm-Poly Lumber or equal.

Anchor straps shall be ¼-Inch by 2-Inch stainless steel and be fastened the structure by ¼-Inch by 3-Inch stainless steel crews with expansion shields.

Provide mortar conforming to ASTM C91, Type M for inside drop outfall reinforcement.

C Construction

Maintain the normal flow of wastewater at all times during installation of the sanitary sewer access structure, construction of the outside drop structure, and when connecting new and existing pipes to the structure.

Whenever shown on the plans, or directed by the engineer, the contractor shall install inside/outside drop structures in conjunction with the installation and modification of sanitary manholes as detailed in the Construction Detail Drawings. The pipe and fittings to be used in the construction of the outside drop inlets shall be of the same material as the sewer main. The pipe and fittings shall be securely anchored to the manhole to prevent displacement during the placement of the concrete encasement.

The 8-Inch inside drop shall be constructed as detailed in the Construction Details as located in the plans or when approved prior to construction by the engineer in writing. Construct Inside Drop, 8-Inch SPV.0200.21 item works in conjunction with the Sanitary Manhole 8-Inch Core SPV.0060.23 item.

The 6-Inch outside drop shall be constructed as detailed in the Construction Details as located in the plans or when approved prior to construction by the engineer in writing. Sanitary Sewer Manhole w/Casting 5-FT Diameter, SPV.0060.20 item shall be constructed to incorporate the components of the 6-Inch outside drop as detailed in the Construction Details and as located in the plans.

The pouring and construction of concrete benches and flow lines in new manholes for the inlet or outlet pipes shall not be considered a part of this work. The construction of concrete benches and flow lines shall be considered incidental to the installation of the manhole. The contractor shall be responsible for maintaining the normal flow of wastewater during tapping of the manhole.

Provide trench excavation, foundations, and backfill according to the requirements as described under the item for sanitary sewer.

All trench excavation and backfilling, including backfill material, compaction, and minor dewatering shall be considered incidental.

Complete any necessary temporary wastewater control according to the Standard Specifications for Sewer and Water Construction in Wisconsin, 6th Edition.

D Measurement

The department will measure Construct Inside/Outside Drop by the vertical foot measured from the invert of the entry tee to the springline of the outgoing sewer according to the Construction Details. If the manhole has a bench above the spring line of the outgoing sewer, the inside drop will be measured from the invert of the tee to the top of the manhole structure bench.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0200.020	Construct Outside Drop, 6-Inch	VF
SPV.0200.021	Construct Inside Drop, 8-Inch	VF

Payment is full compensation for excavating, backfilling and disposing of surplus materials. Sanitary tap connections for the inside drop shall be covered under Sanitary Manhole 8-Inch Core SPV.0060.23.

ADDITIONAL SPECIAL PROVISION 1 (ASP 1) FOR TRANSPORTATION ALLIANCE FOR NEW SOLUTIONS (TrANS) PROGRAM EMPLOYMENT PLACEMENTS AND APPRENTICESHIPS

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), Section 5204(e) – Surface Transportation Workforce Development Training and Education, provides for 100 percent Federal funding if the core program funds are used for training, education, or workforce development purposes, including “pipeline” activities. The core programs includes: Congestion Mitigation and Air Quality Improvement (CMAQ) Program, Highway Bridge Program (HBP), Interstate Maintenance (IM), National Highway System (NHS), and Surface Transportation Program (STP). These workforce development activities cover surface transportation workers, including OJT/SS programs for women and minorities as authorized in 23 U.S.C. §140(b).

TrANS is an employment program originally established in 1995 in Southeastern Wisconsin. Currently TrANS has expanded to include TrANS program locations to serve contractors in Southeast (Milwaukee and surrounding counties), Southcentral (Dane County and surrounding counties including Rock County), and most Northeastern Wisconsin counties from locations in Keshena, Rhinelander and surrounding far Northern areas. TrANS attempts to meet contractor's needs in other geographic locations as possible. It is an industry driven plan of services to address the outreach, preparation, placement and retention of women, minorities and non-minorities as laborers and apprentices in the highway skilled trades. These candidate preparation and contractor coordination services are provided by community based organizations. For a list of the TrANS Coordinators contact the Disadvantaged Business Enterprise Office at (414) 438-4583 in Milwaukee or (608) 266-6961 in Madison. These services are provided to you at no cost.

I. BASIC CONCEPTS

Training reimbursements to employing contractors for new placements, rehires or promotions to apprentice of TrANS Program graduates will be made as follows:

- 1) **On-the-Job Training, Item ASP.1T0G, ASP 1 Graduate.** At the rate of \$5.00 per hour on federal aid projects when TrANS graduates are initially hired, or seasonally rehired, as unskilled laborers or the equivalent.

Eligibility and Duration: To the employing contractor, for up to 2000 hours from the point of initial hire as a TrANS program placement.

Contract Goal: To maintain the intent of the Equal Employment Opportunity program, it is a goal that 12 (number) TrANS Graduate(s) be utilized on this contract.
- 2) **On-the-Job Training, Item ASP.1T0A, ASP 1 Apprentice.** At the rate of \$5.00 per hour on federal aid projects at the point when an employee who came out of the TrANS Program is subsequently entered into an apprenticeship contract in an underutilized skilled trade (this will include the Skilled Laborer Apprenticeship when that standard is implemented).

Eligibility and Duration: To the employing contractor, for the length of time the TrANS graduate is in apprentice status.

Contract Goal: To maintain the intent of the Equal Employment Opportunity program, it is a goal that 7 (number) TrANS Apprentice(s) be utilized on this contract.
- 3) The maximum duration of reimbursement is two years as a TrANS graduate plus time in apprentice status.

- 4) If a TrANS program is not available in the contractor's area and another training program is utilized, payment of On-the-Job Training hours may be approved by the Wisconsin Department of Transportation (WisDOT) if the training program meets the established acceptance criteria. Only On-the-Job Training Hours accumulated after WisDOT approval will be reimbursed as specified under Items ASP.1T0G and ASP.1T0A. For more information, contact the Disadvantaged Business Enterprise Office at the phone numbers listed above.
- 5) WisDOT reserves the right to deny payments under items ASP.1T0G and ASP.1T0A if the contractor either fails to provide training or there is evidence of a lack of good faith in meeting the requirements of this training special provision.

II. RATIONALE AND SPECIAL NOTE

The \$5.00 per hour now being paid for TrANS placements is intended to cover the duration of two years to allow for reaching entry-level laborer status. An additional incentive, the \$5.00 rate, would promote movement into the underutilized skilled trades' apprenticeships and applies until the individual completes their apprenticeship. These incentives benefit TrANS candidates by giving them a better opportunity to enter a skilled trade; benefits contractors who will be assisted in meeting their EEO profiles and goals; and benefits the public who will see the program reinforce larger public-private employment reform in Wisconsin. The pool of TrANS graduates was created for the purpose of addressing underutilization in the skilled trades, an objective that is further reinforced by a parallel retention pilot program, known as the Companywide Reporting. *Whether or not reimbursement is involved, the WisDOT reassures contractors who are in the Companywide Program that TrANS placements still contribute toward fulfilling the new hire goal of 50% women and minorities.* Based on data administered by United States Department of Labor (US DOL), the highway skilled trades remain underutilized for women statewide (less than 6.9%); and for minorities in all counties (% varies by county).

NOTE: *Unless using other advancement strategies, contractors are encouraged to use some or all of this monetary incentive to offset the cut in hourly wages an individual may incur when entering an apprenticeship if the full general laborer hourly rate has been previously paid. No special accounting measures are required.*

III. IMPLEMENTATION

The implementation of ASP 1 is intended to cover only the amount of time it takes for underutilization to be resolved across the trades. This will be measured annually at the county and/or state levels using data administered by WisDWD in relation to goals set by the USDOL-OFCCP. With appropriate state and federal approvals, we may also do some measurement at the company level.

It is the contractor's responsibility to note on their Certified Payrolls if their employee is a TrANS graduate or a TrANS apprentice. The District EEO Coordinators utilize the information on the Certified Payrolls to track the hours accumulated by TrANS Graduates and TrANS apprentices on WisDOT contracts. Payment under this ASP 1 is made based on the hours recorded off of the Certified Payrolls. Tracking may eventually include improved linkages with the WisDWD apprentice database, information from company and committee level sources.

TrANS is nondiscriminatory by regulation, and is a tool for optional use by contractors to address the underutilization of women and minorities as laborers and apprentices in our industry's skilled trades.

IV. TRANS TRAINING

As part of the contractor's equal employment opportunity affirmative action program, training shall be provided to employees enrolled in apprenticeship and on-the-job training programs as follows:

The contractor shall provide on-the-job training aimed at developing full journey workers in the type of trade or job classifications involved. In the event the contractor subcontracts a portion of the contract work, the contractor shall determine how many, if any, of the trainees are to be trained by the subcontractor provided, however, that the contractor shall retain the primary responsibility for meeting the training requirements imposed by this special provision. The contractor shall also insure that this training special provision is made applicable to such subcontract.

Training and upgrading of minorities and women toward journey workers status is a primary objective of this training special provision. Accordingly, the contractor shall make every effort to enroll minority trainees and women (e.g., by conducting systematic and direct recruitment through public and private sources likely to yield minority trainees and women trainees); to the extent such persons are available within a reasonable area of recruitment. The contractor will be given an opportunity and will be responsible for demonstrating the steps that they have taken in pursuance thereof, prior to determination as to whether the contractor is in compliance with this training special provision. This training commitment is not intended, and shall not be used, to discriminate against any applicant for training, whether a member of a minority group or not.

No employee shall be employed as a trainee in any classification in which they have successfully completed a training course leading to journey workers status or in which they have been employed as a journey worker. The contractor should satisfy this requirement by including appropriate questions in the employee application or by other suitable means. Regardless of the method used, the contractor's records should document the findings in each case.

V. APPRENTICESHIP TRAINING

The Federal Highway Administration's (FHWA) policy is to require full use of all available training and skill improvement opportunities to assure increased participation of minority groups,

disadvantaged persons and women in all phases of the highway construction industry. The FHWA On-the-Job Training (OJT) Program requires the State transportation agencies (STAs) to establish apprenticeships and training programs targeted to move women, minorities, and disadvantaged individuals into journey-level positions to ensure that a competent workforce is available to meet highway construction hiring needs, and to address the historical under-representation of members of these groups in highway construction skilled crafts.

The OJT Supportive Services (OJT/SS) Program was established in Title 23 Code of Federal Regulations (CFR), Part 230) to supplement the OJT program and support STA training programs by providing services to highway construction contractors and assistance to highway construction apprentices and trainees. The primary objectives of OJT/SS are:

- (1) To increase the overall effectiveness of the State highway agencies' approved training programs.
- (2) To seek other ways to increase the training opportunities for women, minorities, and disadvantaged individuals.

The STAs are responsible for establishing procedures, subject to the availability of Surface Transportation and Bridge Funds under 23 U.S.C. §140(b) (Nondiscrimination), for the provision of supportive services with respect to training programs approved under 23 CFR, Part 230(a) (Equal Employment Opportunity on Federal and Federal-aid Construction Contracts – including Supportive Services).

The contractor and subcontractor shall maintain records to demonstrate compliance with these apprenticeship requirements. Reasonable exemptions and modifications to and from any or all of these requirements will be determined by the Wisconsin Department of Transportation-Civil Rights Office. A request for an exemption or modification, with justification, shall be made in writing, addressed to WisDOT Civil Rights Office, 4802 Sheboygan Avenue, P.O. Box 7965, Rm. 451, Madison, WI 53707.

ADDITIONAL SPECIAL PROVISION 3

DISADVANTAGED BUSINESS ENTERPRISE (DBE) PROGRAM IMPLEMENTATION

Authority

Wisconsin Department of Transportation (WisDOT) is a recipient of funds from the US Department of Transportation's Federal Highway Administration. The DBE program is a federal program applicable on all contracts administered by WisDOT that include federal-aid highway funds. The authority for the DBE program is the Transportation Bill as approved by Congress periodically. DBE program guidance and requirements are outlined in the Code of Federal Regulations at 49 CFR Part 26. This contract is subject to DBE provisions because it is financed with federal-aid-highway funds. Additionally, this contract is subject to the *State of Wisconsin Standard Specifications for Highway and Structure Construction* and all applicable contract documents.

Requirements

Pursuant to the federal DBE program regulation at 49 CFR Part 26, a contractor's failure to comply with any provision of the DBE program regulatory provisions will be considered a material breach of contract. This is nonnegotiable.

If a contractor fails to carry out the DBE program requirements and/or the Required Contract Provisions for Federal Aid Contracts (FHWA 1273) referenced in this document, sanctions will be assessed depending upon the facts, reasoning, severity, and remedial efforts of the contractor that may include: termination of contract, withholding payment, assessment of monetary sanctions, and/or suspension/debarment proceedings that could result in the disqualification of the contractor from bidding for a designated period of time.

- (1) The Commitment to Subcontract to DBE (Form DT1506 or digital submittal), Attachments A, and Good Faith Effort Documentation (Form DT1202) will be submitted as described in Section 2.
- (2) Any change to DBE Commitments thereafter must follow modification of DBE subcontracting commitment as described in Section 9.
- (3) The Department requires this list of DBE subcontractors from all bidders at time of bid to ensure the lowest possible cost to taxpayers and fairness to other bidders and subcontractors. Bid shopping is prohibited.
- (4) The contractor must utilize the specific DBE firms listed in the approved DBE Commitment to perform the work and/or supply the materials for which the DBE firm is listed unless the contractor obtains written consent in advance from WisDOT. The contractor will not be entitled to payment for any work or materials on the approved DBE Commitment that is not performed or supplied by the listed DBE without WisDOT's written consent.

Description

The Wisconsin Department of Transportation is committed to the compliant administration of the DBE Program. The DBE provisions work in tandem with FHWA 1273 and WisDOT's *Standard Specifications for Highway and Structure Construction* and *Construction and Materials Manual*. The WisDOT Secretary is signatory to assurances of department-wide compliance.

The Department assigns the contract DBE goal as a percentage of work items that could be performed by certified DBE firms on the contract. The assigned DBE goal is expressed on the bid proposal as a percentage applicable to the total contract bid amount.

- (1) WisDOT identifies the assigned DBE goal in its contract advertisements and posts the contract DBE goal on the cover of the bidding proposal. The contractor can meet the assigned contract DBE goal by subcontracting work to a DBE firm or by procuring services or materials from a DBE firm.

- (2) Under the contract, the prime contractor should inform, advise, and develop participating DBE firms to be more knowledgeable contractors who are prepared to successfully complete their contractual agreement through the proactive provision of assistance in the following areas:
 - Produce accurate and complete quotes
 - Understand highway plans applicable to their work
 - Understand specifications and contract requirements applicable to their work
 - Understand contracting reporting requirements
- (3) The Department encourages contractors to assist DBE subcontractors more formally by participating in WisDOT's Business Development program as a mentor, coach, or resource. For comprehensive information on the Disadvantaged Business Enterprise Program, visit the Department's Civil Rights and Compliance Section website at: <http://wisconsindot.gov/Pages/doing-bus/civil-rights/dbe/default.aspx>

1. Definitions

Interpret these terms, used throughout this additional special provision, as follows:

- a. **Assigned DBE Contract Goal:** The percentage shown on the cover of the Highway Work Proposal that represents the feasible level of DBE participation for each contract. The goal is calculated using the Engineer's Estimate and DBE Interest Report. Goal assignment includes review of FHWA funds, analyzes bid items for subcontract opportunity and compatibility with DBE certified firm work codes. Additional factors considered include proximity, proportion, and regulations.
- b. **Bid Shopping:** In construction law, bid shopping is the practice of divulging a subcontractor's bid to another prospective contractor(s) before or after the award of a contract to secure a lower bid.
- c. **DBE:** Disadvantaged Business Enterprise – A for-profit small business concern where socially and economically disadvantaged individuals own at least a 51% interest and control management and daily business operations.
- d. **DBE Commitment:** The DBE Commitment is identified in the Commitment to Subcontract to DBE (Form DT1506) and is expressed as the amount of DBE participation the prime contractor has secured. The DT1506, a contract document completed by the bidder, is required to be considered a responsive bidder on an FHWA-funded contract that has an assigned DBE goal. The prime contractor will have the option to submit the DT1506 digitally, as an entry with the bid in Bid Express, or as an attachment to the bid.
- e. **DBE Utilization:** The actual participation of a DBE subcontractor on a project. WisDOT verifies DBE utilization through review of the DBE Commitment, payments to subcontractors, and contract documentation. The Prime Contractor receives DBE credit for payments made to the DBE firms performing the work listed on the approved DBE Commitment, and those submitted after approved commitment with Attachment A.
- f. **Good Faith Effort:** Legal term describing a diligent and honest effort taken by a reasonable person under the same set of facts or circumstances. For DBE subcontracting, the bidder must show that it took all necessary and reasonable steps to achieve the assigned DBE goal by the scope, intensity, and appropriateness of effort that could reasonably be expected for a contractor to obtain sufficient DBE participation.
- g. **Manufacturer:** A firm that operates or maintains a factory or establishment that produces, on the premises, the materials, supplies, articles, or equipment required under the contract.
- h. **Reasonable Price:** Contractors are expected to assess reasonable price by analyzing the contract scope for DBE subcontract feasibility and comparing common line items in DBE and non-DBE subcontract quotes for the same work. Per federal regulation, reasonable price is not necessarily the lowest price.
- i. **Supplier:** A firm that owns, operates, or maintains a store, warehouse, or other establishment in which the materials, supplies, articles, or equipment required under the contract are bought, kept in stock, and regularly sold or leased to the public.
- j. **Tied quote:** Subcontractor quote that groups multiple bid/line items at a bundled/package price with a notation that the items within the quote will not be separated.

2. WisDOT DBE Program Compliance

a. Documentation Submittal

- The Commitment to Subcontract to DBE (Form DT1506 or digital submittal) must be submitted at the time of bid (Tuesday) by all prime contractors.
- Attachments A OR quotes from all DBEs included in the Commitment must be submitted at bid (Tuesday) **OR**
- Within one-hour following bid submittal by ALL prime contractors via eSubmit (Tuesday).
- If only DBE quotes were submitted, all remaining signed Attachments A must be submitted within 24-hours of bid closing via eSubmit (Wednesday).
- If the assigned DBE contract goal is not met, Documentation of Good Faith Effort (Form DT1202) and supporting documentation must be submitted within 24-hours of bid closing (Wednesday) via eSubmit. [Instructions for eSubmit.](#)

****Bidders have the option of submitting the DBE Commitment at the time of bid via direct entry through Bid Express OR with attachment of Form DT1506 (Commitment to Subcontract to DBE). The DBE Commitment entered with bid is the digital form of the DT1506. Separate submission of Form DT1506 is not required if the DBE Commitment is entered in Bid Express. Form DT1202, if applicable, is no longer required to be submitted at time of bid; submit DT1202 within the 24-hour supplemental time frame following bid closing.**

The DBE Office will not certify Good Faith Effort and the Bureau of Project Development will consider the bid nonresponsive if the contractor fails to furnish the DBE Commitment (digitally entered into the bid OR Form DT1506 as an attachment), Attachments A, and Form DT1202 if applicable, as required. See sample forms in the Appendix.

b. Verification of DBE Commitment

The documentation related to DBE subcontract commitment submitted prior to contract award is evaluated as follows:

(1) DBE Goal Met

If the bidder indicates that the contract DBE goal is met, the Department will evaluate the DBE Commitment submitted with bid OR Form DT1506, and Attachments A to verify the actual DBE percentage calculation. If the DBE Commitment is verified, the contract is eligible for award with respect to the DBE Commitment.

(2) DBE Goal Not Met

- a) If the bidder indicates a bid percentage on the DBE Commitment that does not meet the assigned DBE contract goal, the bidder must request alternative evaluation of good faith effort through submission of Form DT1202 (Documentation of Good Faith Effort) within 24-hours of bid including narrative description. Supplementary documentation of good faith effort that supports the DT1202 submission is also due within 24-hours of bid submission and prior to bid posting. The Department will review the bidder's DBE Commitment and evaluate the bidder's good faith efforts submission.
- b) Following evaluation of the bidder's Good Faith Effort documentation the bidder will be notified that the Department intends to:
 1. *Approve* the request (adequate documentation of GFE has been submitted) - no conditions placed on the contract with respect to the DBE Commitment;
 2. *Deny* the request (inadequate documentation of GFE has been submitted) - the contract is viewed as non-responsive per Wisconsin Standard Specifications for Highway and Structure Construction and will not be executed.

- c) If the Department denies the bidder's request, the contract is ineligible for award. The Department will provide a written explanation for denying the request to the bidder. The bidder may appeal the Department's denial (see Section 4).

Supplemental good faith effort documentation must be submitted through eSubmit.

3. Department's Criteria for Good Faith Effort Documentation

The Federal-aid Construction Contract Provision, referenced as FHWA-1273, explicitly states that the prime contractor shall be responsible for all work performed on the contract by piecework, station work, or subcontract.

The contractor shall take all necessary and reasonable steps to ensure nondiscrimination in the administration of the contract including assurances of equal employment opportunity laws, DBE regulations, and affirmative action. Compliance encompasses responsible and responsive action, documentation, and good faith effort.

Contractually, all contractors, subcontractors, and service providers on the contract are bound by FHWA 1273 and DBE program provisions. **Prime contractors should encourage subcontractors to utilize DBE firms whenever possible to contribute to the assigned DBE contract goal.**

Bidders are required to document good faith effort. Per 49 CFR Part 26.53, good faith effort is demonstrated in one of two ways. The bidder:

- (1) Documents that it has obtained enough DBE participation to meet the goal; OR
- (2) Documents that it made adequate good faith efforts to meet the goal, even though it did not succeed

Appendix A of 49 CFR Part 26 provides guidance concerning good faith efforts. WisDOT evaluates good faith effort on a contract basis just as each contract award is evaluated individually.

The efforts employed by the bidder should be those that WisDOT can reasonably expect a bidder to take to actively and aggressively obtain DBE participation sufficient to meet the DBE contract goal. The Department will only approve demonstration of good faith effort if the bidder documents the quality, quantity, and intensity of the variety of activities undertaken that are commensurate with expected efforts to meet the stated goal.

The Department, in conjunction with industry stakeholders, has developed the following guidance for contractor good faith effort activity. The guidance and the attached appendices provide a framework for the actions required by all parties in the processing and evaluation of bidder's total efforts to achieve the project specific DBE goal prior to the bid letting date.

a. Solicitation Guidance for Prime Contractors:

- (1) Document all efforts and decisions made toward achieving the DBE goal on the contract. The bidder should use WisDOT-approved DBE outreach tools, including the UCP DBE Directory and the Bid Express Small Business Network to foster DBE participation on all applicable contracts.
- (2) As needed, request assistance with DBE outreach and follow-up by contacting the Department's DBE Support Services Office by phone or email request at least 14 days prior to the bid letting date. Phone numbers are (414) 438-4584 and/or (608) 267-3849; Fax: (414) 438-5392; E-mail: DBE_Alert@dot.wi.gov
- (3) Participate in and document a substantive conversation with at least one DBE firm per Let, to discuss questions, concerns, and any other contract related matters that may be applicable to the DBE firm. Guidelines for this conversation are provided in Appendix A of ASP-3.
- (4) Request quotes by identifying potential items to subcontract and solicit. In their initial contacts, contractors are strongly encouraged to include a single page, detailed list of items for which they are accepting quotes, by project, within a letting. *See attached sample entitled "Sample Contractor Solicitation Letter" in Appendix B.* Prime contractors should also indicate a willingness to accept quotes in areas they are planning to perform themselves, as required by federal rules. In some cases, it might be appropriate to use DBE firms to do work in a prime contractor's area of specialization.

- i. Solicit quotes from certified DBE firms who match possible items to subcontract using all reasonable and available means. Additionally, forward copies of solicitations highlighting the work areas for which quotes are being sought to DBE_Alert@dot.wi.gov
- ii. Acceptable outreach tools include SBN (Small Business Network, see Appendix C): <https://www.bidx.com/wi/main>, postal mail, email, fax, and phone.
 - a. Contractors must ask DBE firms for a response in their solicitations. See *Sample Contractor Solicitation Letter*, Appendix B. This letter may be included as an attachment to the sub-quote request.
 - b. Solicit quotes at least 10 calendar days prior to the letting date to allow DBE firms sufficient time to respond. Prime contractors should contact DBE firms early, asking if they need help organizing their quote, assistance confirming equipment needs, or other assistance supporting their submission of a competitive quote for their services.
 - c. A follow up solicitation should take place within 5 calendar days of the letting date. Email and/or SBN are the preferred method for the solicitation.
- iii. Upon request, provide interested DBE firms with adequate information about plans, specifications, and the requirements of the contract by letter, information session, email, phone call, and/or referral.
- iv. When potential exists, the contractor should advise interested DBE firms on how to obtain bonding, line of credit, or insurance if requested.
- v. Document DBE firm's interest in quoting by taking appropriate steps to follow up initial solicitation with:
 - a. Email to all prospective DBE firms in relevant work areas
 - b. Phone call log to DBE firms who express interest via written response or call
 - c. Fax/letter confirmation
 - d. Signed copy of record of subcontractor outreach effort

b. Guidance for Evaluating DBE quotes

- (1) Quote evaluation practices required to evaluate DBE quotes:
 - i. Reasonable Price: Contractors are expected to assess reasonable price by analyzing the contract scope for DBE subcontract feasibility and comparing common line items in DBE and non-DBE subcontract quotes for the same work. Per federal regulation, reasonable price is not necessarily the lowest price. See 49 CFR Part 26, Appendix A. IV.D(2).
- (2) Documentation submitted by the prime of the following evaluation is required to evaluate DBE quotes by contractors:
 - i. Evaluation of DBE firm's ability to perform "possible items to subcontract" using legitimate reasons, including but not limited to, **a discussion** between the prime and DBE firm regarding its capabilities prior to the bid letting. If lack of capacity is the reason for not utilizing the DBE firm's quote, the prime is required to contact the DBE by phone and email regarding their ability to perform the work indicated in the UCP directory listed as their work area by NAICS code. Only the work area indicated by the NAICS code(s) listed in the UCP directory can be counted toward DBE credit. Documentation of the conversation is required.
 - a. In striving to meet an assigned DBE contract goal, contractors are expected to use DBE quotes that are responsive and reasonable. This includes DBE quotes that are not the low quote.
 - b. Additional evaluation - Evaluation of DBE quotes with tied bid items. Typically, this type of quoting represents a cost saving but is not clearly stated as a discount. Tied quotes are usually presented as an 'all or none' quote. When non-DBE subcontractors submit tied bid items in their quotes, the DBE firm's quote may not appear competitive. In such a case, the following steps are taken in comparing the relevant quotes. These are qualitative examples:

- i Compare bid items common to both quotes, noting the reasonableness in the price comparison.
- ii Review quotes from other firms for the bid items not quoted by the DBE firm to see if combining both can provide the same competitive advantage that the tied bid items offered.

See Appendix D – *Good Faith Effort Evaluation Measures* and Appendix E - *Good Faith Effort Best Practices*.

- c. Requesting Good Faith Effort Evaluation** At the time of bid- if the DBE goal is not met in full, the prime contractor must indicate they will file form DT1202- Documentation of Good Faith Effort within 24-hours of bid submission. Supplementary documentation of good faith effort that supports the DT1202 submission is also due within 24-hours of bid submission and prior to bid posting. Supporting documentation for the DT1202 is to include the following:
- (1) Solicitation Documentation: The names, addresses, email addresses, and telephone numbers of DBE firms contacted along with the dates of both initial and follow-up contact; electronic copies of all written solicitations to DBE firms. A printed copy of SBN solicitation is acceptable.
 - (2) Selected Work Items Documentation: Identify economically feasible work units to be performed by DBEs to include activities such as: list of work items to be performed; breaking up of large work items into smaller tasks or quantities; flexible time frames for performance and delivery schedules.
 - (3) Documentation of Project Information provided to interested DBEs: A description of information provided to the DBE firms regarding the plans, specifications, and estimated quantities for portions of the work to be performed by that DBE firm.
 - (4) Documentation of Negotiation with Interested DBEs: Provide sufficient evidence to demonstrate that good faith negotiations took place. Merely sending out solicitations requesting bids from DBEs does not constitute sufficient good faith efforts.
 - (5) Documentation of Sound Reasoning for Rejecting DBEs and copies of each quote received from a DBE firm and, if rejected, copies of quotes from non-DBEs for same items.
 - (6) Documentation of Assistance to Interested DBEs- Bonding, Credit, Insurance, Equipment, Supplies/Materials
 - (7) Documentation of outreach to Minority, Women, and Community Organizations and other DBE Business Development Support: Contact organizations and agencies for assistance in contacting, recruiting, and providing support to DBE subcontractors, suppliers, manufacturers, and truckers at least 14 days before bid opening. Participate in or host activities such as networking events, mentor-protégé programs, small business development workshops, and others consistent with DBE support.

If the Good Faith Effort documentation is deemed adequate, the request will be approved and the DBE office will promptly notify the Prime Contractor and Bureau of Project Development.

If the DBE Office denies the request, the Prime Contractor will receive written correspondence outlining the reasons. The Department encourages the Prime Contractor to communicate with DBE staff to clarify any questions related to meeting goals and/or contractor demonstration of good faith efforts.

If the contract is awarded, the Prime Contractor must obtain written consent from the DBE Office to change or replace any DBE firm listed on the approved DBE Commitment. No contractor, prime or subsequent tier, shall be paid for completing work assigned to a DBE subcontractor on an approved DBE Commitment unless WisDOT has granted permission for the reduction, replacement, or termination of the assigned DBE in writing. If a prime contractor or a subcontractor on any tier uses its own forces to perform work assigned to a DBE on an approved DBE Commitment, **they will not be paid for the work**. Any changes to DBE Commitment after the approval of the DBE Commitment must be reviewed and approved by the DBE Office prior to the change (see Section 9).

Additional resources for demonstrating and tracking good faith effort can be found on the “Contracting with a DBE” webpage in the [ASP-3 and Good Faith Effort Guidance](#) section.

4. Bidder's Documentation of Good Faith Effort Evaluation Request Appeal Process

A bidder can appeal the Department's decision to deny the bidder's demonstration of Good Faith Effort through Administrative Reconsideration. The bidder must provide a written justification refuting the specific reasons for denial as stated in the Department's denial notice. The bidder may meet in person with the Department if so requested. Failure to appeal within 5 business days after receiving the Department's written notice denying the request constitutes a forfeiture of the bidder's right of appeal. Receipt of appeal is confirmed by email date stamp or certified mail signed by WisDOT staff. A contract will not be executed without documentation that the DBE provisions have been fulfilled.

The Department will appoint a representative who did not participate in the original good faith effort determination, to assess the bidder's appeal. The Department will issue a written decision within 5 business days after the bidder presents all written and oral information. In that written decision, the Department will explain the basis for finding that the bidder did or did not demonstrate an adequate good faith effort to meet the contract DBE goal. The Department's decision is final.

5. Determining DBE Eligibility

Directory of DBE firms

- a. The only resource for DBE firms certified in the State of Wisconsin is the Wisconsin Unified Certification Program (UCP) DBE Directory. WisDOT maintains a current list of certified DBE firms at: <http://wisconsindot.gov/Documents/doing-bus/civil-rights/dbe/dbe-ucp-directory.xlsx>
- b. The DBE Program office is available to assist with contracting DBE firms:(608) 267-3849.
- c. DBE firms are certified based on various factors including the federal standards from the Small Business Administration that assigns a North American Industrial Classification (NAICS) Codes. DBE firms are only eligible for credit when performing work in their assigned NAICS code(s). If a DBE subcontractor performs work that is not with its assigned NAICS code, the prime contractor should contact the DBE Office to inquire about compatibility with the Business Development Program.

6. Counting DBE Participation

Assessing DBE Work

The Department will only count the DBE usage towards the contract DBE goal if the DBE firm is certified as a DBE by one of the UCP agencies. The Department only counts the value of the work a DBE actually performs towards the DBE goal. The Department assesses the DBE work as follows:

- a. The Department counts work performed by the DBE firm's own resources. The Department includes the cost of materials and supplies the DBE firm obtains for the work. The Department also includes the cost of equipment the DBE firm leases for the work. The Department will not include the cost of materials, supplies, or equipment the DBE firm purchases or leases from the prime contractor or its affiliate, with the exception of non-project specific leases the DBE has in place before the work is advertised.
- b. The Department counts fees and commissions the DBE subcontractor charges for providing bona fide professional, technical, consultant, or managerial services. The Department also counts fees and commissions the DBE charges for providing bonds or insurance. The Department will only count costs the program engineer deems reasonable based on experience or prevailing market rates.
- c. If a DBE firm subcontracts work, the Department counts the value of the work subcontracted to a DBE subcontractor.
- d. The contractor will maintain records and may be required to furnish periodic reports documenting its performance under this item.
- e. It is the Prime Contractor's responsibility to determine whether the work that is committed and/or contracted to a DBE firm can be counted for DBE credit by referencing the work type and NAICS code listed for the DBE firm on the Wisconsin UCP DBE Directory.

- f. It is the Prime Contractor's responsibility to assess the DBE firm's ability to perform the work for which it is committing/contracting the DBE to do. Note that the Department encourages the Prime Contractor to assist and develop DBE firms to become fully knowledgeable contractors to successfully perform on its contracts.
- g. The Prime Contractor will inform the DBE office via email of all DBE subcontractors added to the project following execution of the contract. The Prime Contractor may omit submission of another form DT1506, but must submit signed Attachment A forms for additional DBE firms.
- h. See Section 7 for DBE credit evaluation for Trucking and Section 8 for DBE credit evaluation for Manufacturers, Suppliers, and Brokers

Naming conventions: When emailing files, please use the following language to identify your submission- "Project #, Proposal #, Let date, Business Name, Attachment A" Email: DBE_Alert@dot.wi.gov

*Note: A sublet request is required for DBE work, regardless of subcontract tier, and also for reporting materials or supplies furnished by a DBE.

- Sublet Requests via form DT1925 or WS1925 are required for 1st Tier DBEs
- For all 2nd Tier and below notification of DBE sublet is indicated by the contractor entering them in CRCS

7. Credit Evaluation for Trucking

All bidders are expected to adhere to the Department's current trucking policy posted on the HCCI website at: <http://wisconsindot.gov/Documents/doing-bus/civil-rights/dbe/trucking-utilization-policy.pdf>

The prime contractor is responsible for ensuring that all subcontractors including trucking firms, receive Form FHWA 1273: <https://www.fhwa.dot.gov/programadmin/contracts/1273/1273.pdf>

See Section 8 for Broker credit.

8. Credit Evaluation for Manufacturers, Suppliers, Brokers

The Department will calculate the amount of DBE credit awarded to a prime using a DBE firm for the provisions of materials and supplies on a contract-by-contract basis. The Department will count the material and supplies that a DBE firm provides under the contract for DBE credit based on whether the DBE firm is a manufacturer, supplier, or broker. Generally, DBE credit is determined through evaluation of the DBE owner's role, responsibility, and contribution to the transaction. Maximum DBE credit is awarded when the DBE firm manufactures materials or supplies. DBE credit decreases when the DBE firm solely supplies materials, and minimal credit is allotted when the DBE firm's role is administrative or transactional. It is the bidder's responsibility to confirm that the DBE firm is considered a supplier or a manufacturer before listing them on Commitment to Subcontract to DBE form DT1506 or DBE Commitment submitted with the bid.

a. Manufacturers

- (1) A manufacturer is a firm that operates or maintains a factory or establishment that produces, on the premises, the materials, supplies, articles, or equipment required under the contract and of the general character described by the specifications.
- (2) If the materials or supplies are obtained from a DBE manufacturer, **100%** percent of the cost of the materials or supplies counts toward DBE goals.

b. Regular Dealers of Material and/or Supplies

- (1) A regular dealer is a firm that owns, operates, or maintains a store, warehouse, or other establishment in which the materials, supplies, articles or equipment of the general character described by the specifications

and required under the contract are bought, kept in stock, and regularly sold or leased to the public in the usual course of business.

- (2) If the materials or supplies are purchased from a DBE regular dealer, count **60%** percent of the cost of the materials or supplies toward DBE goals.
- (3) At a minimum, a regular dealer must meet the following criteria to be counted for DBE credit:
 - i. The DBE firm must be an established, regular business that engages, as its principal business and under its own name, in the purchase and sale or lease of the products in question.
 - ii. The DBE firm must both own and operate distribution equipment for the product--bulk items such as petroleum products, steel, cement, gravel, stone, or asphalt. If some of the distribution equipment is leased, the lease agreement must accompany the DBE Commitment form for evaluation of the dealer's control before the DBE office approves the DBE credit.
- (4) When DBE suppliers are contracted, additional documentation must accompany the DBE Commitment and Attachment A forms. An invoice or bill-of-sale that includes names of the bidder and the DBE supplier, along with documentation of the calculations used as the basis for the purchase agreement, subcontract, or invoice. WisDOT recognizes that the amount on the Attachment A form may be more or less than the amount on the invoice per b.(1) above.
 - i. The bidder should respond to the following questions and include with submission of form DT1506 or the DBE Commitment entered with bid:
 - a. What is the product or material?
 - b. Is this item in the prime's inventory or was the item purchased when contract was awarded?
 - c. Which contract line items were referenced to develop this quote?
 - d. What is the amount of material or product used on the project?
- (5) Supplies purchased in **bulk** from DBE firms at the beginning of the season may be credited to current contracts if submitted with appropriate documentation to the DBE office.
 - i. To ensure that the appropriate credit is assigned, follow the procedure below:
 - a. When DBE suppliers are contracted for bulk supply or commodity purchases, an invoice or bill-of-sale that includes names of the contractor and the DBE supplier should be submitted to the DBE Office via eSubmit (preferred during letting) or the DBE_Alert email box. The supply/commodity credit may be applied during the federal fiscal year (October- September) in which the purchase was made.
 - b. When the contractor intends to apply the credit to a particular project, submit a copy of the original invoice, documentation of the calculations for supplies/commodities to be used on the project, and an Attachment A. Indicate on the Attachment A:
 - c. This supply/commodity is in the prime's inventory or pre-paid in case of commodities
 - d. The full value of the original invoice submitted to the DBE Office, above in (1)
 - e. The amount of material or product used on this project
 - f. Fuel estimate listed on Attachment A will be recorded as a deduction from the full fuel purchase amount shown on the invoice
 - ii. DBE Office Process (Applies only to bulk purchases)
 - a. Supply/Commodity commitment is received
 - b. Engineer verifies amount listed on invoice and enters the full amount into spreadsheet
 - c. The amount of credit applied for each project is updated on the spreadsheet until the bulk purchase is exhausted
 - d. Engineer informs contractor when full amount of bulk purchase has been applied

c. Brokers, Transaction Expeditors, Packagers, Manufacturers' Representatives

- (1) No portion of the cost of the materials, supplies, services themselves will count for DBE credit. However, WisDOT will evaluate the fees or commissions charged when a prime purchases materials, supplies, or services from a DBE certified firm which is neither a manufacturer nor a regular dealer, namely: brokers, packagers, manufacturers' representatives, or other persons who arrange or expedite transactions.
- (2) Brokerage fees are calculated as **10%** of the purchase amount.
- (3) WisDOT may count the amount of fees or commissions charged for assistance in the procurement of the materials and supplies, fees, or transportation charges for the delivery of materials or supplies required on a job site.
- (4) Evaluation of DBE credit includes review of the contract need for the item/service, the sub-contract or invoice for the item/service, and a comparison of the fees customarily allowed for similar services to determine whether they are reasonable.

9. DBE Commitment Modification Policy (Formerly "DBE Replacement Policy")**a. Issuing a Contract Change Order**

Any changes or modifications to the contract once executed are considered contract modifications and as such require a change order. In addition, the DBE office must provide consent for reduction, termination, or replacement of subcontractors approved on the DBE Commitment *in advance* of the modification for the prime contractor to receive payment for work or supplies. Additions to the DBE Commitment do not require advance notification of the DBE office. (see below e. DBE Utilization beyond the approved DBE Commitment)

b. Contractor Considerations

- (1) A prime contractor cannot modify the DBE Commitment through reduction in participation, termination, or replacement of a DBE subcontractor listed on the approved DBE Commitment without prior written consent from the DBE Office. This includes, but is not limited to, instances in which a prime contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm.
- (2) If a prime contractor reduces participation, replaces, or terminates a DBE subcontractor who has been approved for DBE credit toward its contract, the prime is required to provide documentation supporting its inability to fulfill the contractual commitment made to the Department regarding the DBE utilization.
- (3) The Prime Contractor is required to demonstrate efforts to find another DBE subcontractor to perform at least the same amount of work under the contract as the DBE subcontractor that was terminated, to the extent needed to meet the assigned DBE contract goal. When additional opportunity is available by contract modifications, the Prime Contractor must utilize DBE subcontractors that were committed to equal work items, in the original contract.
- (4) In circumstances when a DBE subcontractor fails to complete its work on the contract for any reason, or is terminated from a contract, the Prime Contractor must undertake efforts to maintain its commitment to the assigned DBE goal.
- (5) The DBE subcontractor should communicate with the Prime Contractor regarding its schedule and capacity in the context of the contract. If the DBE firm anticipates that it cannot fulfill its subcontract, they will advise the Prime Contractor and suggest a DBE subcontractor that may replace their services and provide written consent to be released from its subcontract.
 - i. Before the Prime Contractor can request modification to the approved DBE Commitment, the Prime Contractor must:
 - a. Make every effort to fulfill the DBE Commitment by working with the listed DBE subcontractor to ensure that the firm is fully knowledgeable of the Prime Contractor's expectations for successful performance on the contract. Document these efforts in writing.

- b. If those efforts fail, provide written notice to the DBE subcontractor of the Prime Contractor's intent to request to modify the Commitment through reduction in participation, termination, and/or replacement of the subcontractor including the reason(s) for pursuing this action.
- c. Copy the DBE Office on all correspondence related to changing a DBE subcontractor who has been approved for DBE credit on a contract, including preparation and coordination efforts.
- d. Clearly state the amount of time the DBE firm has to remedy and/or respond to the notice of intent to replace/terminate. The DBE must be allowed five days from the date notice was received as indicated by email time stamp or signed certified mail, to respond, in writing. EXCEPTION: The Prime Contractor must provide a verifiable reason for a response period shorter than five days. For example, a WisDOT project engineer or project manager confirms that WisDOT has eliminated an item the DBE subcontractor was contracted for.
- e. The DBE subcontractor must acknowledge the contract modification with written response to the Prime Contractor and the DBE Office. If objecting to the subcontract modification, the DBE subcontractor must outline the basis for objection to the proposed modification, providing sound reasoning for WisDOT to reject the prime's request.

c. Request to Modify DBE Subcontracting Commitment

The written request referenced above may be delivered by email or fax. The request must contain the following:

- (1) Project ID number
- (2) WisDOT Contract Project Engineer's name and contact information
- (3) DBE subcontractor name and work type and/or NAICS code
- (4) Contract's progress schedule
- (5) Reason(s) for requesting that the DBE subcontractor be replaced or terminated
- (6) Attach/include all communication with the DBE subcontractor to deploy/address/resolve work completion

Naming conventions: When emailing files, please use the following language to identify your submission- "Project #, Proposal #, Let date, Business Name, MODIFICATION" Email: DBE_Alert@dot.wi.gov + Project Engineer

WisDOT will review the request and any supporting documentation submitted to evaluate if the circumstance and the reasons constitute good cause for replacing or terminating the approved DBE subcontractor.

Good Causes to Replace a DBE subcontractor according to the federal DBE program guidelines {49 CFR part 26.53}

- The listed DBE subcontractor fails or refuses to execute a written contract
- The listed DBE subcontractor fails or refuses to perform the work of its subcontract in a way consistent with normal industry standards. Provided, however, that good cause does not exist if the failure or refusal of the DBE subcontractor to perform its work on the subcontract results from the bad faith or discriminatory action of the prime contractor
- The listed DBE subcontractor fails or refuses to meet the prime contractor's reasonable, nondiscriminatory bond requirements
- The listed DBE subcontractor becomes bankrupt, insolvent, or exhibits credit unworthiness
- The listed DBE subcontractor is ineligible to work on public works projects because of suspension and debarment proceedings pursuant 2 CFR Parts 180, 215, and 1,200 or applicable state law
- The prime has determined that the listed DBE subcontractor is not a responsible contractor
- The listed DBE subcontractor voluntarily withdraws from the project and provides written notice of its withdrawal
- The listed DBE subcontractor is ineligible to receive DBE credit for the type of work required

- A DBE firm owner dies or becomes disabled with the result that the listed DBE subcontractor is unable to complete its work on the contract.

d. Evaluation and Response to the Request

WisDOT's timely response to the Prime Contractor's request for modification of the approved DBE Commitment will be provided to the prime and the WisDOT project engineer via email.

If WisDOT determines that the Prime Contractor's basis for reduction in participation, replacement, or termination of the DBE subcontractor is not consistent with the good cause guidelines, the DBE office will provide a response via email within 48-hours of receipt of request from the Prime Contractor as indicated by email time stamp. The communication will include: the requirement to utilize the committed DBE, actions to support the completion of the contractual commitment, a list of available WisDOT support services, and administrative remedies, including withholding payment to the prime, that may be invoked for failure to comply with federal DBE guidelines for DBE replacement.

The WisDOT contact for all actions related to modification of the approved DBE Commitment is the DBE Program Engineer who can be reached at DBE_Alert@dot.wi.gov or (414) 335-0413.

e. DBE Utilization beyond the approved DBE Commitment

When the prime or a subcontractor increases the scope of work for an approved DBE subcontractor or adds a DBE subcontractor who was not on the approved form DT1506 or DBE Commitment submitted with bid at any time after contract execution, this is referred to as voluntary DBE contract goal achievement. The contractor must follow these steps to ensure that the participation is accurately credited toward the DBE goal:

- (1) Forward a complete, signed Attachment A form to the DBE Office. A complete Attachment A includes DBE subcontractor contact information, signatures, subcontract value, and description of the work areas to be performed by the DBE. The DBE Office will verify the DBE participation and revise the DBE Commitment based on the email/discussion and the new Attachment A.
- (2) When adding to an existing DBE Commitment, submit a new Attachment A to the DBE Alert mailbox
- (3) OR Submit a final Attachment A to DBE Alert during the Finals Process when Compliance receives notice of "Substantially Complete"

Naming conventions: When emailing files, please use the following language to identify your submission- "Project #, Proposal #, Let date, Business Name, New Attachment A" Email: DBE_Alert@dot.wi.gov

Special note on trucking

- DBE truckers added to the sublets in CRCS *will* be approved without DBE credit (You will see a "N" in CRCS instead of "Y")
- Prime Contractors may enter a "place holder" e.g. \$1000.00, for DBE Trucking in CRCS if the full amount of trucking is unknown for sublet purposes only
- The hiring contractor may obtain the Attachment A with DBE signature included but the **Prime Contractor** must sign the Attachment A before submitting
- DBE truckers need to be added to the DBE commitment once. If the DBE trucker is on the initial commitment (DT1506/E1506) there is no requirement to submit another Attachment A for that trucker for that contract.

10. Commercially Useful Function

- a. Commercially Useful Function (CUF) is evaluated after the contract has been executed, while the DBE certified firm is performing contracted work items.
- b. The Department uses Form DT1011, DBE Commercially Useful Function Review and Certification to evaluate if the DBE is performing a commercially useful function. WisDOT counts expenditures of a DBE toward the DBE goal only if the DBE is performing a commercially useful function on that contract.

- c. A DBE firm is performing a commercially useful function if the following conditions are met:
 - (1) For contract work, the DBE is responsible for executing a distinct portion of the work and is carrying out its responsibilities by actually performing, managing, and supervising that work.
 - (2) For materials and supplies, the DBE is responsible for negotiating price, determining quality and quantity, ordering, and paying for those materials and supplies.
- d. Offsite Hauling – when DBE truck will haul between a pit and plant or location other than the construction site associated with the commitment
 - (1) Indicate Offsite Hauling on Attachment A
 - (2) Discuss offsite hauling at weekly progress meetings with Project Engineer (PE)
 - (3) PE conducts spot checks of pits/plants to verify DBE truck is hauling and/or verifying hauling log
 - (4) Prime should be prepared to submit haul tickets, plant/pit tickets, timecards, and other pertinent documentation if requested by PE or DBE Office

11. Credit Evaluation for DBE Primes

WisDOT calculates DBE credit based on the amount and type of work performed by DBE certified firms for work submitted with required documentation. If the prime contractor is a DBE certified firm, the Department will only count the work that the DBE prime performs with its own forces for DBE neutral credit. The Department will also calculate DBE credit for work performed by any other DBE certified subcontractor, DBE certified supplier, and DBE certified manufacturer on the contract in each firm's approved NAICS code/work areas that are submitted with required documentation. Crediting for manufacturers and suppliers is calculated consistent with Section 8 of this document and 49 CFR Part 26.

12. Joint Venture

A joint venture is an association of a DBE firm and one or more other firms to carry out a single, for-profit business enterprise, for which the parties combine their property, capital, efforts, skills and knowledge, and in which the DBE is responsible for a distinct, clearly defined portion of the work of the contract and whose share in the capital contribution, control, management, risks, and profits of the joint venture are commensurate with its ownership interest. If a DBE performs as a participant in a joint venture, the Department will only credit the portion of the total dollar value of the contract equal to the portion of the work that the DBE performs with its own forces.

13. Mentor-Protégé

- a. If a DBE performs as a participant in a mentor-protégé agreement, the Department will credit the portion of the work performed by the DBE protégé firm.
- b. DBE credit is evaluated and confirmed by the DBE Office for any contracts on which the mentor-protégé team identifies itself to the DBE Office as a current participant of the Mentor-Protégé Program.
 - (1) DBE credit may only be awarded to a non-DBE mentor firm for using its own protégé firm for less than one half of its goal on any contract; and
 - (2) Not award DBE credit to a non-DBE mentor firm for using its own protégé firm for more than every other contract performed by the protégé firm.
- c. A DBE protégé firm may be eligible for conditional NAICS code extension for training with the mentor. Request permission from the DBE Office- Certification area.
- d. Refer to WisDOT's Mentor-Protégé guidelines for guidance on the number of contracts and amount of DBE credit allowed on WisDOT projects.

14. Use of Joint Checks

The use of joint checks is allowable if it is a commonly recognized business practice in the material industry. A joint check is defined as a two-party check between a DBE subcontractor, a prime contractor, and the regular dealer or materials supplier who is neither the prime nor an affiliate of the prime. Typically, the prime contractor issues one check as payor to the DBE subcontractor and to the supplier jointly (to guarantee payment to the supplier) as payment for the material/supplies used by the DBE firm in cases where the DBE subcontractor and materials have been approved for DBE credit. The DBE subcontractor gains the opportunity to establish a direct contracting relationship with the supplier to potentially facilitate a business rapport that results in a line of credit or increased partnering opportunities.

The cost of material and supplies purchased by the DBE firm is part of the value of work performed by the DBE to be counted toward the goal. To receive credit, the DBE firm must be responsible for negotiating price, determining quality and quantity, ordering the materials, and installing (where applicable) and "paying for the material itself." See 49 CFR 26.55(c)(1).

The approval to use joint checks constitutes a commitment to provide further information to WisDOT, upon request by staff. WisDOT will allow the use of joint checks when the following conditions are met:

- a. The Prime Contractor must request permission to use joint checks from the DBE Office by submitting the Application to Use Joint Checks.
 - (1) Request should be made when the DBE Commitment or the Request to Sublet is submitted; the request will not be considered if submitted after the DBE Subcontractor starts its work.
 - (2) Approval/Permission must be granted prior to the issuance of any joint checks.
 - (3) The payment schedule for the supplier must be presented to the DBE office before the first check is issued.
 - (4) The joint check for supplies must be strictly for the cost of approved supplies.
- b. The DBE subcontractor is responsible for furnishing and/or installing the material/work item and is not an 'extra participant' in the transaction. The DBE firm's role in the transaction cannot be limited solely to signing the check(s) to release payment to the material supplier. At a minimum, the DBE subcontractor's tasks should include the following:
 - (1) The DBE subcontractor (not the prime/payor) negotiates the quantities, price, and delivery of materials.
 - (2) The DBE subcontractor consents to sign/release the check to the supplier by signing the [Application to Use Joint Checks](#) after establishing the conditions and documentation of payment within the subcontract terms or in a separate written document.
- c. The Prime contractor/payor acts solely as a guarantor.
 - (1) The Prime Contractor agrees to furnish the check used for the payment of materials/supplies under the contract.
 - (2) The prime contractor/payor cannot require the subcontractor to use a specific supplier or the prime contractor's negotiated unit price.

15. Payment

Costs for conforming to this Additional Special Provision (ASP) and any associated DBE requirements are incidental to the contract.

Appendix A

Substantive Conversation Guidelines

The substantive conversation is critical to all bidders' demonstration of good faith effort to meet the DBE goal prior to bid opening. Relationship building between primes and subcontractors is crucial to DBE goal attainment. Responsible bidders seek to build rapport with potential DBE subcontractors to understand capacity, areas of expertise, and assess contracting feasibility. Bidders who compete for WisDOT contracts are specialty contractors responding to a growing and changing contract environment. Just as these specialists are responsible for care of the roads, they are likewise responsible for contributing to the health of the industry. The substantive conversation drives collaboration that will build industry health and capacity. The following is intended to provide guidance for such discussions but is not an exhaustive list. Contractors are encouraged to incorporate their existing strategies for cultivating business relationships as well.

Prior to Bid Opening- this discussion should happen as early as possible (WisDOT advertisements are released weeks prior to each Let)

1. Determine DBE subcontractor's interest in quoting
2. If response indicates inexperience with quoting- offer support/assistance to the DBE in understanding the industry including fundamentals a subcontractor needs to know, required reading and/or resources.
3. Assess their interest and experience in the road construction industry by asking questions such as:
 - Have you competed for other WisDOT contracts? Ratio of competed/to wins
 - Have you performed on any transportation industry contracts (locally or with other states)?
 - What the largest contract you've completed?
 - Have you worked in the industry: apprentice, journeyman, safety, inspection etc.?
 - Does this project fit into your schedule? Are you working on any contracts now?
 - Have you reviewed a copy of the plans? Are you comfortable performing within the scope and quantity considerations of this contract?
 - What region do you work in? Home base?
 - Which line items are you considering?
 - Have you read/are you familiar with WisDOT Standard Specifications? Construction Material Manual?
 - Do you understand where your work fits in the project schedule, project phases?

Following Bid Opening- this discussion can happen at any time

1. After reviewing their quote, note the following in your discussion:
 - Does the quote look complete? Irregular?
 - Are there errors in the quote? Are items very high or very low?
 - In general, does the quote look competitive?
2. Questions and Advice for the bidder to share with the potential DBE subcontractor:
 - What line items would typically be in a competitive quote for a subcontractor of their specialty?
 - How many employees and what is their role/experience/expertise in your firm?
 - Do you have resources for labor (union member, family-based, community-resourced) and capital (banking relationship, bond agent, CPA)?
 - Where have you worked: cities, states, government, commercial, residential/private sector, etc. Explain similarities or differences.
 - Refer them to reliable, trusted, industry resources that can educate or connect them to relevant resources, education/certification resources, more appropriate contract opportunities.
 - Discussion about prime contract and subcontract liability, critical path items, contract quantities, schedule risks, and potential profit/loss (for upcoming known projects or in general).
 - Discussion of bonding, insurance, and overall business risk considerations.

Appendix B

Sample Contractor Solicitation Letter Page 1

(This sample is provided as a guide, not a formatting requirement)

DBE Solicitation - [Month] [Day], [Year] WisDOT Bid Letting

Attention all DBEs. [Prime Contractor] is actively seeking your quote for the [Month][Day], [Year] Bid Letting. [Prime Contractor] is considering bidding on the projects listed on page 2 as a prime contractor. Please see page 2 for instructions and the sub-contractable opportunities for each proposal.

Does [Prime Contractor] accept quotes in areas we might self-perform? Yes, we do! We support this federal rule and (if needed) we consider areas we might self-perform an opportunity to provide in the field assistance and training if we award your quote.

Where can DBEs find the plans, specifications & addenda? Please visit [Prime Contractor's] plan room [LINK] or on WisDOT's Highway Construction Contract Information HCCI website: [Wisconsin Department of Transportation Highway Construction Contract Information \(wisconsindot.gov\)](https://wisconsindot.gov/HighwayConstructionContractInformation). This same website can be checked for the contract status.

What should your quote include? All the costs required to complete the items you propose to perform including labor, equipment, material, and related bonding or insurance. The quote should also note items that you are DBE certified to perform, tied items, and any special terms. Please use page 2 as your cover sheet for your quote.

Do you have a question regarding bonding, credit, insurance, equipment, or supplies/materials? We welcome all DBE questions! Please call [Prime Contractor] and ask to speak with [Contact]. [Prime Contractor] can provide basic information as well as a referral to a trusted industry partner for insurance and bonding needs.

When are quotes due?

[Month] [Day], [Year] at [Time]. We accept quotes via SBN, email, or fax. Please make every effort to have your quotes in by this time or earlier. Quality check your quote so it includes the correct letting date, project ID, proposal number, unit price and extension.

Who can DBEs contact for questions, information, clarification or for a quote evaluation? [Project Manager Name] [Phone] [Email]. If you are quoting [Prime Contractor] for the first time, we encourage you to come meet with us in person to discuss the project. Our office hours are 7:30 a.m. – 5:00 p.m. On bid day, we are in the office by 6:30 a.m.

Why partner with [Prime Contractor]?

DBE partnership is a core part of [Prime Contractor's] mission. Including DBEs at the beginning of each project is essential in the success of each project. We consider DBEs to be important industry partners who bring dedication and knowledge at various stages during construction. We are proud to be an industry leader with our DBE partnership. Your success as a DBE is our success.

Sample Contractor Solicitation Letter Page 2*(This sample is provided as a guide, not a formatting requirement)***REQUEST FOR QUOTE****[Prime Contractor]****Letting Date: [Month] [Day], [Year]****Project IDs: 1234-56-00 (Proposal #1) & 1234-01-78 (Proposal #6)**

Please check all that apply:

- ☐ Yes, we will be quoting the projects & items listed below
- ☐ No, we are not interested in quoting on the letting or its items referenced below
- ☐ Please take our name off your monthly DBE contact list
- ☐ We have questions about quoting this letting. Please have someone contact me at this number:

Prime Contractor Contact: _____

DBE: _____

Phone: _____

Fax: _____

Email: _____

Please circle the proposals and items you will be quoting below and contact us with any questions

Proposal	1	6
County	Dane County	Crawford County
Clearing & Grubbing	X	X
Dump Truck Hauling	X	X
Curb/Gutter/Sidewalk	X	
Erosion Control Items		X
Excavation	X	X
Pavement Marking		X
Traffic Control	X	
Sawing	X	X
QMP, Base		X
Pipe Underdrain	X	
Landscape		X
Beam Guard	X	
Electrical	X	
Signs/Posts/Markers		X
Survey/Staking		X

Again, please make every effort to have your quotes into our office by **time deadline** prior to the letting date.

Sample Contractor Solicitation Email - Simplified

(This sample is provided as a guide, not a formatting requirement)

ATTENTION DBEs

- [Prime Contractor] specializes in municipal projects in the XX Region(s)
- We have successfully competed for and completed XX WisDOT projects over the past XX years
- Consider [Prime Contractor] your partner on WisDOT Projects

[Prime Contractor] is seeking your subcontractor quote for the XX/XX/20XX WisDOT bid letting on the below projects:

Project	Proposal	County	Region
1234-56-00	2	Dane	SW
1234-01-78	6	Crawford	SW

- Please review the attachments **[attach Solicitation Letter]** and respond with your intent to quote (or not) along with the work items you are interested in performing and respond via fax or email by date. The quote should note items that you are DBE certified to perform, tied items, and any special terms. Please include labor, equipment, material, and related bonding or insurance.
- If you have any questions regarding bonding, credit, insurance, equipment and/or materials/supplies, please feel free to call [Prime Contractor] and ask for [Contact]. **(Include if your company is willing to answer these types of DBE questions)**
- Plans and Specifications can be found: **WisDOT HCCI Website: List webpage where plans are located**
- If you do choose to quote, please make every effort to have your quote into our office by time and date. Make sure the correct letting date, project number, unit price and extension are included in your quote.
- Should you have questions regarding the mentioned project, please call our office at (414) 555-5555 and we will direct you to the correct estimator/project manager.
Our office hours are 7:30 a.m. - 5:00 p.m.

Thank you – we look forward to working with your company on this project!

Prime Contractor
Project Manager

Direct: 414-555-5555

Cell: 414-555-5556

Sample Contractor Solicitation Email to **non-DBE** WisDOT Subcontractors - Simplified

(This sample is provided as a guide, not a formatting requirement)

ATTENTION WisDOT SUBCONTRACTORS

[Prime Contractor] is considering bidding on the below projects for the XX/XX/20XX WisDOT Bid Letting:

Project	Proposal	County	Region	DBE Goal
1234-56-00	2	Dodge	SW	6.00%
1234-01-78	11	Adams	NC	3.00%
1234-00-99	20	Buffalo	NW	5.00%
1234-00-98	33	Portage	NC	6.00%

The above projects have DBE goals and [Prime Contractor] is committed to DBE inclusion with every project. As such, we are requesting:

- All WisDOT Subcontractors to **solicit and utilize** DBEs in your quotes.
- DBE participation can be achieved through purchasing materials from DBE suppliers, using DBE subcontractors and/or DBE trucking firms or any combination of these.
- If there is an opportunity to untie an item in your quote so a DBE can be utilized, please look for those opportunities as well.
- Your quote will be evaluated based on the amount of DBE participation your company is able to provide when compared to other quotes for the same work.

If you do choose to quote, please make every effort to have your quote into our office by **time and date**. Please submit all quotes to [Email]. Make sure the correct letting date, project number, unit price and extension are included in your quote.

Should you have questions regarding the mentioned project, the Project Manager contact is: [Name] [Phone Number] [Email]

Thank you for utilizing DBEs who are trusted industry partners with WisDOT projects.

Prime Contractor
Project Manager

Direct: 414-555-5555
Cell: 414-555-5556

Appendix C

Small Business Network (SBN) Overview

The Small Business Network is a part of the Bid Express® service that was created to ensure that prime bidders have a centralized online location to find subs - including small and disadvantaged business enterprises (DBEs). It is available for prime bidders to use as part of their Basic Service subscription. Within the Small Business Network, **Prime Contractors** can:

1. Easily select proposals, work types and items:
 - a. After adding applicable work types, select items that you wish to quote. Enter the sub-quote quantities and add comments, if desired. Adding or removing items and work types can be done quickly. If needed, you can save the sub-quote for later completion.
2. Create sub-quotes for the subcontracting community:
 - a. Create sub-quotes with ease using the intuitive sub-quote creator. In seven short steps, you can rapidly create a custom sub-quote directed to all subcontractors that bid on the applicable work types. Steps include: provide contact information and sub-quote expiration date, select letting and proposal, add work types and items, specify terms and conditions, upload attachments, and select vendors.
 - b. Create a sub-quote to send to subcontractors or suppliers that lists the items in a proposal that you want quoted
 - c. Create an unlimited number of sub-quotes for items you want quoted, and optionally mark them as a DBE preferred request.
 - d. Add attachments to sub-quotes.
3. View sub-quote requests & responses:
 - a. After logging into the Bid Express service, you can quickly review all of your sub-quote requests and all unsolicited sub-quote requests from subcontractors. To simplify the Small Business Network home screen, sub-quote requests can be hidden with one click if they are not applicable.
 - b. View or receive unsolicited sub-quotes that subcontractors have posted, complete with terms, conditions and pricing.
4. View Record of Subcontractor Outreach Effort:
 - a. For each sub-quote produced, a *Record of Subcontractor Outreach Effort* is generated that shows the response statistics for a particular sub-quote. If accepted by the letting agency, this report may serve as proof of a "Good Faith" effort in reaching out to the DBE community.
 - b. Easily locate pre-qualified and certified small and disadvantaged businesses.
 - c. Advertise to small and disadvantaged businesses more efficiently and cost effectively.
 - d. Document your interactions with subs/DBEs by producing an Outreach Report (may be accepted as proof of DBE outreach at the discretion of each agency).

The Small Business Network help small businesses learn more about opportunities, compete more effectively, network with other contractors and subcontractors, and win more jobs. The DBE will provide free SBN accounts to DBEs when requested. Use DBE_Alert@dot.wi.gov to request an account. **DBE firms can:**

1. View and reply to sub-quote requests from primes:
 - a. After logging into the Bid Express service, you can quickly review all incoming sub-quote requests and all unsolicited sub-quotes created by your company. Receive notifications by selected work type. To simplify on the Small Business Network home screen, sub-quote requests can be filtered by work types relevant to your interests or hidden with one click if they are not applicable.
2. Select items when responding to sub-quote requests from primes:
 - a. You have the freedom to choose and price any number of items when responding to a sub-quote request. Quantities can be modified, and per-item comments are also available.
 - b. View requests for sub-quotes for work that primes have posted for projects they are bidding, add your pricing, terms, and conditions, and submit completed sub-quotes to the requesting primes.
 - c. Add attachments to a sub-quote.
3. Create and send unsolicited sub-quotes to specific contractors:
 - a. Create unsolicited sub-quotes with ease using the intuitive sub-quote creator. In eight short steps, you can rapidly create a custom sub-quote directed at any number of specific vendors of your choosing. Steps include: provide contact information and sub-quote expiration date, select letting and proposal, add work types and items, specify terms and conditions, upload attachments, and select vendors.
4. Easily select and price items for unsolicited sub-quotes:
 - a. After adding applicable work types, select items that you wish to quote. The extended price calculates automatically, cutting out costly calculation errors. Comments can be provided on a per-item basis as well.
 - b. Create an unsolicited sub-quote that lists the items from a proposal that you want to quote, include pricing, terms and conditions, and send it to selected prime/plan holder.
 - c. Add attachments to a sub-quote.
 - d. Add unsolicited work items to sub-quotes that you are responding to.
5. Easy Access to Valuable Information
 - a. Receive a confirmation that your sub-quote was opened by a prime.
 - b. View Bid Tab Analysis data from past bids, including the high, average and low prices of items.
 - c. View important notices and publications from DOT targeted to small and disadvantaged businesses.
6. Accessing Small Business Network for WisDOT contracting opportunities
 - a. If you are a contractor not yet subscribing to the Bid Express service, go to www.bidx.com and select "Order Bid Express." The Small Business Network is a part of the Bid Express Basic Service.

Appendix D

Good Faith Effort Evaluation Measures *by categories referenced in DBE regulations*

Bidders must demonstrate that they took all necessary and reasonable steps to achieve the assigned DBE contract goal. For each contract, all bidders must submit documentation indicating the goal has been met or if falling short of meeting the assigned goal, must request a DBE Goal Waiver and document all efforts employed to secure DBE subcontractor participation on Form DT1202.

DBE staff analyze the bidder's documented good faith efforts to determine if action taken was sufficient to meet the goal. Sufficiency is measured contract-by-contract. WisDOT evaluates active and aggressive efforts, quality, quantity, scope, intensity, and appropriateness of the bidder's efforts as a scale of the principles of Good Faith outlined in 49 CFR Part 26, Appendix A. Additional emphasis is placed on the bidder's demonstration of timely submission of documentation and communication with DBE subcontractors, and business development initiatives undertaken to support DBE firm growth.

The following is a sample of good faith effort activities that are rated according to the accompanying rubric. Contractors are encouraged to identify additional activities that align with their business type(s).

- Personal, tailored solicitation to firms that specialize in work types planned or desired for subcontracting
- Follow up to initial solicitation via email or phone
- Substantive conversation including topics such as contract liability, critical path work items, schedule risks, and potential profit/loss
- SBN utilization including posting quotes
- Review and response to DBE quotes including provision of information about plans, specifications, and requirements as applicable
- Documentation requesting subcontractors support DBE goal by solicitation and inclusion of DBE subcontractor quotes
- Responsive and timely submission of organized documentation
- Analysis of number of DBE firms who do work types that you typically subcontract
- Analysis of number of DBE firms who reside in geographical areas where prime seeks work
- Analysis of firms who express interest in bidding/quoting including the number of firms who declined your solicitation
- Reference check of DBE subcontractor work or training (documentation of questions and response required)
- Number of different efforts undertaken to meet the assigned DBE goal as documented in accompanying Form DT1202
- Submission of all DBE quotes received matched with a variety of work to be performed by DBEs
- Number and names of DBE firms provided written advice, or referral to industry-specific business development resources
- Overall pattern of DBE utilization on all WisDOT contracts which may include contracting with municipalities
- Documentation of resources expended to meet assigned DBE goal (#of hours, staff titles, average pay rate, actions taken)
- Analysis of subcontractable work items to be completed by prime beyond prime contractor's 30%
- Risk analysis of work items that are typically in tied quotes that could be unbundled
- List of contract work items in smallest economically feasible units, identifying schedule impact
- Submission of a Gap Analysis identifying DBE skillset and/or industry needs
- Staff training in EEO and Civil Rights laws as documented in training logs
- Written Capacity Assessment completed with DBE firm documenting its ability to perform the work quoted
- DBE engagement efforts beyond simple solicitation that include a substantive discussion, initiated as early in the acquisition process as possible (*points added for each day prior to letting*)
- Outreach and marketing efforts with minority, women, and veteran-focused organizations at least 10 days prior to bid opening
- Active involvement in WisDOT's Business Development Program, TrANS training, facilitated networking efforts, workshops
- Customized teaching/training efforts for future opportunities with DBE subcontractor, contract specific and/or annually
- Introduction and reference provided for DBE subcontractor to a prime who has not previously contracted with the DBE firm
- Prime utilization of a DBE subcontractor the prime has not contracted with previously
- Written referral/recommendation to bond/insurance agents, manufacturer, supplier
- Documented efforts fostering DBE participation through administrative and/or technical assistance
- Evidence of negotiation with the DBE firm about current and future Let opportunities
- Recommendation of local and state services that support small business and access to opportunity: DOA, SBA, WEDC, WPI, etc.
- Advice on bonding, lines of credit, or insurance as required to complete the items quoted and contract requirements

GFE Evaluation Rubric – Phase 1 – Initial Review

DT1202	Examples	Rating	OBOEC Feedback
Solicitation Documentation	Identify all reasonable and available activities performed to solicit the interest of all certified DBEs who have capacity and ability to perform work on the project. <i>Such as: Updated solicitation letter and email, timely solicitation, and follow-up, and/or utilized various methods to communicate solicitation (ex: letter, email, publication, posting and/or website)</i>		
Selected Work Items Documentation	All work items are broken out into economically feasible units to facilitate DBE participation. <i>Such as: Selected work items are specific to each proposal and clearly identified in all solicitation(s)</i>		
Documentation of Project Information provided to Interested DBEs	Provide interested DBEs with adequate information about the plans, specifications, and any other contractual requirements in a timely manner to assist DBEs in response to solicitation. <i>Such as: Project information is clearly identified in all solicitation(s)</i>		
Documentation of Negotiation with Interested DBEs	Provide sufficient evidence demonstrating that good faith negotiations took place during the bid letting. <i>Such as: Documented attempts with DBEs or on behalf of DBEs to increase DBE participation</i>		
Documentation of Sound Reason for Rejecting DBEs	Provide sufficient evidence demonstrating that DBEs are rejected for sound reasons. <i>Such as: Detailed and thoughtful analysis that considers both the percentage and dollar difference when rejecting a DBE including past performance, relevant business experience and stability, safety record, business ethic and integrity, technical capacity, and other tangible factors.</i>		
Documentation of Assistance to Interested DBEs- bonding, credit, insurance, equipment, supplies/materials	Documented assistance in both solicitation(s) and outreach to DBEs.		
Documentation of Outreach to Minority, Women, and Community organizations and other DBE Business Development Support	Effectively use the services of minority, women, and community organizations as well as contractors' groups, local, state, and federal business assistance offices and organization that provide assistance in recruiting and supporting DBEs, as well participation in activities that support DBE business development. <i>Such as: Variety of activities that translate into meaningful DBE participation</i>		
Documentation of other GFE activities	<i>Such as: Used DT1202 Excel Workbook, Diversity & Inclusion company policy, Mentor-Protégé participant, awarded neutral DBE after bid submission, included company GFE overview/strategy information and/or company website highlights DBE opportunities and participation</i>		
Overall Demonstration of GFE			

GFE EVALUATION RATING LEGEND – PHASE 1 – Initial Review

Documentation provided by bidder is evaluated and rated on the rubric. Bidders should include activities characterized by the following types of effort:

ACTIVE & AGGRESSIVE: Demonstrated through engaged and assertive activity

QUALITY: Demonstrated through essential character of conscientious and serious activity

QUANTITY: Demonstrated through a measurable number of activities

SCOPE & INTENSITY: Demonstrated through a rigorous approach to an appropriate and purposeful range of activities

TIMING: Demonstrated through engagement efforts beyond simple solicitation, initiated early in the process

GFE EVALUATION – PHASE 2 – Team Review**GFE Team completes:**

- Review of activities included on the rubric
- Review of the intent to award and sound reasoning submitted by Prime
- Bid analysis to confirm if any bid submitted met the DBE goal
- Review average of other bidders DBE goal achievement
- Team review of combined efforts documented in Phase 1 and 2 constitute final GFE determination

Rating Scale:

- **GFE Approval:**
Bona Fide = 6 or more categories color coded green.
Genuine effort characterized by sincere and earnest activities – “Solicitation” and “Sound Reasoning” must be green
- **GFE Approval:**
Sufficient = 5 or more categories color coded green or yellow
Adequate effort documented with a variety of quality activities – “Solicitation” and “Sound Reasoning” must be green or yellow
- **GFE Denial:**
Pro Forma efforts = 4 or less categories color coded green or yellow. Perfunctory effort characterized by routine or superficial activities

Green = Exceeds expectations

Yellow = Meets expectations

Red = Areas in need of attention and/or absence of documentation

See OBOEC Rubric Analysis Feedback

Excerpt from Appendix A to 49 CFR Part 26:

V. In determining whether a bidder has made good faith efforts, it is essential to scrutinize its documented efforts. At a minimum, you must review the performance of other bidders in meeting the contract goal. For example, when the apparent successful bidder fails to meet the contract goal, but others meet it, you may reasonably raise the question of whether, with additional efforts, the apparent successful bidder could have met the goal. If the apparent successful bidder fails to meet the goal but meets or exceeds the average DBE participation obtained by other bidders, you may view this, in conjunction with other factors, as evidence of the apparent successful bidder having made good faith efforts. As provided in §26.53(b)(2)(vi), you must also require the contractor to submit copies of each DBE and non-DBE subcontractor quote submitted to the bidder when a non-DBE subcontractor was selected over a DBE for work on the contract to review whether DBE prices were substantially higher; and contact the DBEs listed

GFE RUBRIC ANALYSIS	
OBOEC DECISION	APPROVAL OR DENIAL
Prime Contractor	
Proposal	
Project	
Bid Letting	
DBE Goal Amount	
DBE Goal Amount Achieved	
Bid Analysis	
Goal %	Achieved %
Apparent Low Bidder	%
Bidder B	
Bidder C	
Average of OTHER Bidders (Not including Apparent Low Bidder)	
DBE Quotes Received	
DBE Quotes Awarded	
DBE Quote(s) Rejected	Rejected Quote Analysis
DBE Quote(s) Awarded	Awarded DBE Amount

Appendix E

Good Faith Effort Best Practices

This list is not a set of requirements; it is a list of potential strategies

Primes

- Prime contractor open houses inviting DBE firms to see the bid “war room” or providing technical assistance.
- Participate in speed networking and mosaic exercises as arranged by DBE office.
- Host information sessions not directly associated with a bid letting.
- Participate in a formal mentor protégé or joint venture with a DBE firm.
- Participate in WisDOT advisory committees i.e. TRANSAC, or Mega Project committee meetings.
- Facilitate a small group DBE ‘training session’ clarifying how your firm prepares for bid letting, evaluates subcontractors, preferred qualifications, and communication methods.
- Encourage subcontractors to solicit and highlight DBE participation in their quotes to you.
- Quality of communication, not quantity creates the best results. Contractors should be thorough in communicating with DBE firms before the bid and provide any assistance requested to assure best possible bid.

DBE

- DBE firms should contact primes as soon as possible with questions regarding their quotes or bid; seven days prior is optimal.
- Continually check for contract addendums on the HCCI website through the Thursday prior to letting to stay abreast of changes.
- Review the status of contracts on the HCCI website reviewing the ‘apparent low bidder’ list and bid tabs at a minimum.
- Prepare a portfolio or list of related projects and prime and supplier references; be sure to note transportation related projects of similar size and scope, firm expertise and staffing.
- Participate in DBE office assessment programs.
- Participate on advisory and mega-project committees.
- Sign up to receive the DBE Contracting Update.
- Consider membership in relevant industry or contractor organizations.
- Active participation is a must. Quote as many projects as you can reasonably work on; quoting the primes and bidding as a prime with the Department are the only ways to get work.

Appendix F

Good Faith Effort Evaluation Guidance

Appendix A of 49 CFR Part 26

I. When, as a recipient, you establish a contract goal on a DOT-assisted contract for procuring construction, equipment, services, or any other purpose, a bidder must, in order to be responsible and/or responsive, make sufficient good faith efforts to meet the goal. The bidder can meet this requirement in either of two ways. First, the bidder can meet the goal, documenting commitments for participation by DBE firms sufficient for this purpose. Second, even if it doesn't meet the goal, the bidder can document adequate good faith efforts. This means that the bidder must show that it took all necessary and reasonable steps to achieve a DBE goal or other requirement of this part which, by their scope, intensity, and appropriateness to the objective, could reasonably be expected to obtain sufficient DBE participation, even if they were not fully successful.

II. In any situation in which you have established a contract goal, Part 26 requires you to use the good faith efforts mechanism of this part. As a recipient, you have the responsibility to make a fair and reasonable judgment whether a bidder that did not meet the goal made adequate good faith efforts. It is important for you to consider the quality, quantity, and intensity of the different kinds of efforts that the bidder has made, based on the regulations and the guidance in this Appendix.

The efforts employed by the bidder should be those that one could reasonably expect a bidder to take if the bidder were actively and aggressively trying to obtain DBE participation sufficient to meet the DBE contract goal. Mere pro forma efforts are not good faith efforts to meet the DBE contract requirements. We emphasize, however, that your determination concerning the sufficiency of the firm's good faith efforts is a judgment call. Determinations should not be made using quantitative formulas.

III. The Department also strongly cautions you against requiring that a bidder meet a contract goal (i.e., obtain a specified amount of DBE participation) in order to be awarded a contract, even though the bidder makes an adequate good faith efforts showing. This rule specifically prohibits you from ignoring bona fide good faith efforts.

IV. The following is a list of types of actions which you should consider as part of the bidder's good faith efforts to obtain DBE participation. It is not intended to be a mandatory checklist, nor is it intended to be exclusive or exhaustive. Other factors or types of efforts may be relevant in appropriate cases.

A. (1) Conducting market research to identify small business contractors and suppliers and soliciting through all reasonable and available means the interest of all certified DBEs that have the capability to perform the work of the contract. This may include attendance at pre-bid and business matchmaking meetings and events, advertising and/or written notices, posting of Notices of Sources Sought and/or Requests for Proposals, written notices or emails to all DBEs listed in the State's directory of transportation firms that specialize in the areas of work desired (as noted in the DBE directory) and which are located in the area or surrounding areas of the project.

(2) The bidder should solicit this interest as early in the acquisition process as practicable to allow the DBEs to respond to the solicitation and submit a timely offer for the subcontract. The bidder should determine with certainty if the DBEs are interested by taking appropriate steps to follow up initial solicitations.

B. Selecting portions of the work to be performed by DBEs in order to increase the likelihood that the DBE goals will be achieved. This includes, where appropriate, breaking out contract work items into economically feasible units (for example, smaller tasks or quantities) to facilitate DBE participation, even when the prime contractor might otherwise prefer to perform these work items with its own forces. This may include, where possible, establishing flexible timeframes for performance and delivery schedules in a manner that encourages and facilitates DBE participation.

C. Providing interested DBEs with adequate information about the plans, specifications, and requirements of the contract in a timely manner to assist them in responding to a solicitation with their offer for the subcontract.

D. (1) Negotiating in good faith with interested DBEs. It is the bidder's responsibility to make a portion of the work available to DBE subcontractors and suppliers and to select those portions of the work or material needs consistent with the available DBE subcontractors and suppliers, so as to facilitate DBE participation. Evidence of such negotiation includes the names, addresses, and telephone numbers of DBEs that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting; and evidence as to why additional Agreements could not be reached for DBEs to perform the work.

(2) A bidder using good business judgment would consider a number of factors in negotiating with subcontractors, including DBE subcontractors, and would take a firm's price and capabilities as well as contract goals into consideration. However, the fact that there may be some additional costs involved in finding and using DBEs is not in itself sufficient reason for a bidder's failure to meet the contract DBE goal, as long as such costs are reasonable. Also, the ability or desire of a prime contractor to perform the work of a contract with its own organization does not relieve the bidder of the responsibility to make good faith efforts. Prime contractors are not, however, required to accept higher quotes from DBEs if the price difference is excessive or unreasonable.

E. (1) Not rejecting DBEs as being unqualified without sound reasons based on a thorough investigation of their capabilities. The contractor's standing within its industry, membership in specific groups, organizations, or associations and political or social affiliations (for example union vs. non-union status) are not legitimate causes for the rejection or non-solicitation of bids in the contractor's efforts to meet the project goal. Another practice considered an insufficient good faith effort is the rejection of the DBE because its quotation for the work was not the lowest received. However, nothing in this paragraph shall be construed to require the bidder or prime contractor to accept unreasonable quotes in order to satisfy contract goals.

(2) A prime contractor's inability to find a replacement DBE at the original price is not alone sufficient to support a finding that good faith efforts have been made to replace the original DBE. The fact that the contractor has the ability and/or desire to perform the contract work with its own forces does not relieve the contractor of the obligation to make good faith efforts to find a replacement DBE, and it is not a sound basis for rejecting a prospective replacement DBE's reasonable quote.

F. Making efforts to assist interested DBEs in obtaining bonding, lines of credit, or insurance as required by the recipient or contractor.

G. Making efforts to assist interested DBEs in obtaining necessary equipment, supplies, materials, or related assistance or services.

H. Effectively using the services of available minority/women community organizations; minority/women contractors' groups; local, State, and Federal minority/women business assistance offices; and other organizations as allowed on a case-by-case basis to provide assistance in the recruitment and placement of DBEs.

V. In determining whether a bidder has made good faith efforts, it is essential to scrutinize its documented efforts. At a minimum, you must review the performance of other bidders in meeting the contract goal. For example, when the apparent successful bidder fails to meet the contract goal, but others meet it, you may reasonably raise the question of whether, with additional efforts, the apparent successful bidder could have met the goal. If the apparent successful bidder fails to meet the goal, but meets or exceeds the average DBE participation obtained by other bidders, you may view this, in conjunction with other factors, as evidence of the apparent successful bidder having made good faith efforts. As provided in §26.53(b)(2)(vi), you must also require the contractor to submit copies of each DBE and non-DBE subcontractor quote submitted to the bidder when a non-DBE subcontractor was selected over a DBE for work on the contract to review whether DBE prices were substantially higher; and contact the DBEs listed on a contractor's solicitation to inquire as to whether they were contacted by the prime. Pro forma mailings to DBEs requesting bids are not alone sufficient to satisfy good faith efforts under the rule.

VI. A promise to use DBEs after contract award is not considered to be responsive to the contract solicitation or to constitute good faith efforts.

[79 FR 59600, Oct. 2, 2014]

Appendix G
(SAMPLE) Forms DT1506 and DT1202

COMMITMENT TO SUBCONTRACT TO DBE

Wisconsin Department of Transportation

Proposal #

County: _____

DBE Goal Achieved: 0.00 %

[illegible]

**COMMITMENT TO SUBCONTRACT TO DBE
ATTACHMENT A**

CONFIRMATION OF PARTICIPATION

Project I.D.:	Proposal Number:
Letting Date:	

Name of DBE Firm Participating in this Contract:	
Name of the Prime/Subcontractor who hired the DBE Firm: <i>(list all names of tiers if more than one)</i>	
Type of Work or Type of Material Supplied:	
Total Subcontract Value:	Total DBE Credit Value:

FOR PRIME CONTRACTORS ONLY: I certify that I made arrangements with the participating DBE firm to perform the type of work listed or supply the material indicated above for the subcontract value listed above.	Prime Contractor Representative's Signature
	Prime Contractor Representative's Name (Print Name)
	Prime Contractor (Print Company Name)
	Date

FOR PARTICIPATING DBE FIRMS ONLY: I certify that I made arrangements with the Prime Contractor or the Hiring Contractor to perform the type of work or supply the material indicated above for the subcontract value listed above. FOR DBE TRUCKING FIRMS ONLY: I certify that I will utilize, for DBE credit, only trucks listed on my WisDOT approved Schedule of Owned/Leased Vehicles for DBE Credit form and I will be utilizing the number of trucks as listed below.	Participating DBE Firm Representative's Signature	Date
	Participating DBE Firm Representative's Name (Print Name)	
	Participating DBE Firm (Print Company Name)	
	DBE Firm's Address:	

# Owned Trucks	# Leased Trucks	# DBE-Owned Leased Trucks	# Non-DBE-Owned Leased Trucks

☐ Off site Hauling

**DOCUMENTATION OF GOOD FAITH EFFORT**Wisconsin Department of Transportation
DT1202.....3/2020

Project ID *****	Proposal No. *****	Letting *****
Prime Contractor *****	County *****	
Person Submitting Document *****	Telephone Number *****	
Address *****	Email Address *****	

All bidders must undertake necessary and reasonable steps to achieve the assigned DBE contract goal per federal regulatory guidance at 49 CFR Part 26. Bidders use this form to document all efforts employed to meet the assigned goal as a record of contractor good faith efforts (GFE). Refer to ASP3 or 49 CFR Part 26 for guidance on actions that demonstrate good faith effort.

It is critical to list all efforts, attach documentation, and follow the instructions to complete this submission. Documentation of good faith effort includes copies of each DBE and non-DBE subcontractor quote submitted to the bidder for the same line items. Utilize the sample documentation logs to document and organize efforts.

Submit good faith effort documentation per ASP-3 guidelines.

Instructions: Provide a narrative description of all activities pursued to demonstrate good faith efforts, any corresponding documentation, and applicable explanation on separate pages. Include the following items, organized in the order listed below.

1.→ Solicitation Documentation:

a.→ Purpose: To identify all reasonable and available activities the bidder performed to solicit the interest of all certified DBEs who have the capacity and ability to perform work on the project. All solicitation efforts should begin as early as possible to ensure DBEs have ample time to respond and ask questions.

b.→ Action: Identify and list all activities engaged in to solicit DBEs using all reasonable and available means such as written notice and follow-up communications; substantive conversations; pre-bid meetings; networking events; market research; advertising.

2.→ Selected Work Items Documentation:

a.→ Purpose: To ensure that all work items are broken out into economically feasible units to facilitate DBE participation. This must occur even when you prefer to perform the work yourself.

b.→ Action: Identify economically feasible work units to be performed by DBEs to include activities such as: list of work items to be performed; breaking up of large work items into smaller tasks or quantities; flexible time frames for performance and delivery schedules.

3.→ Documentation of Project Information provided to Interested DBEs:

a.→ Purpose: To provide interested DBEs with adequate information about the plans, specifications, and any other contractual requirements in a timely manner to assist DBEs in response to solicitation.

b.→ Action: Provide DBEs access to plans, specifications, and other contract requirements. Early solicitation allows ample opportunity to provide project information, links to Let advertisements, and substantive engagement with DBEs.

4. → Documentation of Negotiation with Interested DBEs:

a. → Purpose: To ensure that negotiations with interested DBEs were made in good faith providing evidence as to why agreements could not be reached for DBEs to perform work.

b. → Action: Provide sufficient evidence to demonstrate that good faith negotiations took place. Merely sending out solicitations requesting bids from DBEs does not constitute sufficient good faith efforts. A bidder using good business judgment considers a number of factors in negotiating with all subcontractors, and the firm's price and capabilities in addition to contract goals are taken into consideration. However, the fact that there may be some additional costs involved in finding and using DBEs is not in itself sufficient reason for failing to meet the DBE goal as long as costs are reasonable. (see 49 CFR Part 26 Appendix A)

5. → Documentation of Sound Reason for Rejecting DBEs:

a. → Purpose: To ensure that bidders avoid rejecting DBEs as unqualified without sound reasons. Reasons for rejection must be based on thorough investigation of DBE capabilities.

b. → Action: Provide sufficient evidence to demonstrate that DBE was rejected for sound reasons such as past performance, relevant business experience and stability, safety record, business ethic and integrity, technical capacity, other tangible factors.

6. → Documentation of Assistance to Interested DBEs--Bonding, Credit, Insurance, Equipment, Supplies/Materials:

a. → Purpose: To assist interested DBEs in obtaining bonds, lines of credit, insurance, equipment, supplies, materials, and other assistance or services.

b. → Action: Assist interested DBEs in obtaining bonding, lines of credit or insurance, and provide technical assistance or information related to plans, specifications, and project requirements. Assist DBEs in obtaining equipment, supplies, materials or other services related to meeting project requirements (excluding supplies or equipment the DBE purchases from the prime).

7. → Documentation of outreach to Minority, Women, and Community Organizations and other DBE Business Development Support:

a. → Purpose: To effectively use the services of minority, women, and community organizations as well as contractors' groups, local, state, and federal business assistance offices and organization that provide assistance in recruiting and supporting DBEs, as well as participation in activities that support DBE business development.

b. → Action: Contact organizations and agencies for assistance in contacting, recruiting, and providing support to DBE subcontractors, suppliers, manufacturers, and truckers at least 14 days before bid opening. Participate in or host activities such as networking events, mentor-protégé programs, small business development workshops, and others consistent with DBE support.

Return to:
 Wisconsin Department of Transportation
 DBE Program Office
 PO Box 7965
 Madison, WI 53707-7965
 DBE_Alert@dot.wi.gov

I certify that I have utilized comprehensive good faith efforts to solicit and utilize DBE firms to meet the DBE participation requirements of this contract proposal, as demonstrated by my responses and as specified in Additional Special Provision 3 (ASP-3).

I certify that the information given in the Documentation of Good Faith Efforts is true and correct to the best of my knowledge and belief.

I further understand that any willful falsification, fraudulent statement, or misrepresentation will result in appropriate sanctions, which may involve debarment and/or prosecution under applicable state (Trans 504) and Federal laws.

		(Bidder/Authorized Representative Signature)

		(Print Name)

		(Title)

Good Faith Effort--Sample Documentation Logs

The sample logs below are provided as guides rather than exhaustive list. See ASP3, Appendix A for additional examples of demonstrable good faith efforts. Attach documentation for each activity listed.

Acceptable forms of documentation include copies of solicitations sent to DBEs, notes from substantive conversations and negotiations with DBEs, copies of advertisements placed, email communications, all quotes received from DBEs and from all subcontractors who were considered alongside DBE quotes, proof of attendance at applicable networking events; flyers for events or workshops for DBEs offered by the prime, and other physical records of good faith efforts activities.

SOLICITATION LOG

Date	Activity	Name of DBE Solicited	Follow-up
4/1/2020	Sent May-Let solicitation	Winterland Electric	Spoke with Mark Winterland on 4/15/20 to ask if he would quote.

SELECTED WORK ITEMS SOLICITED LOG

Work Type	DBE Firm	Contact Person	Date	Contact Mode
Pavement Marking	ABC Marking	Leslie Lynch	4/1/2020	Email; phone
	#1 Marking Co.	Mark Smart	4/1/2020	Email; left VM
Electrical	Winterland Electric	Tabitha Tinker	4/3/2020	Email, left VM
	Superstar Wiring	Jose Huascar	4/3/2020	Email; phone

INFORMATION PROVIDED LOG

Request Date	DBE Firm	Information Requested & Provided	Response Date
4/1/2020	Winterland Electric	Requested info on electrical requirements; provided plan and link to specs	4/3/2020
4/21/2020	Absolute Construction	Wanted to know how and when supplies are paid for by WisDOT; referred to spec that covers stockpiling	4/21/2020

NEGOTIATIONS LOG

Date	DBE Firm	Contact Name	Work Type	Quotes Rec'd?	Considered for project?	If not selected, why?
4/12/2020	ABC Landscape	John Dean	Erosion Control	Yes	No	Cannot perform all items
4/17/2020	Wild Ferns	Sandy Lynn	Erosion Control	Yes	Yes	
4/20/2020	#1 Marking	Mark Smart	Electrical	Yes	Yes	

ASSISTANCE LOG

Date	DBE Firm	Contact Person	Assistance Provided
4/1/2020	ABC Sawing	Jackie Swiggle	Informed DBE on how to obtain bonding
4/17/2020	Supreme Construction	Winston Walters	Provided contact for wholesale supply purchase

OUTREACH & BUSINESS DEVELOPMENT LOG

Date	Agency/Organization Contacted	Contact Person	Assistance Requested
4/1/2020	Women in Construction	LaTonya Klein	Contact information for woman-owned suppliers
4/28/2020	WBIC	Sam Smith	Asked for information to provide to DBE regarding financing programs through WBIC

Official Form DT1202 can be found here: <https://wisconsindot.gov/pages/global-footer/formdocs/default.aspx>

ADDITIONAL SPECIAL PROVISION 4

This special provision does not limit the right of the department, prime contractor, or subcontractors at any tier to withhold payment for work not acceptably completed or work subject to an unresolved contract dispute.

Payment to First-Tier Subcontractors

Within 10 calendar days of receiving a progress payment for work completed by a subcontractor, pay the subcontractor for that work. The prime contractor may withhold payment to a subcontractor if, within 10 calendar days of receipt of that progress payment, the prime contractor provides written notification to the subcontractor and the department documenting "just cause" for withholding payment.

The prime contractor is not allowed to withhold retainage from payments due subcontractors.

Payment to Lower-Tier Subcontractors

Ensure that subcontracting agreements at all tiers provide prompt payment rights to lower-tier subcontractors that parallel those granted first-tier subcontractors in this provision.

Acceptance and Final Payment

Within 30 calendar days of receiving the semi-final estimate from the department, submit written certification that subcontractors at all tiers are paid in full for acceptably completed work.

Additional Special Provision 6 (ASP-6)
Modifications to the standard specifications

Make the following revisions to the standard specifications:

108 Prosecution and Progress

Add subsection 108.9.4.1 effective with the November 2023 letting:

108.9.4.1 Winter Suspension for Completion Date Contracts

- (1) The contractor may request a winter suspension for a completion date contract. If the department determines weather conditions do not allow for the completion of the remaining work, the department may approve the contractor's request and determine the start date of the winter suspension. The end date of the winter suspension is March 31 or a date mutually agreed upon by both parties. For multi-year contracts, the department will only consider winter suspension for the final year of the contract.
 - (2) During winter suspension, store all materials in a manner that does not obstruct vehicular and pedestrian traffic and protect the materials from damage. Install traffic control and other safety devices necessary to protect the traveling public and pedestrians. Provide suitable drainage and install temporary erosion control where necessary. If the winter suspension begins when liquidated damages are being assessed, or when the work has not progressed as scheduled and would not have been completed prior to the completion date, the cost of necessary pre-suspension work is incidental. If the winter suspension begins prior to the contract completion date, and the work has progressed as scheduled and would have been completed prior to the completion date, the cost of pre-suspension work will be paid as specified under 109.4.
 - (3) For a winter suspension that begins prior to the contract completion date and the work has progressed as scheduled and would have been completed prior to the completion date, the engineer will extend contract time to correspond with the end of the winter suspension and liquidated damages will not be assessed during the winter suspension.
 - (4) For a winter suspension that begins when liquidated damages are being assessed or when the work has not progressed as scheduled and would not have been completed prior to the completion date, the engineer will not extend contract time. Time will be suspended until the end of the winter suspension. Liquidated damages will not be assessed during the winter suspension and liquidated damages will resume at the end of the winter suspension.
-

108.10.2 Excusable, Non-Compensable Delays

108.10.2.1 General

Replace entire section with the following effective with the January 2024 letting:

- (1) Non-compensable delays, 108.10.2.1(3), are excusable delays not the contractor's or the department's fault. The engineer will not pay for the delay costs listed in 109.4.7 for non-compensable delays.
 - (2) For non-compensable delays under calendar day and completion date contracts, the engineer will extend contract time if the conditions specified in 108.10.1 are met. The department will relieve the contractor from associated liquidated damages, as specified in 108.11, if the engineer extends time under 108.10.1.
 - (3) The following are non-compensable delays:
 1. Delays due to earthquakes, other cataclysmic phenomena of nature the contractor cannot foresee and avoid, severe weather or job conditions caused by recent weather as specified in 108.10.2.2.
 2. Extraordinary delays in material deliveries the contractor or their suppliers cannot foresee and forestall resulting from strikes, lockouts, freight embargoes, industry-wide shortages, governmental acts, or sudden disasters.
 3. Delays due to acts of the government, a political subdivision other than the department, or the public enemy.
 4. Delays from fires or epidemics.
 5. Delays from strikes beyond the contractor's power to settle not caused by improper acts or omissions of the contractor, their subcontractors, or their suppliers.
 6. Altered quantities as specified in 109.3.
-

108.10.3 Excusable Compensable Delays

Replace entire section with the following effective with the January 2024 letting:

- (1) Compensable delays are excusable delays due to the department's actions or lack of actions. The engineer will grant a time extension for a compensable delay if the conditions specified in 108.10.1 are met.
- (2) The following are compensable delays:

1. A contract change for revised work as specified for extra work under 104.2.2.1, for a differing site condition under 104.2.2.2, or for significant changes in the character of the work under 104.2.2.4.
 2. A contract change for an engineer-ordered suspension under 104.2.2.3.
 3. The unexpected discovery of human remains, an archaeological find, or historical find consistent with 107.25.
 4. The unexpected discovery of a hazardous substance consistent with 107.24.
 5. The non-completion of work that utilities or other third parties perform, if that work is not completed as specified in the contract.
- (3) For a compensable delay or a time extension, the department will relieve the contractor from associated liquidated damages under 108.11, and will pay the contractor for delay costs determined as follows:
1. Adjust the contract price as specified in 109.4.2 through 109.4.5 for delays under item 1 of 108.10.3(2).
 2. Adjust the contract price as specified in 109.4.7 for delays under items 2 through 5 of 108.10.3(2).

310 Open Graded Base

310.2 Materials

Replace paragraph two with the following effective with the November 2023 letting:

- (2) The contractor may substitute material conforming to the gradation requirements for crushed aggregate specified in Table 310-01 if that material conforms to the fracture requirements for open-graded crushed gravel specified in 301.2.4.5.

TABLE 310-01 COARSE AGGREGATE (% passing by weight)

AASHTO No. 67^[1]	
SEIVE	COARSE AGGREGATE (% PASSING by WEIGHT) AASHTO No. 67
2-inch	-
1 1/2-inch	-
1-inch	100
3/4-inch	90 – 100
1/2-inch	-
3/8-inch	20 – 55
No. 4	0 – 10
No. 8	0 – 5
No. 16	-
No. 30	-
No. 50	-
No. 100	-
No. 200	<=1.5

^[1] Size according to AASHTO M43.

390 Base Patching

390.4 Measurement

Replace entire section with the following effective with the November 2023 letting:

- (1) The department will measure Removing Pavement for Base Patching by the cubic yard acceptably completed. Measure the depth from the bottom of the adjacent pavement to the top of the patch.
- (2) The department will measure Base Patching Asphaltic by the ton acceptably completed as specified for asphaltic pavement in 450.4.
- (3) The department will measure Base Patching Concrete HES and Base Patching Concrete SHES by the cubic yard acceptably completed. Measure the depth from the bottom of the adjacent pavement to the top of the patch.

390.5 Payment

Replace entire section with the following effective with the November 2023 letting:

- (1) The department will pay for measured quantities at the contract unit price under the following bid items:

<u>ITEM NUMBER</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
390.0100	Removing Pavement for Base Patching	CY
390.0201	Base Patching Asphaltic	TON
390.0305	Base Patching Concrete HES	CY
390.0405	Base Patching Concrete SHES	CY

- (2) Payment for Removing Pavement for Base Patching is full compensation for removing old pavement; for preparing the foundation and bringing up to grade. If the engineer orders the contractor to excavate yielding or unstable subgrade materials and backfill with suitable materials, the department will pay for that work with contract bid items or as agreed upon using 109.4.
- (3) Payment for Base Patching Asphaltic is full compensation for providing and compacting asphaltic mixture including asphaltic binder.
- (4) Payment for Base Patching Concrete HES and Base Patching Concrete SHES is full compensation for providing, curing, and protecting concrete. Payment also includes providing tie bars and dowel bars in unhardened concrete and steel within the patch. For tie bars and dowel bars provided in concrete not placed under the contract, the department will pay separately under the Drilled Tie Bars and Drilled Dowel Bars bid items as specified in 416.5.
- (5) Payment for Base Patching SHES also includes providing test data to the engineer as specified in 416.2.4.
- (6) The department will pay for sawing existing concrete pavement for removal under the Sawing Concrete bid item as specified in 690.5.

460 Hot Mix Asphalt Pavement**460.2.8.2.1.3.1 Contracts with 5000 Tons of Mixture or Greater**

Replace paragraph four with the following effective with the November 2023 letting:

- (4) Use the test methods identified below, or other methods the engineer approves, to perform the following tests at the frequency indicated:

Blended aggregate gradations:

Drum plants:

- Field extraction by ignition oven according to WTM T308, chemical extraction according to AASHTO T-164 method A or B; or automated extraction according to WTM D8159. Gradation of resulting aggregate sample determined according to WTM T30.
- Belt samples, optional for virgin mixtures, obtained from stopped belt or from the belt discharge using an engineer-approved sampling device and performed according to WTM T11 and T27.

Batch plants:

- Field extraction by ignition oven according to WTM T308, chemical extraction according to AASHTO T-164 method A or B; or automated extraction according to WTM D8159. Gradation of resulting aggregate sample determined according to WTM T30.

Asphalt content (AC) in percent:

Determine AC using one of the following methods:

- AC by ignition oven according to WTM T308.
- AC by chemical extraction according to AASHTO T-164 method A or B.
- AC by automated extraction according to WTM D8159.
- If the department is using an ignition oven to determine AC, conform to WTP H003.
- If the department is not using an ignition oven to determine AC, ignition oven correction factor (IOCF) must still be reverified for any of the reasons listed in WTP H003 Table 2 and conform to WTP H-003 sections 3 through 6.
- Gradation of resulting aggregate sample determined according to WTM T30.

Bulk specific gravity of the compacted mixture:

According to WTM T166.

Theoretical maximum specific gravity:

According to WTM T209.

Air voids (Va) by calculation according to WTM T269.

VMA by calculation according to WTM R35.

460.2.8.3.1.4 Department Verification Testing Requirements

Replace paragraph three with the following effective with the November 2023 letting:

- (3) The department will perform testing conforming to the following standards:
 - Bulk specific gravity (G_{mb}) of the compacted mixture according to WTM T166.
 - Maximum specific gravity (G_{mm}) according to WTM T209.
 - Air voids (V_a) by calculation according to WTM T269.
 - VMA by calculation according to WTM R35.
 - Asphalt content by ignition oven according to WTM T308, chemical extraction according to AASHTO T-164 method A or B, or automated extraction according to WTM D8159. If using an ignition oven to determine AC, conform to WTP H-003.

460.3.3.2 Pavement Density Determinations

Replace entire section with the following effective with the February 2024 letting:

- (1) The engineer will determine the target maximum density using department procedures described in WTM T355. The engineer will determine density according to CMM 815 and WTM T355 as soon as practicable after compaction and before placement of subsequent layers or before opening to traffic.
- (2) Do not re-roll compacted mixtures with deficient density test results. Do not operate continuously below the specified minimum density. Stop production, identify the source of the problem, and make corrections to produce work meeting the specification requirements.
- (3) A lot is defined as one day's production for each subplot type or one production shift if running 24 hours per day and placed within a single layer for each location and target maximum density category indicated in table 460-3. The lot density is the average of the tests taken for that lot. The department determines the number of tests per lot according to WTP H-002.
- (4) An HTPC-certified Nuclear Density Technician I (NUCDENSITYTEC-I) or a nuclear density ACT working under a NUCDENSITYTEC-I technician, will locate samples and perform the testing. A NUCDENSITYTEC-I technician will coordinate and take responsibility for the work an ACT performs. No more than one ACT can work under a single NUCDENSITYTEC-I technician. The responsible NUCDENSITYTEC-I technician will ensure that sample location and testing is performed correctly, analyze test results, and provide density results to the contractor weekly.

503 Prestressed Concrete Members

503.2.2 Concrete

Replace paragraph five with the following effective with the November 2023 letting:

- (5) Furnish prestressed concrete members cast from air-entrained concrete, except I-type girders may use non-air-entrained concrete. Use type I, IL, IS, IP, IT, II, or III cement. The contractor may replace up to 30 percent of type I, IL, II, or III cement with an equal weight of fly ash, slag, or a combination of fly ash and slag. Ensure that fly ash conforms to 501.2.4.2.2 and slag conforms to 501.2.4.2.3. Use only one source and replacement rate for work under a single bid item. Use a department-approved air-entraining admixture conforming to 501.2.5.2 for air-entrained concrete. Use only coarse aggregate conforming to 310.2(2).

604 Slope Paving

604.2 Materials

Replace paragraph three with the following effective with the November 2023 letting:

- (3) Under the Slope Paving Crushed Aggregate bid item, furnish crushed stone or crushed gravel conforming to the gradation in Table 604-01, but with the additional requirements that at least 75 percent of the particles, by count, have at least one fractured face. Determine fracture according to WTM D5821.

TABLE 604-01 COARSE AGGREGATE (% passing by weight)

AASHTO No. 4 ^[1]	
SEIVE	COARSE AGGREGATE (% PASSING by WEIGHT) AASHTO No. 4
2-inch	100
1 1/2-inch	90 - 100
1-inch	20 - 55
3/4-inch	0 - 15
1/2-inch	-
3/8-inch	0 - 5
No. 4	-
No. 8	-
No. 16	-
No. 30	-
No. 50	-
No. 100	-
No. 200	<=1.5

^[1] Size according to AASHTO M43.

612 Underdrains

612.3.9 Trench Underdrains

Replace paragraph one with the following effective with the November 2023 letting:

- (1) Under the Underdrain Trench bid item, excavate and backfill underdrain trenches. Backfill with coarse aggregate gradation conforming to 604.2(3). Before backfilling place geotextile as the plans show.

614 Semi-rigid Barrier Systems and End Treatments

614.2.6 Sand Barrel Arrays

Replace paragraph one with the following effective with the November 2023 letting:

- (1) Furnish sand barrels from the APL. Use fine aggregate conforming to gradation shown in Table 614-2 mixed with sodium chloride conforming to AASHTO M143. Apply an object marker to front-most barrel in the array.

TABLE 614-2 FINE AGGREGATE GRADATION

SEIVE	FINE AGGREGATE (% PASSING by WEIGHT)
3/8-inch	100
No. 4	90 - 100
No. 8	-
No. 16	45 - 85
No. 30	-
No. 50	5 - 30
No. 100	0 - 10
No. 200	<=3.5

628 Erosion Control**628.2.13 Rock Bags**

Replace paragraph two with the following effective with the November 2023 letting:

- (2) Fill the bags with a clean, sound, hard, durable, engineer-approved coarse aggregate conforming by visual inspection to the gradation specified for coarse aggregate gradation in 604.2(3).

639 Drilling Wells**639.2.1 General**

Replace paragraph two with the following effective with the November 2023 letting:

- (2) For grout use fine aggregate conforming to 501.2.7.2; and gradation conforming to 614.2.6(1); and type I, IL, IS, IP, or IT cement.

652 Electrical Conduit**652.3.1.2 Installing Underground**

Replace paragraph two with the following effective with the November 2023 letting:

- (2) Excavate trenches true to line and grade to provide the conduit uniform bearing throughout its length. Do not backfill the trench before inspecting the conduit. Carefully tamp the backfill in place as specified for placing backfill in layers in 651.3. Place at least 0.7 cubic feet of coarse aggregate gradation conforming to 604.2(3) directly under each drainage hole.

ERRATA

390.3.4 Special High Early Strength Concrete Patching

Correct errata link in paragraph (1) by changing from 416.3.8 to 416.3.7.

- (1) Construct as specified for special high early strength repairs under 416.3.7 except as follows:
 - The contractor may delay removal for up to 14 calendar days after cutting the existing pavement.
 - Open to traffic as specified for concrete base in 320.3.

ADDITIONAL SPECIAL PROVISION 7

A. Reporting 1st Tier and DBE Payments During Construction

1. Comply with reporting requirements specified in the department's Civil Rights Compliance, Contractor's User Manual, Sublets and Payments.
2. Report payments to all DBE firms within 10 calendar days of receipt of a progress payment by the department or a contractor for work performed, materials furnished, or materials stockpiled by a DBE firm. Report the payment as specified in A(1) for all work satisfactorily performed and for all materials furnished or stockpiled.
3. Report payments to all first tier subcontractor relationships within 10 calendar days of receipt of a progress payment by the department for work performed. Report the payment as specified in A(1) for all work satisfactorily performed.
4. All tiers shall report payments as necessary to comply with the DBE payment requirement as specified in A(2).
5. DBE firms must enter all payments to DBE and non-DBE firms regardless of tier.
6. Require all first tier relationships, DBE firms and all other tier relationships necessary to comply with the DBE payment requirement in receipt of a progress payment by contractor to acknowledge receipt of payment as specified in A(1), (2), (3) and (4).
7. All agreements made by a contractor shall include the provisions in A(1), (2), (3), (4), (5), and (6), and shall be binding on all first tier subcontractor relationships, all contractors and subcontractors utilizing DBE firms on the project, and all payments from DBE firms.

B. Costs for conforming to this special provision are incidental to the contract.

NOTE: CRCS Prime Contractor payment is currently not automated and will need to be manually loaded into the Civil Rights Compliance System. Copies of prime contractor payments received (check or ACH) will have to be forwarded to paul.ndon@dot.wi.gov within 5 days of payment receipt to be logged manually.

***Additionally, for information on Subcontractor Sublet assignments, Subcontractor Payments and Payment Tracking, please refer to the CRCS Payment and Sublets manual at:

<https://wisconsindot.gov/Documents/doing-bus/civil-rights/labornwage/crcs-payments-sublets-manual.pdf>

ADDITIONAL SPECIAL PROVISION 9

Electronic Certified Payroll or Labor Data Submittal

- (1) Use the department's Civil Rights Compliance System (CRCS) to electronically submit certified payroll reports for contracts with federal funds and labor data for contracts with state funds only. Details are available online through the department's highway construction contractor information (HCCI) site on the Labor, Wages, and EEO Information page at:
<https://wisconsindot.gov/Pages/doing-bus/civil-rights/labornwage/default.aspx>
- (2) Ensure that all tiers of subcontractors, including all trucking firms, either submit their weekly certified payroll reports (contracts with federal funds) or labor data (contracts with state funds only) electronically through CRCS. These payrolls or labor data are due within seven calendar days following the close of the payroll period. Every firm providing physical labor towards completing the project is a subcontractor under this special provision.
- (3) Upon receipt of contract execution, promptly make all affected firms aware of the requirements under this special provision and arrange for them to receive CRCS training as they are about to begin their submittals. The department will provide training either in a classroom setting at one of our regional offices or by telephone. Contact Paul Ndon at (414) 438-4584 to schedule the training.
- (4) The department will reject all paper submittals for information required under this special provision. All costs for conforming to this special provision are incidental to the contract.
- (5) Firms wishing to export payroll/labor data from their computer system into CRCS should have their payroll coordinator contact Paul Ndon at paul.ndon@dot.wi.gov. Not every contractor's payroll system is capable of producing export files. For details, see Section 4.8 CPR Auto Submit (Data Mapping) on pages 49-50; 66-71 of the CRCS Payroll Manual at:
<https://wisconsindot.gov/Documents/doing-bus/civil-rights/labornwage/crcs-payroll-manual.pdf>

REQUIRED CONTRACT PROVISIONS FEDERAL-AID CONSTRUCTION CONTRACTS

- I. General
- II. Nondiscrimination
- III. Non-segregated Facilities
- IV. Davis-Bacon and Related Act Provisions
- V. Contract Work Hours and Safety Standards Act Provisions
- VI. Subletting or Assigning the Contract
- VII. Safety: Accident Prevention
- VIII. False Statements Concerning Highway Projects
- IX. Implementation of Clean Air Act and Federal Water Pollution Control Act
- X. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion
- XI. Certification Regarding Use of Contract Funds for Lobbying
- XII. Use of United States-Flag Vessels:

ATTACHMENTS

A. Employment and Materials Preference for Appalachian Development Highway System or Appalachian Local Access Road Contracts (included in Appalachian contracts only)

I. GENERAL

1. Form FHWA-1273 must be physically incorporated in each construction contract funded under title 23, United States Code, as required in 23 CFR 633.102(b) (excluding emergency contracts solely intended for debris removal). The contractor (or subcontractor) must insert this form in each subcontract and further require its inclusion in all lower tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services). 23 CFR 633.102(e).

The applicable requirements of Form FHWA-1273 are incorporated by reference for work done under any purchase order, rental agreement or agreement for other services. The prime contractor shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider. 23 CFR 633.102(e).

Form FHWA-1273 must be included in all Federal-aid design-build contracts, in all subcontracts and in lower tier subcontracts (excluding subcontracts for design services, purchase orders, rental agreements and other agreements for supplies or services) in accordance with 23 CFR 633.102. The design-builder shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Contracting agencies may reference Form FHWA-1273 in solicitation-for-bids or request-for-proposals documents, however, the Form FHWA-1273 must be physically incorporated (not referenced) in all contracts, subcontracts and lower-tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services related to a construction contract). 23 CFR 633.102(b).

2. Subject to the applicability criteria noted in the following sections, these contract provisions shall apply to all work

performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract. 23 CFR 633.102(d).

3. A breach of any of the stipulations contained in these Required Contract Provisions may be sufficient grounds for withholding of progress payments, withholding of final payment, termination of the contract, suspension / debarment or any other action determined to be appropriate by the contracting agency and FHWA.

4. Selection of Labor: During the performance of this contract, the contractor shall not use convict labor for any purpose within the limits of a construction project on a Federal-aid highway unless it is labor performed by convicts who are on parole, supervised release, or probation. 23 U.S.C. 114(b). The term Federal-aid highway does not include roadways functionally classified as local roads or rural minor collectors. 23 U.S.C. 101(a).

II. NONDISCRIMINATION (23 CFR 230.107(a); 23 CFR Part 230, Subpart A, Appendix A; EO 11246)

The provisions of this section related to 23 CFR Part 230, Subpart A, Appendix A are applicable to all Federal-aid construction contracts and to all related construction subcontracts of \$10,000 or more. The provisions of 23 CFR Part 230 are not applicable to material supply, engineering, or architectural service contracts.

In addition, the contractor and all subcontractors must comply with the following policies: Executive Order 11246, 41 CFR Part 60, 29 CFR Parts 1625-1627, 23 U.S.C. 140, Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), Title VI of the Civil Rights Act of 1964, as amended (42 U.S.C. 2000d et seq.), and related regulations including 49 CFR Parts 21, 26, and 27; and 23 CFR Parts 200, 230, and 633.

The contractor and all subcontractors must comply with: the requirements of the Equal Opportunity Clause in 41 CFR 60-1.4(b) and, for all construction contracts exceeding \$10,000, the Standard Federal Equal Employment Opportunity Construction Contract Specifications in 41 CFR 60-4.3.

Note: The U.S. Department of Labor has exclusive authority to determine compliance with Executive Order 11246 and the policies of the Secretary of Labor including 41 CFR Part 60, and 29 CFR Parts 1625-1627. The contracting agency and the FHWA have the authority and the responsibility to ensure compliance with 23 U.S.C. 140, Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and Title VI of the Civil Rights Act of 1964, as amended (42 U.S.C. 2000d et seq.), and related regulations including 49 CFR Parts 21, 26, and 27; and 23 CFR Parts 200, 230, and 633.

The following provision is adopted from 23 CFR Part 230, Subpart A, Appendix A, with appropriate revisions to conform to the U.S. Department of Labor (US DOL) and FHWA requirements.

1. Equal Employment Opportunity: Equal Employment Opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (see 28 CFR Part 35, 29 CFR Part 1630, 29 CFR Parts 1625-1627, 41 CFR Part 60 and 49 CFR Part 27) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140, shall constitute the EEO and specific affirmative action standards for the contractor's project activities under this contract. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR Part 35 and 29 CFR Part 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

a. The contractor will work with the contracting agency and the Federal Government to ensure that it has made every good faith effort to provide equal opportunity with respect to all of its terms and conditions of employment and in their review of activities under the contract. 23 CFR 230.409 (g)(4) & (5).

b. The contractor will accept as its operating policy the following statement:

"It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, sexual orientation, gender identity, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, pre-apprenticeship, and/or on-the-job training."

2. EEO Officer: The contractor will designate and make known to the contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active EEO program and who must be assigned adequate authority and responsibility to do so.

3. Dissemination of Policy: All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action or are substantially involved in such action, will be made fully cognizant of and will implement the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer or other knowledgeable company official.

b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.

c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minorities and women.

d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

4. Recruitment: When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minorities and women in the area from which the project work force would normally be derived.

a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minorities and women. To meet this requirement, the contractor will identify sources of potential minority group employees and establish with such identified sources procedures whereby minority and women applicants may be referred to the contractor for employment consideration.

b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, the contractor is expected to observe the provisions of that agreement to the extent that the system meets the contractor's compliance with EEO contract provisions. Where implementation of such an agreement has the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Federal nondiscrimination provisions.

c. The contractor will encourage its present employees to refer minorities and women as applicants for employment. Information and procedures with regard to referring such applicants will be discussed with employees.

5. Personnel Actions: Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, age or disability. The following procedures shall be followed:

a. The contractor will conduct periodic inspections of project sites to ensure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.

b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with its obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action

within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of their avenues of appeal.

6. Training and Promotion:

a. The contractor will assist in locating, qualifying, and increasing the skills of minorities and women who are applicants for employment or current employees. Such efforts should be aimed at developing full journey level status employees in the type of trade or job classification involved.

b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs (i.e., apprenticeship and on-the-job training programs for the geographical area of contract performance). In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision. The contracting agency may reserve training positions for persons who receive welfare assistance in accordance with 23 U.S.C. 140(a).

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of employees who are minorities and women and will encourage eligible employees to apply for such training and promotion.

7. Unions: If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use good faith efforts to obtain the cooperation of such unions to increase opportunities for minorities and women. 23 CFR 230.409. Actions by the contractor, either directly or through a contractor's association acting as agent, will include the procedures set forth below:

a. The contractor will use good faith efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minorities and women for membership in the unions and increasing the skills of minorities and women so that they may qualify for higher paying employment.

b. The contractor will use good faith efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, sexual orientation, gender identity, national origin, age, or disability.

c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the contracting agency and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the contractor with a reasonable flow of referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, age, or disability; making full efforts to obtain qualified and/or qualifiable minorities and women. The failure of a union to provide

sufficient referrals (even though it is obligated to provide exclusive referrals under the terms of a collective bargaining agreement) does not relieve the contractor from the requirements of this paragraph. In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the contracting agency.

8. Reasonable Accommodation for Applicants /

Employees with Disabilities: The contractor must be familiar with the requirements for and comply with the Americans with Disabilities Act and all rules and regulations established thereunder. Employers must provide reasonable accommodation in all employment activities unless to do so would cause an undue hardship.

9. Selection of Subcontractors, Procurement of Materials and Leasing of Equipment:

The contractor shall not discriminate on the grounds of race, color, religion, sex, sexual orientation, gender identity, national origin, age, or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall take all necessary and reasonable steps to ensure nondiscrimination in the administration of this contract.

a. The contractor shall notify all potential subcontractors, suppliers, and lessors of their EEO obligations under this contract.

b. The contractor will use good faith efforts to ensure subcontractor compliance with their EEO obligations.

10. Assurances Required:

a. The requirements of 49 CFR Part 26 and the State DOT's FHWA-approved Disadvantaged Business Enterprise (DBE) program are incorporated by reference.

b. The contractor, subrecipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate, which may include, but is not limited to:

- (1) Withholding monthly progress payments;
- (2) Assessing sanctions;
- (3) Liquidated damages; and/or
- (4) Disqualifying the contractor from future bidding as non-responsible.

c. The Title VI and nondiscrimination provisions of U.S. DOT Order 1050.2A at Appendixes A and E are incorporated by reference. 49 CFR Part 21.

11. Records and Reports: The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following the date of the final payment to the contractor for all contract work and shall be available at reasonable times and places for inspection by authorized representatives of the contracting agency and the FHWA.

a. The records kept by the contractor shall document the following:

(1) The number and work hours of minority and non-minority group members and women employed in each work classification on the project;

(2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women; and

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minorities and women.

b. The contractors and subcontractors will submit an annual report to the contracting agency each July for the duration of the project indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on [Form FHWA-1391](#). The staffing data should represent the project work force on board in all or any part of the last payroll period preceding the end of July. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data. The employment data should reflect the work force on board during all or any part of the last payroll period preceding the end of July.

III. NONSEGREGATED FACILITIES

This provision is applicable to all Federal-aid construction contracts and to all related construction subcontracts of more than \$10,000. 41 CFR 60-1.5.

As prescribed by 41 CFR 60-1.8, the contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, sexual orientation, gender identity, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensure that its employees are not assigned to perform their services at any location under the contractor's control where the facilities are segregated. The term "facilities" includes waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, washrooms, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees. The contractor shall provide separate or single-user restrooms and necessary dressing or sleeping areas to assure privacy between sexes.

IV. DAVIS-BACON AND RELATED ACT PROVISIONS

This section is applicable to all Federal-aid construction projects exceeding \$2,000 and to all related subcontracts and lower-tier subcontracts (regardless of subcontract size), in accordance with 29 CFR 5.5. The requirements apply to all projects located within the right-of-way of a roadway that is functionally classified as Federal-aid highway. 23 U.S.C. 113. This excludes roadways functionally classified as local roads or rural minor collectors, which are exempt. 23 U.S.C. 101. Where applicable law requires that projects be treated as a project on a Federal-aid highway, the provisions of this subpart will apply regardless of the location of the project. Examples include: Surface Transportation Block Grant Program projects funded under 23 U.S.C. 133 [excluding recreational trails projects], the Nationally Significant Freight and Highway

Projects funded under 23 U.S.C. 117, and National Highway Freight Program projects funded under 23 U.S.C. 167.

The following provisions are from the U.S. Department of Labor regulations in 29 CFR 5.5 "Contract provisions and related matters" with minor revisions to conform to the FHWA-1273 format and FHWA program requirements.

1. Minimum wages (29 CFR 5.5)

a. *Wage rates and fringe benefits.* All laborers and mechanics employed or working upon the site of the work (or otherwise working in construction or development of the project under a development statute), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act ([29 CFR part 3](#))), the full amount of basic hourly wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. As provided in paragraphs (d) and (e) of 29 CFR 5.5, the appropriate wage determinations are effective by operation of law even if they have not been attached to the contract. Contributions made or costs reasonably anticipated for bona fide fringe benefits under the Davis-Bacon Act ([40 U.S.C. 3141\(2\)\(B\)](#)) on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph 1.e. of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics must be paid the appropriate wage rate and fringe benefits on the wage determination for the classification(s) of work actually performed, without regard to skill, except as provided in paragraph 4. of this section. Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: *Provided*, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classifications and wage rates conformed under paragraph 1.c. of this section) and the Davis-Bacon poster (WH-1321) must be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

b. *Frequently recurring classifications.* (1) In addition to wage and fringe benefit rates that have been determined to be prevailing under the procedures set forth in [29 CFR part 1](#), a wage determination may contain, pursuant to § 1.3(f), wage and fringe benefit rates for classifications of laborers and mechanics for which conformance requests are regularly submitted pursuant to paragraph 1.c. of this section, provided that:

(i) The work performed by the classification is not performed by a classification in the wage determination for which a prevailing wage rate has been determined;

(ii) The classification is used in the area by the construction industry; and

(iii) The wage rate for the classification bears a reasonable relationship to the prevailing wage rates contained in the wage determination.

(2) The Administrator will establish wage rates for such classifications in accordance with paragraph 1.c.(1)(iii) of this section. Work performed in such a classification must be paid at no less than the wage and fringe benefit rate listed on the wage determination for such classification.

c. *Conformance.* (1) The contracting officer must require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract be classified in conformance with the wage determination. Conformance of an additional classification and wage rate and fringe benefits is appropriate only when the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(ii) The classification is used in the area by the construction industry; and

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) The conformance process may not be used to split, subdivide, or otherwise avoid application of classifications listed in the wage determination.

(3) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken will be sent by the contracting officer by email to DBAconformance@dol.gov. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(4) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer will, by email to DBAconformance@dol.gov, refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(5) The contracting officer must promptly notify the contractor of the action taken by the Wage and Hour Division

under paragraphs 1.c.(3) and (4) of this section. The contractor must furnish a written copy of such determination to each affected worker or it must be posted as a part of the wage determination. The wage rate (including fringe benefits where appropriate) determined pursuant to paragraph 1.c.(3) or (4) of this section must be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

d. *Fringe benefits not expressed as an hourly rate.* Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor may either pay the benefit as stated in the wage determination or may pay another bona fide fringe benefit or an hourly cash equivalent thereof.

e. *Unfunded plans.* If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, *Provided*, That the Secretary of Labor has found, upon the written request of the contractor, in accordance with the criteria set forth in § 5.28, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

f. *Interest.* In the event of a failure to pay all or part of the wages required by the contract, the contractor will be required to pay interest on any underpayment of wages.

2. Withholding (29 CFR 5.5)

a. *Withholding requirements.* The contracting agency may, upon its own action, or must, upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor so much of the accrued payments or advances as may be considered necessary to satisfy the liabilities of the prime contractor or any subcontractor for the full amount of wages and monetary relief, including interest, required by the clauses set forth in this section for violations of this contract, or to satisfy any such liabilities required by any other Federal contract, or federally assisted contract subject to Davis-Bacon labor standards, that is held by the same prime contractor (as defined in § 5.2). The necessary funds may be withheld from the contractor under this contract, any other Federal contract with the same prime contractor, or any other federally assisted contract that is subject to Davis-Bacon labor standards requirements and is held by the same prime contractor, regardless of whether the other contract was awarded or assisted by the same agency, and such funds may be used to satisfy the contractor liability for which the funds were withheld. In the event of a contractor's failure to pay any laborer or mechanic, including any apprentice or helper working on the site of the work all or part of the wages required by the contract, or upon the contractor's failure to submit the required records as discussed in paragraph 3.d. of this section, the contracting agency may on its own initiative and after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

b. *Priority to withheld funds.* The Department has priority to funds withheld or to be withheld in accordance with paragraph

2.a. of this section or Section V, paragraph 3.a., or both, over claims to those funds by:

(1) A contractor's surety(ies), including without limitation performance bond sureties and payment bond sureties;

(2) A contracting agency for its procurement costs;

(3) A trustee(s) (either a court-appointed trustee or a U.S. trustee, or both) in bankruptcy of a contractor, or a contractor's bankruptcy estate;

(4) A contractor's assignee(s);

(5) A contractor's successor(s); or

(6) A claim asserted under the Prompt Payment Act, [31 U.S.C. 3901–3907](#).

3. Records and certified payrolls (29 CFR 5.5)

a. Basic record requirements (1) Length of record retention. All regular payrolls and other basic records must be maintained by the contractor and any subcontractor during the course of the work and preserved for all laborers and mechanics working at the site of the work (or otherwise working in construction or development of the project under a development statute) for a period of at least 3 years after all the work on the prime contract is completed.

(2) Information required. Such records must contain the name; Social Security number; last known address, telephone number, and email address of each such worker; each worker's correct classification(s) of work actually performed; hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in [40 U.S.C. 3141\(2\)\(B\)](#) of the Davis-Bacon Act); daily and weekly number of hours actually worked in total and on each covered contract; deductions made; and actual wages paid.

(3) Additional records relating to fringe benefits. Whenever the Secretary of Labor has found under paragraph 1.e. of this section that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in [40 U.S.C. 3141\(2\)\(B\)](#) of the Davis-Bacon Act, the contractor must maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits.

(4) Additional records relating to apprenticeship. Contractors with apprentices working under approved programs must maintain written evidence of the registration of apprenticeship programs, the registration of the apprentices, and the ratios and wage rates prescribed in the applicable programs.

b. Certified payroll requirements (1) Frequency and method of submission. The contractor or subcontractor must submit weekly, for each week in which any DBA- or Related Acts-covered work is performed, certified payrolls to the contracting

agency. The prime contractor is responsible for the submission of all certified payrolls by all subcontractors. A contracting agency or prime contractor may permit or require contractors to submit certified payrolls through an electronic system, as long as the electronic system requires a legally valid electronic signature; the system allows the contractor, the contracting agency, and the Department of Labor to access the certified payrolls upon request for at least 3 years after the work on the prime contract has been completed; and the contracting agency or prime contractor permits other methods of submission in situations where the contractor is unable or limited in its ability to use or access the electronic system.

(2) Information required. The certified payrolls submitted must set out accurately and completely all of the information required to be maintained under paragraph 3.a.(2) of this section, except that full Social Security numbers and last known addresses, telephone numbers, and email addresses must not be included on weekly transmittals. Instead, the certified payrolls need only include an individually identifying number for each worker (e.g., the last four digits of the worker's Social Security number). The required weekly certified payroll information may be submitted using Optional Form WH-347 or in any other format desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division website at <https://www.dol.gov/sites/dolgov/files/WHDL/legacy/files/wh347.pdf> or its successor website. It is not a violation of this section for a prime contractor to require a subcontractor to provide full Social Security numbers and last known addresses, telephone numbers, and email addresses to the prime contractor for its own records, without weekly submission by the subcontractor to the contracting agency.

(3) Statement of Compliance. Each certified payroll submitted must be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor, or the contractor's or subcontractor's agent who pays or supervises the payment of the persons working on the contract, and must certify the following:

(i) That the certified payroll for the payroll period contains the information required to be provided under paragraph 3.b. of this section, the appropriate information and basic records are being maintained under paragraph 3.a. of this section, and such information and records are correct and complete;

(ii) That each laborer or mechanic (including each helper and apprentice) working on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in [29 CFR part 3](#); and

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification(s) of work actually performed, as specified in the applicable wage determination incorporated into the contract.

(4) Use of Optional Form WH-347. The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 will satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 3.b.(3) of this section.

(5) *Signature.* The signature by the contractor, subcontractor, or the contractor's or subcontractor's agent must be an original handwritten signature or a legally valid electronic signature.

(6) *Falsification.* The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under [18 U.S.C. 1001](#) and [31 U.S.C. 3729](#).

(7) *Length of certified payroll retention.* The contractor or subcontractor must preserve all certified payrolls during the course of the work and for a period of 3 years after all the work on the prime contract is completed.

c. *Contracts, subcontracts, and related documents.* The contractor or subcontractor must maintain this contract or subcontract and related documents including, without limitation, bids, proposals, amendments, modifications, and extensions. The contractor or subcontractor must preserve these contracts, subcontracts, and related documents during the course of the work and for a period of 3 years after all the work on the prime contract is completed.

d. *Required disclosures and access* (1) *Required record disclosures and access to workers.* The contractor or subcontractor must make the records required under paragraphs 3.a. through 3.c. of this section, and any other documents that the contracting agency, the State DOT, the FHWA, or the Department of Labor deems necessary to determine compliance with the labor standards provisions of any of the applicable statutes referenced by § 5.1, available for inspection, copying, or transcription by authorized representatives of the contracting agency, the State DOT, the FHWA, or the Department of Labor, and must permit such representatives to interview workers during working hours on the job.

(2) *Sanctions for non-compliance with records and worker access requirements.* If the contractor or subcontractor fails to submit the required records or to make them available, or refuses to permit worker interviews during working hours on the job, the Federal agency may, after written notice to the contractor, sponsor, applicant, owner, or other entity, as the case may be, that maintains such records or that employs such workers, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available, or to permit worker interviews during working hours on the job, may be grounds for debarment action pursuant to § 5.12. In addition, any contractor or other person that fails to submit the required records or make those records available to WHD within the time WHD requests that the records be produced will be precluded from introducing as evidence in an administrative proceeding under [29 CFR part 6](#) any of the required records that were not provided or made available to WHD. WHD will take into consideration a reasonable request from the contractor or person for an extension of the time for submission of records. WHD will determine the reasonableness of the request and may consider, among other things, the location of the records and the volume of production.

(3) *Required information disclosures.* Contractors and subcontractors must maintain the full Social Security number and last known address, telephone number, and email address

of each covered worker, and must provide them upon request to the contracting agency, the State DOT, the FHWA, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or other compliance action.

4. Apprentices and equal employment opportunity (29 CFR 5.5)

a. *Apprentices (1) Rate of pay.* Apprentices will be permitted to work at less than the predetermined rate for the work they perform when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship (OA), or with a State Apprenticeship Agency recognized by the OA. A person who is not individually registered in the program, but who has been certified by the OA or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice, will be permitted to work at less than the predetermined rate for the work they perform in the first 90 days of probationary employment as an apprentice in such a program. In the event the OA or a State Apprenticeship Agency recognized by the OA withdraws approval of an apprenticeship program, the contractor will no longer be permitted to use apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(2) *Fringe benefits.* Apprentices must be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringe benefits must be paid in accordance with that determination.

(3) *Apprenticeship ratio.* The allowable ratio of apprentices to journeyworkers on the job site in any craft classification must not be greater than the ratio permitted to the contractor as to the entire work force under the registered program or the ratio applicable to the locality of the project pursuant to paragraph 4.a.(4) of this section. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated in paragraph 4.a.(1) of this section, must be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under this section must be paid not less than the applicable wage rate on the wage determination for the work actually performed.

(4) *Reciprocity of ratios and wage rates.* Where a contractor is performing construction on a project in a locality other than the locality in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyworker's hourly rate) applicable within the locality in which the construction is being performed must be observed. If there is no applicable ratio or wage rate for the locality of the project, the ratio and wage rate specified in the contractor's registered program must be observed.

b. *Equal employment opportunity.* The use of apprentices and journeyworkers under this part must be in conformity with

the equal employment opportunity requirements of Executive Order 11246, as amended, and [29 CFR part 30](#).

c. Apprentices and Trainees (programs of the U.S. DOT).

Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. 23 CFR 230.111(e)(2). The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeyworkers shall not be greater than permitted by the terms of the particular program.

5. Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract as provided in 29 CFR 5.5.

6. Subcontracts. The contractor or subcontractor must insert FHWA-1273 in any subcontracts, along with the applicable wage determination(s) and such other clauses or contract modifications as the contracting agency may by appropriate instructions require, and a clause requiring the subcontractors to include these clauses and wage determination(s) in any lower tier subcontracts. The prime contractor is responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in this section. In the event of any violations of these clauses, the prime contractor and any subcontractor(s) responsible will be liable for any unpaid wages and monetary relief, including interest from the date of the underpayment or loss, due to any workers of lower-tier subcontractors, and may be subject to debarment, as appropriate. 29 CFR 5.5.

7. Contract termination: debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract as provided in 29 CFR 5.5.

9. Disputes concerning labor standards. As provided in 29 CFR 5.5, disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of eligibility. a. By entering into this contract, the contractor certifies that neither it nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of [40 U.S.C. 3144\(b\)](#) or § 5.12(a).

b. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of [40 U.S.C. 3144\(b\)](#) or § 5.12(a).

c. The penalty for making false statements is prescribed in the U.S. Code, Title 18 Crimes and Criminal Procedure, [18 U.S.C. 1001](#).

11. Anti-retaliation. It is unlawful for any person to discharge, demote, intimidate, threaten, restrain, coerce, blacklist, harass, or in any other manner discriminate against, or to cause any person to discharge, demote, intimidate, threaten, restrain, coerce, blacklist, harass, or in any other manner discriminate against, any worker or job applicant for:

a. Notifying any contractor of any conduct which the worker reasonably believes constitutes a violation of the DBA, Related Acts, this part, or [29 CFR part 1](#) or [3](#);

b. Filing any complaint, initiating or causing to be initiated any proceeding, or otherwise asserting or seeking to assert on behalf of themselves or others any right or protection under the DBA, Related Acts, this part, or [29 CFR part 1](#) or [3](#);

c. Cooperating in any investigation or other compliance action, or testifying in any proceeding under the DBA, Related Acts, this part, or [29 CFR part 1](#) or [3](#); or

d. Informing any other person about their rights under the DBA, Related Acts, this part, or [29 CFR part 1](#) or [3](#).

V. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

Pursuant to 29 CFR 5.5(b), the following clauses apply to any Federal-aid construction contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 29 CFR 5.5(a) or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchpersons and guards.

1. Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek. 29 CFR 5.5.

2. Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph 1. of this section the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages and interest from the date of the underpayment. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or

mechanic, including watchpersons and guards, employed in violation of the clause set forth in paragraph 1. of this section, in the sum currently provided in 29 CFR 5.5(b)(2)* for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph 1. of this section.

* \$31 as of January 15, 2023 (See 88 FR 88 FR 2210) as may be adjusted annually by the Department of Labor, pursuant to the Federal Civil Penalties Inflation Adjustment Act of 1990.

3. Withholding for unpaid wages and liquidated damages

a. *Withholding process.* The FHWA or the contracting agency may, upon its own action, or must, upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor so much of the accrued payments or advances as may be considered necessary to satisfy the liabilities of the prime contractor or any subcontractor for any unpaid wages; monetary relief, including interest; and liquidated damages required by the clauses set forth in this section on this contract, any other Federal contract with the same prime contractor, or any other federally assisted contract subject to the Contract Work Hours and Safety Standards Act that is held by the same prime contractor (as defined in § 5.2). The necessary funds may be withheld from the contractor under this contract, any other Federal contract with the same prime contractor, or any other federally assisted contract that is subject to the Contract Work Hours and Safety Standards Act and is held by the same prime contractor, regardless of whether the other contract was awarded or assisted by the same agency, and such funds may be used to satisfy the contractor liability for which the funds were withheld.

b. *Priority to withheld funds.* The Department has priority to funds withheld or to be withheld in accordance with Section IV paragraph 2.a. or paragraph 3.a. of this section, or both, over claims to those funds by:

- (1) A contractor's surety(ies), including without limitation performance bond sureties and payment bond sureties;
- (2) A contracting agency for its procurement costs;
- (3) A trustee(s) (either a court-appointed trustee or a U.S. trustee, or both) in bankruptcy of a contractor, or a contractor's bankruptcy estate;
- (4) A contractor's assignee(s);
- (5) A contractor's successor(s); or
- (6) A claim asserted under the Prompt Payment Act, [31 U.S.C. 3901](#)–3907.

4. **Subcontracts.** The contractor or subcontractor must insert in any subcontracts the clauses set forth in paragraphs 1. through 5. of this section and a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor is responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs 1. through 5. In the

event of any violations of these clauses, the prime contractor and any subcontractor(s) responsible will be liable for any unpaid wages and monetary relief, including interest from the date of the underpayment or loss, due to any workers of lower-tier subcontractors, and associated liquidated damages and may be subject to debarment, as appropriate.

5. **Anti-retaliation.** It is unlawful for any person to discharge, demote, intimidate, threaten, restrain, coerce, blacklist, harass, or in any other manner discriminate against, or to cause any person to discharge, demote, intimidate, threaten, restrain, coerce, blacklist, harass, or in any other manner discriminate against, any worker or job applicant for:

a. Notifying any contractor of any conduct which the worker reasonably believes constitutes a violation of the Contract Work Hours and Safety Standards Act (CWHSSA) or its implementing regulations in this part;

b. Filing any complaint, initiating or causing to be initiated any proceeding, or otherwise asserting or seeking to assert on behalf of themselves or others any right or protection under CWHSSA or this part;

c. Cooperating in any investigation or other compliance action, or testifying in any proceeding under CWHSSA or this part; or

d. Informing any other person about their rights under CWHSSA or this part.

VI. SUBLETTING OR ASSIGNING THE CONTRACT

This provision is applicable to all Federal-aid construction contracts on the National Highway System pursuant to 23 CFR 635.116.

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the contracting agency. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635.116).

a. The term "perform work with its own organization" in paragraph 1 of Section VI refers to workers employed or leased by the prime contractor, and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor or lower tier subcontractor, agents of the prime contractor, or any other assignees. The term may include payments for the costs of hiring leased employees from an employee leasing firm meeting all relevant Federal and State regulatory requirements. Leased employees may only be included in this term if the prime contractor meets all of the following conditions: (based on longstanding interpretation)

- (1) the prime contractor maintains control over the supervision of the day-to-day activities of the leased employees;
- (2) the prime contractor remains responsible for the quality of the work of the leased employees;

- (3) the prime contractor retains all power to accept or exclude individual employees from work on the project; and
- (4) the prime contractor remains ultimately responsible for the payment of predetermined minimum wages, the submission of payrolls, statements of compliance and all other Federal regulatory requirements.

b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid or propose on the contract as a whole and in general are to be limited to minor components of the overall contract. 23 CFR 635.102.

2. Pursuant to 23 CFR 635.116(a), the contract amount upon which the requirements set forth in paragraph (1) of Section VI is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.

3. Pursuant to 23 CFR 635.116(c), the contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the contracting officer determines is necessary to assure the performance of the contract.

4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the contracting agency has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract. (based on long-standing interpretation of 23 CFR 635.116).

5. The 30-percent self-performance requirement of paragraph (1) is not applicable to design-build contracts; however, contracting agencies may establish their own self-performance requirements. 23 CFR 635.116(d).

VII. SAFETY: ACCIDENT PREVENTION

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR Part 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract. 23 CFR 635.108.

2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and

health standards (29 CFR Part 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704). 29 CFR 1926.10.

3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704).

VIII. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, Form FHWA-1022 shall be posted on each Federal-aid highway project (23 CFR Part 635) in one or more places where it is readily available to all persons concerned with the project:

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 11, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined under this title or imprisoned not more than 5 years or both."

IX. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT (42 U.S.C. 7606; 2 CFR 200.88; EO 11738)

This provision is applicable to all Federal-aid construction contracts in excess of \$150,000 and to all related subcontracts. 48 CFR 2.101; 2 CFR 200.327.

By submission of this bid/proposal or the execution of this contract or subcontract, as appropriate, the bidder, proposer, Federal-aid construction contractor, subcontractor, supplier, or vendor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251-1387). Violations must be reported to the Federal Highway Administration and the Regional Office of the Environmental Protection Agency. 2 CFR Part 200, Appendix II.

The contractor agrees to include or cause to be included the requirements of this Section in every subcontract, and further agrees to take such action as the contracting agency may direct as a means of enforcing such requirements. 2 CFR 200.327.

X. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, consultant contracts or any other covered transaction requiring FHWA approval or that is estimated to cost \$25,000 or more – as defined in 2 CFR Parts 180 and 1200. 2 CFR 180.220 and 1200.220.

1. Instructions for Certification – First Tier Participants:

a. By signing and submitting this proposal, the prospective first tier participant is providing the certification set out below.

b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective first tier participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective first tier participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction. 2 CFR 180.320.

c. The certification in this clause is a material representation of fact upon which reliance was placed when the contracting agency determined to enter into this transaction. If it is later determined that the prospective participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the contracting agency may terminate this transaction for cause of default. 2 CFR 180.325.

d. The prospective first tier participant shall provide immediate written notice to the contracting agency to whom this proposal is submitted if any time the prospective first tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances. 2 CFR 180.345 and 180.350.

e. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180, Subpart I, 180.900-180.1020, and 1200. "First Tier Covered Transactions" refers to any covered transaction between a recipient or subrecipient of Federal funds and a participant (such as the prime or general contract). "Lower Tier Covered Transactions" refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). "First Tier Participant" refers to the participant who has entered into a covered transaction with a recipient or subrecipient of Federal funds (such as the prime or general contract). "Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

f. The prospective first tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction. 2 CFR 180.330.

g. The prospective first tier participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transactions," provided by the department or contracting agency, entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the \$25,000 threshold. 2 CFR 180.220 and 180.300.

h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. 2 CFR 180.300; 180.320, and 180.325. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. 2 CFR 180.335. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the System for Award Management website (<https://www.sam.gov/>). 2 CFR 180.300, 180.320, and 180.325.

i. Nothing contained in the foregoing shall be construed to require the establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of the prospective participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph (f) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default. 2 CFR 180.325.

2. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – First Tier Participants:

a. The prospective first tier participant certifies to the best of its knowledge and belief, that it and its principals:

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency, 2 CFR 180.335;.

(2) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property, 2 CFR 180.800;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (a)(2) of this certification, 2 CFR 180.700 and 180.800; and

(4) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default. 2 CFR 180.335(d).

(5) Are not a corporation that has been convicted of a felony violation under any Federal law within the two-year period preceding this proposal (USDOT Order 4200.6 implementing appropriations act requirements); and

(6) Are not a corporation with any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted, or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability (USDOT Order 4200.6 implementing appropriations act requirements).

b. Where the prospective participant is unable to certify to any of the statements in this certification, such prospective participant should attach an explanation to this proposal. 2 CFR 180.335 and 180.340.

3. Instructions for Certification - Lower Tier Participants:

(Applicable to all subcontracts, purchase orders, and other lower tier transactions requiring prior FHWA approval or estimated to cost \$25,000 or more - 2 CFR Parts 180 and 1200). 2 CFR 180.220 and 1200.220.

a. By signing and submitting this proposal, the prospective lower tier participant is providing the certification set out below.

b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which

this transaction originated may pursue available remedies, including suspension and/or debarment.

c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances. 2 CFR 180.365.

d. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180, Subpart I, 180.900 – 180.1020, and 1200. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations. "First Tier Covered Transactions" refers to any covered transaction between a recipient or subrecipient of Federal funds and a participant (such as the prime or general contractor). "Lower Tier Covered Transactions" refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). "First Tier Participant" refers to the participant who has entered into a covered transaction with a recipient or subrecipient of Federal funds (such as the prime or general contractor). "Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated. 2 CFR 1200.220 and 1200.332.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the \$25,000 threshold. 2 CFR 180.220 and 1200.220.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the System for Award Management website (<https://www.sam.gov/>), which is compiled by the General Services Administration. 2 CFR 180.300, 180.320, 180.330, and 180.335.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily

excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment. 2 CFR 180.325.

* * * * *

4. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Participants:

a. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals:

(1) is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency, 2 CFR 180.355;

(2) is a corporation that has been convicted of a felony violation under any Federal law within the two-year period preceding this proposal (USDOT Order 4200.6 implementing appropriations act requirements); and

(3) is a corporation with any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted, or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability. (USDOT Order 4200.6 implementing appropriations act requirements)

b. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant should attach an explanation to this proposal.

* * * * *

XI. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts which exceed \$100,000. 49 CFR Part 20, App. A.

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or

cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

3. The prospective participant also agrees by submitting its bid or proposal that the participant shall require that the language of this certification be included in all lower tier subcontracts, which exceed \$100,000 and that all such recipients shall certify and disclose accordingly.

XII. USE OF UNITED STATES-FLAG VESSELS:

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, or any other covered transaction. 46 CFR Part 381.

This requirement applies to material or equipment that is acquired for a specific Federal-aid highway project. 46 CFR 381.7. It is not applicable to goods or materials that come into inventories independent of an FHWA funded-contract.

When oceanic shipments (or shipments across the Great Lakes) are necessary for materials or equipment acquired for a specific Federal-aid construction project, the bidder, proposer, contractor, subcontractor, or vendor agrees:

1. To utilize privately owned United States-flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to this contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels. 46 CFR 381.7.

2. To furnish within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, 'on-board' commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (b)(1) of this section to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Office of Cargo and Commercial Sealift (MAR-620), Maritime Administration, Washington, DC 20590. (MARAD requires copies of the ocean carrier's (master) bills of lading, certified onboard, dated, with rates and charges. These bills of lading may contain business sensitive information and therefore may be submitted directly to MARAD by the Ocean Transportation Intermediary on behalf of the contractor). 46 CFR 381.7.

**ATTACHMENT A - EMPLOYMENT AND MATERIALS
PREFERENCE FOR APPALACHIAN DEVELOPMENT
HIGHWAY SYSTEM OR APPALACHIAN LOCAL ACCESS
ROAD CONTRACTS (23 CFR 633, Subpart B, Appendix B)**

This provision is applicable to all Federal-aid projects funded under the Appalachian Regional Development Act of 1965.

1. During the performance of this contract, the contractor undertaking to do work which is, or reasonably may be, done as on-site work, shall give preference to qualified persons who regularly reside in the labor area as designated by the DOL wherein the contract work is situated, or the subregion, or the Appalachian counties of the State wherein the contract work is situated, except:

a. To the extent that qualified persons regularly residing in the area are not available.

b. For the reasonable needs of the contractor to employ supervisory or specially experienced personnel necessary to assure an efficient execution of the contract work.

c. For the obligation of the contractor to offer employment to present or former employees as the result of a lawful collective bargaining contract, provided that the number of nonresident persons employed under this subparagraph (1c) shall not exceed 20 percent of the total number of employees employed by the contractor on the contract work, except as provided in subparagraph (4) below.

2. The contractor shall place a job order with the State Employment Service indicating (a) the classifications of the laborers, mechanics and other employees required to perform the contract work, (b) the number of employees required in each classification, (c) the date on which the participant estimates such employees will be required, and (d) any other pertinent information required by the State Employment Service to complete the job order form. The job order may be placed with the State Employment Service in writing or by telephone. If during the course of the contract work, the information submitted by the contractor in the original job order is substantially modified, the participant shall promptly notify the State Employment Service.

3. The contractor shall give full consideration to all qualified job applicants referred to him by the State Employment Service. The contractor is not required to grant employment to any job applicants who, in his opinion, are not qualified to perform the classification of work required.

4. If, within one week following the placing of a job order by the contractor with the State Employment Service, the State Employment Service is unable to refer any qualified job applicants to the contractor, or less than the number requested, the State Employment Service will forward a certificate to the contractor indicating the unavailability of applicants. Such certificate shall be made a part of the contractor's permanent project records. Upon receipt of this certificate, the contractor may employ persons who do not normally reside in the labor area to fill positions covered by the certificate, notwithstanding the provisions of subparagraph (1c) above.

5. The provisions of 23 CFR 633.207(e) allow the contracting agency to provide a contractual preference for the use of mineral resource materials native to the Appalachian region.

6. The contractor shall include the provisions of Sections 1 through 4 of this Attachment A in every subcontract for work which is, or reasonably may be, done as on-site work.

NON-DISCRIMINATION PROVISIONS

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

1. Compliance with Regulations: The contractor (hereinafter includes consultants) will comply with the Acts and the Regulations relative to Non-discrimination in Federally-assisted programs of the U.S. Department of Transportation, Federal Highway Administration, as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.

2. Non-discrimination: The contractor, with regard to the work performed by it during the contract, will not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor will not participate directly or indirectly in the discrimination prohibited by the Acts and the Regulations, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR Part 21.

3. Solicitations for Subcontracts, Including Procurements of Materials and Equipment: In all solicitations, either by competitive bidding, or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the contractor of the contractor's obligations under this contract and the Acts and the Regulations relative to Non-discrimination on the grounds of race, color, or national origin.

4. Information and Reports: The contractor will provide all information and reports required by the Acts, the Regulations, and directives issued pursuant thereto and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Recipient or the Federal Highway Administration to be pertinent to ascertain compliance with such Acts, Regulations, and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish the information, the contractor will so certify to the Recipient or the Federal Highway Administration, as appropriate, and will set forth what efforts it has made to obtain the information.

5. Sanctions for Noncompliance: In the event of a contractor's noncompliance with the Non-discrimination provisions of this contract, the Recipient will impose such contract sanctions as it or the Federal Highway Administration may determine to be appropriate, including, but not limited to:

- a. Withholding payments to the contractor under the contract until the contractor complies; and/or
- b. Cancelling, terminating, or suspending a contract, in whole or in part.

6. Incorporation of Provisions: The contractor will include the provisions of paragraphs one through six in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations and directives issued pursuant thereto. The contractor will take action with respect to any subcontract or procurement as the Recipient or the Federal Highway Administration may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the contractor may request the Recipient to enter into any litigation to protect the interests of the Recipient. In addition, the contractor may request the United States to enter into the litigation to protect the interests of the United States.

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "contractor") agrees to comply with the following non-discrimination statutes and authorities; including but not limited to:

Pertinent Non-Discrimination Authorities:

- Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d et seq., 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin); and 49 CFR Part 21.
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C. § 4601), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Federal-Aid Highway Act of 1973, (23 U.S.C. § 324 et seq.), (prohibits discrimination on the basis of sex);
- Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. § 794 et seq.), as amended, (prohibits discrimination on the basis of disability); and 49 CFR Part 27;
- The Age Discrimination Act of 1975, as amended, (42 U.S.C. § 6101 et seq.), (prohibits discrimination on the basis of age);
- Airport and Airway Improvement Act of 1982, (49 USC § 471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987, (PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms "programs or activities" to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);
- Titles II and III of the Americans with Disabilities Act, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. §§ 12131-12189) as implemented by Department of Transportation regulations at 49 C.F.R. parts 37 and 38;
- The Federal Aviation Administration's Non-discrimination statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures Non-discrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;
- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of Limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);
- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S.C. 1681 et seq).

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246)

1. The Offeror's or Bidder's attention is called to the "Employment Practices" and "Equal Opportunity Clause" set forth in the Required Contract Provisions, FHWA 1273.
2. The goals and timetables for minority and female participation expressed in percentage terms for the contractor's aggregate work force in each trade, on all construction work in the covered area, are as follows:

Goals for Minority Participation for Each Trade:

<u>County</u>	<u>%</u>	<u>County</u>	<u>%</u>	<u>County</u>	<u>%</u>
Adams	1.7	Iowa	1.7	Polk	2.2
Ashland	1.2	Iron	1.2	Portage	0.6
Barron	0.6	Jackson	0.6	Price	0.6
Bayfield	1.2	Jefferson	7.0	Racine	8.4
Brown	1.3	Juneau	0.6	Richland	1.7
Buffalo	0.6	Kenosha	3.0	Rock	3.1
Burnett	2.2	Kewaunee	1.0	Rusk	0.6
Calumet	0.9	La Crosse	0.9	St. Croix	2.9
Chippewa	0.5	Lafayette	0.5	Sauk	1.7
Clark	0.6	Langlade	0.6	Sawyer	0.6
Columbia	1.7	Lincoln	0.6	Shawano	1.0
Crawford	0.5	Manitowoc	1.0	Sheboygan	7.0
Dane	2.2	Marathon	0.6	Taylor	0.6
Dodge	7.0	Marinette	1.0	Trempealeau	0.6
Door	1.0	Marquette	1.7	Vernon	0.6
Douglas	1.0	Menominee	1.0	Vilas	0.6
Dunn	0.6	Milwaukee	8.0	Walworth	7.0
Eau Claire	0.5	Monroe	0.6	Washburn	0.6
Florence	1.0	Oconto	1.0	Washington	8.0
Fond du Lac	1.0	Oneida	0.6	Waukesha	8.0
Forest	1.0	Outagamie	0.9	Waupaca	1.0
Grant	0.5	Ozaukee	8.0	Waushara	1.0
Green	1.7	Pepin	0.6	Winnebago	0.9
Green Lake	1.0	Pierce	2.2	Wood	0.6

Goals for female participation for each trade: 6.9%

These goals are applicable to all the contractor's construction work, (whether or not it is federal or federally assisted), performed in the covered area. If the contractor performs construction work in the geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and nonfederally involved construction.

The contractor's compliance with the Executive Order and the Regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from contractor to contractor or from project to project for the sole purpose of meeting the contractor's goals shall be a violation of the contract, the Executive Order and the Regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within ten (10) working days of award of any construction subcontract in excess of \$10,000.00 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address and telephone number of the subcontractor, employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

As referred to in this section, the Director means:

Director
Office of Federal Contract Compliance Programs
Ruess Federal Plaza
310 W. Wisconsin Ave., Suite 1115
Milwaukee, WI 53202

The "Employer Identification Number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.

4. As used in this notice, and in the contract resulting from solicitation, the "covered area" is the county(ies) in Wisconsin to which this proposal applies.

ADDITIONAL FEDERAL-AID PROVISIONS

NOTICE TO ALL BIDDERS

To report bid rigging activities call:

1-800-424-9071

The U.S. Department of Transportation (DOT) operates the above toll-free "hotline" Monday through Friday, 8:00 a.m. to 5:00 p.m., Eastern Time. Anyone with knowledge of possible bid rigging, bidding collusion, or other fraudulent activities should use the "hotline" to report such activities.

The "hotline" is part of the DOT's continuing effort to identify and investigate highway construction contract fraud and abuse and is operated under the direction of the DOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.

BUY AMERICA PROVISION

Buy America (as documented in [88 FR 57750 \(2 CFR part 184 and 200\)](#) from the Office of Management and Budget: [Federal Register: Guidance for Grants and Agreements](#)) shall be domestic products and permanently incorporated in this project as classified in the following three categories, and as noted in the Construction and Materials Manual (CMM):

1. Iron and Steel

All iron and steel manufacturing and coating processes (from the initial melting stage through the application of coatings) must have occurred within the United States. Coating includes epoxy coating, galvanizing, painting and any other coating that protects or enhances the value of a material subject to the requirements of Buy America.

The exemption of the iron and steel manufacturing and coating processes Buy America requirement is the minimal use of foreign materials if the total cost of such material permanently incorporated in the product does not exceed one-tenth of one percent (1/10 of 1%) of the total contract cost or \$2,500.00, whichever is greater. For purposes of this paragraph, the cost is that shown to be the value of the subject products as they are delivered to the project.

2. Manufactured Product

All manufactured products (as defined in CMM 228.5) are covered under a previous waiver from 1983 and are currently exempt from Buy America.

3. Construction Material

All construction materials (as defined in [88 FR 57750 \(2 CFR part 184 and 200\)](#) and as referenced in CMM 228.5) must comply with Buy America. All manufacturing process of construction materials must occur in the United States.

[88 FR 55817 \(DOT-OST-2022-0124\)](#) allows a limited waiver of Buy America requirements for de minimis costs and small grants.

- The Total value of the non-compliant products is no more than the lesser of \$1,000,000 or 5% of total applicable costs for the project¹; or
- The total amount of Federal financial assistance applied to the project, through awards or subaward, is below \$500,000²

The contractor shall take actions and provide documentation conforming to CMM 228.5 to ensure compliance with this Buy America provision.

<https://wisconsin.gov/rdwy/cmm/cm-02-28.pdf>

Upon completion of the project, certify to the engineer, in writing using department form DT4567 that all iron and steel, manufactured products, and construction materials conform to this Buy America provision.

Form DT4567 is available at: <https://wisconsin.gov/Documents/formdocs/dt4567.docx>

Attach a list of iron or steel and construction material exemptions and their associated costs to the certification form.

¹ The de minimis public interest waiver does not apply to iron and steel subject to the requirements of 23 U.S.C. 313 on financial assistance administered by FHWA. The de minimis threshold in 23 CFR 635.410(b)(4) continues to apply for iron and steel.

² The small grant portion of the waiver does not apply to iron, steel, and manufactured goods subject to the requirements of 49 U.S.C. 22905(a).

CARGO PREFERENCE ACT REQUIREMENT

All Federal-aid projects shall comply with 46 CFR 381.7 (a) – (b) as follows:

(a) *Agreement Clauses.* “Use of United States-flag vessels:”

(1) Pursuant to Pub. L. 664 (43 U.S.C. 1241(b)) at least 50 percent of any equipment, materials or commodities procured, contracted for or otherwise obtained with funds granted, guaranteed, loaned, or advanced by the U.S. Government under this agreement, and which may be transported by ocean vessel, shall be transported on privately owned United States-flag commercial vessels, if available.

(2) Within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, ‘on-board’ commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (a)(1) of this section shall be furnished to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590.”

(b) *Contractor and Subcontractor Clauses.* “Use of United States-flag vessels: The contractor agrees—”

(1) To utilize privately owned United States-flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to this contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels.

(2) To furnish within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, ‘on-board’ commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (b) (1) of this section to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590.

(3) To insert the substance of the provisions of this clause in all subcontracts issued pursuant to this contract.

**WISCONSIN DEPARTMENT OF TRANSPORTATION
DIVISION OF TRANSPORTATION AND SYSTEM DEVELOPMENT**

**SUPPLEMENTAL REQUIRED CONTRACT PROVISIONS
FOR PROJECTS WITH FEDERAL AID**

I. PREVAILING WAGE RATES

The attached U.S. Department of Labor (Davis-Bacon Minimum Wage Rates) furnishes the minimum prevailing wage rates pursuant to the Davis-Bacon and Related Acts. The wage rates shown are the minimum rates required by the contract to be paid during its life, however this is not a representation that labor can be obtained at these rates. It is the responsibility of bidders to inform themselves as to the local labor conditions and prospective changes or adjustments of wage rates. No increase in the contract price will be allowed or authorized on account of the payment of wage rates in excess of those listed herein.

II. COVERAGE OF TRUCK DRIVERS

Truck drivers are covered by Davis-Bacon Minimum Wage Rates in the following circumstances:

- Drivers of a contractor or subcontractor for time spent working on the site of the work.
- Drivers of a contractor or subcontractor for time spent loading and/or unloading materials and supplies on the site of the work, if such time is not de minimis.
https://www.dol.gov/whd/FOH/FOH_Ch15.pdf
- Truck drivers transporting materials or supplies between a facility that is deemed part of the site of the work and the actual construction site.
- Truck drivers transporting portions of the building or work between a site established specifically for the performance of the contract where a significant portion of such building or work is constructed and the physical place where the building or work called for in the contract will remain.

Truck drivers are not covered by Davis-Bacon Minimum Wage Rates in the following circumstances:

- Material delivery truck drivers while off the site of the work.
- Drivers of a contractor or subcontractor traveling between a Davis-Bacon job and a commercial supply facility while they are off the site of the work.”
- Truck drivers whose time spent on the site of the work is de minimis, such as only a few minutes at a time merely to pick up or drop off materials or supplies.

Details are available online at:

<https://www.dol.gov/whd/recovery/pwrb/Tab9.pdf>

<https://wisconsindot.gov/Pages/doing-bus/civil-rights/labornwage/trckng.aspx>

III. POSTINGS AT THE SITE OF THE WORK

In addition to the required postings furnished by the department, the contractor shall post the following in at least one conspicuous and accessible place at the site of work:

- a. A copy of the contractor's Equal Employment Opportunity Policy.

All required documents shall be posted by the first day of work and be accurate and complete. Postings must be readable, in an area where they will be noticed, and maintained until the last day of work.

IV. RESOURCES

Required information regarding compliance with federal provisions is found in the following resources:

- FHWA-1273 included in this contract
- U.S. Department of Labor Prevailing Wage Resource Book
- U.S. Department of Labor Field Operations Handbook
- U.S. Code of Federal Regulations
- Any applicable law, Act, or Executive Order enacted by the federal government at the time of the letting of this contract

Superseded General Decision Number: WI20230010

State: Wisconsin

Construction Type: Highway

Counties: Wisconsin Statewide.

HIGHWAY, AIRPORT RUNWAY & TAXIWAY CONSTRUCTION PROJECTS (does not include bridges over navigable waters; tunnels; buildings in highway rest areas; and railroad construction)

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$17.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2024.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$12.90 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2024.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

1	01/26/2024
2	02/02/2024
3	02/16/2024
4	03/15/2024
5	05/24/2024
6	06/21/2024
7	06/28/2024
8	07/05/2024

BRWI0001-002 06/01/2023

CRAWFORD, JACKSON, JUNEAU, LA CROSSE, MONROE, TREMPLEAU, AND
VERNON COUNTIES

	Rates	Fringes
BRICKLAYER.....	\$ 40.18	25.88

BRWI0002-002 06/01/2023

ASHLAND, BAYFIELD, DOUGLAS, AND IRON COUNTIES

	Rates	Fringes
BRICKLAYER.....	\$ 47.10	25.16

BRWI0002-005 06/01/2023

ADAMS, ASHLAND, BARRON, BROWN, BURNETT, CALUMET, CHIPPEWA,
CLARK, COLUMBIA, DODGE, DOOR, DUNN, FLORENCE, FOND DU LAC,
FOREST, GREEN LAKE, IRON, JEFFERSON, KEWAUNEE, LANGLADE,
LINCOLN, MANITOWOC, MARATHON, MARINETTE, MARQUETTE, MENOMINEE,
OCONTO, ONEIDA, OUTAGAMIE, POLK, PORTAGE, RUSK, ST CROIX, SAUK,
SHAWANO, SHEBOYGAN, TAYLOR, VILAS, WALWORTH, WAUPACA, WAUSHARA,
WINNEBAGO, AND WOOD COUNTIES

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	\$ 39.97	25.02

BRWI0003-002 06/01/2023

BROWN, DOOR, FLORENCE, KEWAUNEE, MARINETTE, AND OCONTO COUNTIES

	Rates	Fringes
BRICKLAYER.....	\$ 40.00	26.06

BRWI0004-002 06/01/2023

KENOSHA, RACINE, AND WALWORTH COUNTIES

	Rates	Fringes
BRICKLAYER.....	\$ 44.50	26.96

BRWI0006-002 06/01/2023

ADAMS, CLARK, FOREST, LANGLADE, LINCOLN, MARATHON, MENOMINEE,
ONEIDA, PORTAGE, PRICE, TAYLOR, VILAS AND WOOD COUNTIES

Rates	Fringes

BRICKLAYER.....	\$ 40.08	25.98

BRWI0007-002 06/01/2023		
GREEN, LAFAYETTE, AND ROCK COUNTIES		
	Rates	Fringes
BRICKLAYER.....	\$ 40.95	26.80

BRWI0008-002 06/05/2023		
MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES		
	Rates	Fringes
BRICKLAYER.....	\$ 44.96	25.67

BRWI0011-002 06/01/2023		
CALUMET, FOND DU LAC, MANITOWOC, AND SHEBOYGAN COUNTIES		
	Rates	Fringes
BRICKLAYER.....	\$ 40.00	26.06

BRWI0019-002 06/01/2023		
BARRON, BUFFALO, BURNETT, CHIPPEWA, DUNN, EAU CLAIRE, PEPIN, PIERCE, POLK, RUSK, ST. CROIX, SAWYER AND WASHBURN COUNTIES		
	Rates	Fringes
BRICKLAYER.....	\$ 39.32	26.74

BRWI0034-002 06/01/2023		
COLUMBIA AND SAUK COUNTIES		
	Rates	Fringes
BRICKLAYER.....	\$ 41.56	26.19

CARP0068-011 05/02/2022		
BURNETT (W. of Hwy 48), PIERCE (W. of Hwy 29), POLK (W. of Hwys 35, 48 & 65), AND ST. CROIX (W. of Hwy 65) COUNTIES		
	Rates	Fringes
Carpenter & Piledrivermen.....	\$ 41.19	27.05

CARP0264-003 06/05/2023		
KENOSHA, MILWAUKEE, OZAUKEE, RACINE, WAUKESHA, AND WASHINGTON COUNTIES		
	Rates	Fringes
CARPENTER.....	\$ 41.91	29.72

CARP0310-002 06/05/2023

ADAMS, ASHLAND, BAYFIELD (Eastern 2/3), FOREST, IRON, JUNEAU,
LANGLADE, LINCOLN, MARATHON, ONEIDA, PORTAGE, PRICE, SHAWANO
(Western Portion of the County), TAYLOR, VILAS, AND WOOD
COUNTIES

	Rates	Fringes
CARPENTER.....	\$ 38.86	27.06
Piledriver.....	\$ 39.43	27.02

CARP0314-001 06/05/2023

COLUMBIA, DANE, DODGE, GRANT, GREEN, IOWA, JEFFERSON,
LAFAYETTE, RICHLAND, ROCK, SAUK, AND WALWORTH COUNTIES

	Rates	Fringes
CARPENTER.....	\$ 38.86	27.06
Piledriver.....	\$ 39.43	27.02

CARP0361-004 05/01/2018

BAYFIELD (West of Hwy 63) AND DOUGLAS COUNTIES

	Rates	Fringes
CARPENTER.....	\$ 36.15	20.43

CARP0731-002 06/05/2023

CALUMET (Eastern Portion of the County), FOND DU LAC (Eastern
Portion of the County), MANITOWOC, AND SHEBOYGAN COUNTIES

	Rates	Fringes
CARPENTER.....	\$ 38.86	27.06
Piledriver.....	\$ 39.43	27.02

CARP0955-002 06/05/2023

CALUMET (Western Portion of the County), FOND DU LAC (Western
Portion of the County), GREEN LAKE, MARQUETTE, OUTAGAMIE,
WAUPACA, WAUSHARA, AND WINNEBAGO

	Rates	Fringes
CARPENTER.....	\$ 38.86	27.06
PILEDRIIVER.....	\$ 39.43	27.02

CARP1056-002 06/01/2023

ADAMS, ASHLAND, BARRON, BAYFIELD , BROWN, BUFFALO, BURNETT
,CALUMET, CHIPPEWA, CLARK, COLUMBIA, CRAWFORD, DANE, DODGE,
DOOR, DUNN, EAU CLAIRE, FLORENCE, FOND DU LAC, FOREST, GRANT,
GREEN, GREEN LAKE, IOWA, IRON, JACKSON, JEFFERSON, JUNEAU,
KEWAUNEE, LA CROSSE, LAFAYETTE, LANGLADE, LINCOLN, MANITOWOC,
MARATHON, MARINETTE, MARQUETTE, MENOMINEE, MONROE, OCONTO,
ONEIDA, OUTAGAMIE, PEPIN, PIERCE (E. of Hwy. 29 & 65), POLK (E.
of Hwy. 35, 48 & 65), PORTAGE, PRICE, RICHLAND, ROCK, RUSK,

SAUK, SAWYER, SHAWANO, SHEBOYGAN, ST. CROIX (E. of Hwy. 65),
TAYLOR, TREMPLEALEAU, VERNON, VILAS, WALWORTH, WASHBURN,
WAUPACA, WAUSHARA, WINNEBAGO, AND WOOD COUNTIES

	Rates	Fringes
MILLWRIGHT.....	\$ 40.00	27.77

CARP1074-002 06/05/2023

BARRON, BURNETT, CHIPPEWA, CLARK, DUNN, EAU CLAIRE, PEPIN,
PIERCE (E. of Hwy. 29 & 65), POLK (E. of Hwy. 35, 48 & 65),
RUSK, SAWYER, ST. CROIX (E. of Hwy. 65), AND WASHBURN

	Rates	Fringes
CARPENTER.....	\$ 38.86	27.06
PILEDRIIVER.....	\$ 39.43	27.02

CARP1143-002 06/05/2023

BUFFALO, CRAWFORD, JACKSON, LA CROSSE, MONROE, TREMPLEALEAU AND
VERNON COUNTIES

	Rates	Fringes
CARPENTER.....	\$ 38.86	27.06
PILEDRIIVER.....	\$ 39.43	27.02

CARP1146-002 06/05/2023

BROWN, DOOR, FLORENCE, KEWAUNEE, MARINETTE, MENOMINEE, OCONTO,
AND SHAWANO (Western Portion of the County) COUNTIES

	Rates	Fringes
CARPENTER.....	\$ 38.86	27.06
PILEDRIIVER.....	\$ 39.43	27.02

CARP2337-009 06/05/2023

KENOSHA, MILWAUKEE, OZAUKEE, RACINE, WASHINGTON, AND WAUKESHA

	Rates	Fringes
PILEDRIVERMAN.....	\$ 39.22	34.01

ELEC0014-002 05/26/2024

ASHLAND, BARRON, BAYFIELD, BUFFALO, BURNETT, CHIPPEWA, CLARK
(except Maryville, Colby, Unity, Sherman, Fremont, Lynn &
Sherwood), CRAWFORD, DUNN, EAU CLAIRE, GRANT, IRON, JACKSON, LA
CROSSE, MONROE, PEPIN, PIERCE, POLK, PRICE, RICHLAND, RUSK, ST
CROIX, SAWYER, TAYLOR, TREMPLEALEAU, VERNON, AND WASHBURN
COUNTIES

	Rates	Fringes
Electricians:.....	\$ 42.73	23.99

ELEC0014-007 05/26/2024

REMAINING COUNTIES

	Rates	Fringes
Teledata System Installer		
Installer/Technician.....	\$ 30.27	19.11

Low voltage construction, installation, maintenance and removal of teledata facilities (voice, data, and video) including outside plant, telephone and data inside wire, interconnect, terminal equipment, central offices, PABX, fiber optic cable and equipment, micro waves, V-SAT, bypass, CATV, WAN (wide area networks), LAN (local area networks), and ISDN (integrated systems digital network).

ELEC0127-002 06/01/2023

KENOSHA COUNTY

	Rates	Fringes
Electricians:.....	\$ 46.05	30%+13.15

ELEC0158-002 05/30/2021

BROWN, DOOR, KEWAUNEE, MANITOWOC (except Schleswig), MARINETTE(Wausuakee and area South thereof), OCONTO, MENOMINEE (East of a line 6 miles West of the West boundary of Oconto County), SHAWANO (Except Area North of Townships of Aniwa and Hutchins) COUNTIES

	Rates	Fringes
ELECTRICIAN.....	\$ 36.14	29.75%+10.26

ELEC0159-003 05/30/2021

COLUMBIA, DANE, DODGE (Area West of Hwy 26, except Chester and Emmet Townships), GREEN, LAKE (except Townships of Berlin, Seneca, and St. Marie), IOWA, MARQUETTE (except Townships of Neshkoka, Crystal Lake, Newton, and Springfield), and SAUK COUNTIES

	Rates	Fringes
ELECTRICIAN.....	\$ 43.38	23.13

ELEC0219-004 06/01/2019

FLORENCE COUNTY (Townships of Aurora, Commonwealth, Fern, Florence and Homestead) AND MARINETTE COUNTY (Township of Niagara)

	Rates	Fringes
Electricians:		
Electrical contracts over \$180,000.....	\$ 33.94	21.80
Electrical contracts under		

\$180,000.....	\$ 31.75	21.73

ELEC0242-005 05/30/2021

DOUGLAS COUNTY

	Rates	Fringes
Electricians:.....	\$ 41.37	69.25%

ELEC0388-002 06/01/2023

ADAMS, CLARK (Colby, Freemont, Lynn, Mayville, Sherman, Sherwood, Unity), FOREST, JUNEAU, LANGLADE, LINCOLN, MARATHON, MARINETTE (Beecher, Dunbar, Goodman & Pembine), MENOMINEE (Area West of a line 6 miles West of the West boundary of Oconto County), ONEIDA, PORTAGE, SHAWANO (Aniwa and Hutchins), VILAS AND WOOD COUNTIES

	Rates	Fringes
Electricians:.....	\$ 38.74	26%+11.76

ELEC0430-002 06/01/2023

RACINE COUNTY (Except Burlington Township)

	Rates	Fringes
Electricians:.....	\$ 46.70	25.02

ELEC0494-005 05/28/2023

MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
Electricians:.....	\$ 47.75	26.72

ELEC0494-006 05/28/2023

CALUMET (Township of New Holstein), DODGE (East of Hwy 26 including Chester Township), FOND DU LAC, MANITOWOC (Schleswig), and SHEBOYGAN COUNTIES

	Rates	Fringes
Electricians:.....	\$ 41.40	23.90

ELEC0494-013 05/28/2023

DODGE (East of Hwy 26 including Chester Twp, excluding Emmet Twp), FOND DU LAC (Except Waupun), MILWAUKEE, OZAUKEE, MANITOWOC (Schleswig), WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
Sound & Communications		
Installer.....	\$ 34.65	18.36
Technician.....	\$ 34.65	18.36

Installation, testing, maintenance, operation and servicing

of all sound, intercom, telephone interconnect, closed circuit TV systems, radio systems, background music systems, language laboratories, electronic carillon, antenna distribution systems, clock and program systems and low-voltage systems such as visual nurse call, audio/visual nurse call systems, doctors entrance register systems. Includes all wire and cable carrying audio, visual, data, light and radio frequency signals. Includes the installation of conduit, wiremold, or raceways in existing structures that have been occupied for six months or more where required for the protection of the wire or cable, but does not mean a complete conduit or raceway system. work covered does not include the installation of conduit, wiremold or any raceways in any new construction, or the installation of power supply outlets by means of which external electric power is supplied to any of the foregoing equipment or products

ELEC0577-003 06/01/2023

CALUMET (except Township of New Holstein), GREEN LAKE (N. part including Townships of Berlin, St Marie, and Seneca), MARQUETTE (N. part including Townships of Crystal Lake, Neshkoro, Newton, and Springfield), OUTAGAMIE, WAUPACA, WAUSHARA, AND WINNEBAGO COUNTIES

	Rates	Fringes
Electricians:.....	\$ 38.94	29.50%+10.00

* ELEC0890-003 06/01/2024

DODGE (Emmet Township only), GREEN, JEFFERSON, LAFAYETTE, RACINE (Burlington Township), ROCK AND WALWORTH COUNTIES

	Rates	Fringes
Electricians:.....	\$ 43.65	25.95%+12.26

ELEC0953-001 06/02/2019

	Rates	Fringes
Line Construction:		
(1) Lineman.....	\$ 47.53	21.43
(2) Heavy Equipment Operator.....	\$ 42.78	19.80
(3) Equipment Operator.....	\$ 38.02	18.40
(4) Heavy Groundman Driver..	\$ 33.27	16.88
(5) Light Groundman Driver..	\$ 30.89	16.11
(6) Groundsman.....	\$ 26.14	14.60

ENGI0139-005 06/01/2023

	Rates	Fringes
Power Equipment Operator		
Group 1.....	\$ 43.77	27.40
Group 2.....	\$ 43.27	27.40
Group 3.....	\$ 42.77	27.40
Group 4.....	\$ 42.51	27.40
Group 5.....	\$ 42.22	27.40

HAZARDOUS WASTE PREMIUMS:

EPA Level ""A"" protection - \$3.00 per hour
EPA Level ""B"" protection - \$2.00 per hour
EPA Level ""C"" protection - \$1.00 per hour

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Cranes, tower cranes, and derricks with or without attachments with a lifting capacity of over 100 tons; or cranes, tower cranes, and derricks with boom, leads and/or jib lengths measuring 176 feet or longer.

GROUP 2: Cranes, tower cranes and derricks with or without attachments with a lifting capacity of 100 tons or less; or cranes, tower cranes, and derricks with boom, leads, and/or jibs lengths measuring 175 feet or under and Backhoes (excavators) weighing 130,000 lbs and over; caisson rigs; pile driver; dredge operator; dredge engineer; Boat Pilot.

GROUP 3: Mechanic or welder - Heavy duty equipment; cranes with a lifting capacity of 25 tons or under; concrete breaker (manual or remote); vibratory/sonic concrete breaker; concrete laser screed; concrete slipform paver; concrete batch plant operator; concrete pvt. spreader - heavy duty (rubber tired); concrete spreader & distributor; automatic subgrader (concrete); concrete grinder & planing machine; concrete slipform curb & gutter machine; slipform concrete placer; tube finisher; hydro blaster (10,000 psi & over); bridge paver; concrete conveyor system; concrete pump; Rotec type Conveyor; stabilizing mixer (self-propelled); shoulder widener; asphalt plant engineer; bituminous paver; bump cutter & grooving machine; milling machine; screed (bituminous paver); asphalt heater, planer & scarifier; Backhoes (excavators) weighing under 130,000 lbs; grader or motor patrol; tractor (scraper, dozer, pusher, loader); scraper - rubber tired (single or twin engine); endloader; hydraulic backhoe (tractor type); trenching machine; skid rigs; tractor, side boom (heavy); drilling or boring machine (mechanical heavy); roller over 5 tons; percussion or rotary drilling machine; air track; blaster; loading machine (conveyor); tugger; boatmen; winches & A-frames; post driver; material hoist.

GROUP 4: Greaser, roller steel (5 tons or less); roller (pneumatic tired) - self propelled; tractor (mounted or towed compactors & light equipment); shouldering machine; self-propelled chip spreader; concrete spreader; finishing machine; mechanical float; curing machine; power subgrader; joint sawer (multiple blade) belting machine; burlap machine; texturing machine; tractor endloader (rubber tired) - light; jeep digger; forklift; mulcher; launch operator; fireman, environmental burner

GROUP 5: Air compressor; power pack; vibrator hammer and extractor; heavy equipment, leadman; tank car heaters; stump chipper; curb machine operator; Concrete proportioning plants; generators; mudjack operator; rock breaker; crusher or screening plant; screed (milling machine); automatic belt conveyor and surge bin; pug mill operator; Oiler, pump (over 3 inches); Drilling Machine Tender, day light machine

GROUP 6: Off-road material hauler with or without ejector.

IRON0008-002 06/01/2023

BROWN, CALUMET, DOOR, FOND DU LAC, KEWAUNEE, MANITOWOC,
MARINETTE, OCONTO, OUTAGAMI, SHAWANO, SHEBOYGAN, AND WINNEBAGO
COUNTIES:

	Rates	Fringes
IRONWORKER.....	\$ 41.73	30.67

Paid Holidays: New Year's Day, Memorial Day, July 4th, Labor
Day, Thanksgiving Day & Christmas Day.

IRON0008-003 06/01/2023

KENOSHA, MILWAUKEE, OZAUCKEE, RACINE, WALWORTH (N.E. 2/3),
WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
IRONWORKER.....	\$ 43.40	30.67

Paid Holidays: New Year's Day, Memorial Day, July 4th, Labor
Day, Thanksgiving Day & Christmas Day.

IRON0383-001 06/02/2024

ADAMS, COLUMBIA, CRAWFORD, DANE, DODGE, FLORENCE, FOREST,
GRANT, GREENE, (Excluding S.E. tip), GREEN LAKE, IOWA,
JEFFERSON, JUNEAU, LA CROSSE, LAFAYETTE, LANGLADE, MARATHON,
MARQUETTE, MENOMINEE, MONROE, PORTAGE, RICHLAND, ROCK (Northern
area, vicinity of Edgerton and Milton), SAUK, VERNON, WAUPACA,
WAUSHARA, AND WOOD COUNTIES

	Rates	Fringes
IRONWORKER.....	\$ 42.00	31.93

IRON0498-005 06/01/2023

GREEN (S.E. 1/3), ROCK (South of Edgerton and Milton), and
WALWORTH (S.W. 1/3) COUNTIES:

	Rates	Fringes
IRONWORKER.....	\$ 45.18	47.08

IRON0512-008 04/30/2023

BARRON, BUFFALO, CHIPPEWA, CLARK, DUNN, EAU CLAIRE, JACKSON,
PEPIN, PIERCE, POLK, RUSK, ST CROIX, TAYLOR, AND TREMPLEAU
COUNTIES

	Rates	Fringes
IRONWORKER.....	\$ 43.00	34.11

IRON0512-021 04/30/2023

ASHLAND, BAYFIELD, BURNETT, DOUGLAS, IRON, LINCOLN, ONEIDA,
PRICE, SAWYER, VILAS AND WASHBURN COUNTIES

	Rates	Fringes
IRONWORKER.....	\$ 39.14	34.00

LAB00113-002 06/03/2024

MILWAUKEE AND WAUKESHA COUNTIES

	Rates	Fringes
LABORER		
Group 1.....	\$ 35.61	25.01
Group 2.....	\$ 35.76	25.01
Group 3.....	\$ 35.96	25.01
Group 4.....	\$ 36.11	25.01
Group 5.....	\$ 36.26	25.01
Group 6.....	\$ 32.10	25.01

LABORERS CLASSIFICATIONS

GROUP 1: General Laborer; Tree Trimmer; Conduit Layer;
Demolition and Wrecking Laborer; Guard Rail, Fence, and
Bridge Builder; Landscaper; Multiplate Culvert Assembler;
Stone Handler; Bituminous Worker (Shoveler, Loader, and
Utility Man); Batch Truck Dumper or Cement Handler;
Bituminous Worker (Dumper, Ironer, Smoother, and Tamper);
Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawyer and Filler
(Pavement); Vibrator or Tamper Operator (Mechanical Hand
Operated); Chain Saw Operator; Demolition Burning Torch
Laborer

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter
(Curb, Sidewalk, and Pavement); Strike Off Man

GROUP 4: Line and Grade Specialist

GROUP 5: Blaster and Powderman

GROUP 6: Flagperson; traffic control person

LAB00113-003 06/03/2024

OZAUKEE AND WASHINGTON COUNTIES

	Rates	Fringes
LABORER		
Group 1.....	\$ 34.86	25.01
Group 2.....	\$ 34.96	25.01
Group 3.....	\$ 35.01	25.01
Group 4.....	\$ 35.21	25.01
Group 5.....	\$ 35.06	25.01
Group 6.....	\$ 31.95	25.01

LABORERS CLASSIFICATIONS

GROUP 1: General Laborer; Tree Trimmer; Conduit Layer; Demolition and Wrecking Laborer; Guard Rail, Fence, and Bridge Builder; Landscaper; Multiplate Culvert Assembler; Stone Handler; Bituminous Worker (Shoveler, Loader, and Utility Man); Batch Truck Dumper or Cement Handler; Bituminous Worker (Dumper, Ironer, Smoother, and Tamper); Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawyer and Filler (Pavement); Vibrator or Tamper Operator (Mechanical Hand Operated);

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter (Curb, Sidewalk, and Pavement); Strike Off Man

GROUP 4: Line and Grade Specialist

GROUP 5: Blaster; powderman

GROUP 6: Flagperson and Traffic Control Person

LAB00113-011 06/03/2024

KENOSHA AND RACINE COUNTIES

	Rates	Fringes
LABORER		
Group 1.....	\$ 34.67	25.01
Group 2.....	\$ 34.82	25.01
Group 3.....	\$ 35.02	25.01
Group 4.....	\$ 34.99	25.01
Group 5.....	\$ 35.52	25.01
Group 6.....	\$ 31.81	25.01

LABORERS CLASSIFICATIONS:

GROUP 1: General laborer; Tree Trimmer; Conduit Layer; Demolition and Wrecking Laborer; Guard Rail, Fence, and Bridge Builder; Landscaper; Multiplate Culvert Assembler; Stone Handler; Bituminous Worker (Shoveler, Loader, and Utility Man); Batch Truck Dumper or Cement Handler; Bituminous worker (Dumper, Ironer, Smoother, and Tamper); Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawyer and Filler (Pavement); Vibrator or Tamper Operator (Mechanical Hand Operated); Chain Saw Operator; Demolition Burning Torch Laborer

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter (Curb, Sidewalk, and Pavement); Strike Off Man

GROUP 4: Line and Grade Specialist

GROUP 5: Blaster and Powderman

GROUP 6: Flagman; traffic control person

LAB00140-002 06/03/2024

ADAMS, ASHLAND, BARRON, BAYFIELD, BROWN, BUFFALO, BURNETT,

CALUMET, CHIPPEWA, CLARK, COLUMBIA, CRAWFORD, DODGE, DOOR,
DOUGLAS, DUNN, EAU CLAIRE, FLORENCE, FOND DU LAC, FOREST,
GRANT, GREEN, GREEN LAKE, IRON, JACKSON, JUNEAU, IOWA,
JEFFERSON, KEWAUNEE, LA CROSSE, LAFAYETTE, LANGLADE, LINCOLN,
MANITOWOC, MARATHON, MARINETTE, MARQUETTE, MENOMINEE, MONROE,
OCONTO, ONEIDA, OUTAGAMIE, PEPIN, PIERCE, POLK, PORTAGE, PRICE,
RICHLAND, ROCK, RUSK, SAUK, SAWYER, SHAWANO, SHEBOYGAN, ST.
CROIX, TAYLOR, TREMPLEAU, VERNON, VILLAS, WALWORTH, WASHBURN,
WAUPACA, WAUSHARA, WINNEBAGO, AND WOOD COUNTIES

	Rates	Fringes
LABORER		
Group 1.....	\$ 40.57	19.45
Group 2.....	\$ 40.67	19.45
Group 3.....	\$ 40.72	19.45
Group 4.....	\$ 40.92	19.45
Group 5.....	\$ 40.77	19.45
Group 6.....	\$ 37.20	19.45

LABORER CLASSIFICATIONS

GROUP 1: General Laborer; Tree Trimmer; Conduit Layer;
Demolition and Wrecking Laborer; Guard Rail, Fence, and
Bridge Builder; Landscaper; Multiplate Culvert Assembler;
Stone Handler; Bituminous Worker (Shoveler, Loader, and
Utility Man); Batch Truck Dumper or Cement Handler;
Bituminous Worker (Dumper, Ironer, Smoother and Tamper);
Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawyer and Filler
(Pavement); Vibrator or Tamper Operator (Mechanical Hand
Operated); Chain Saw Operator, Demolition Burning Torch
Laborer

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter
(Curb, Sidewalk and Pavement); Strike Off Man

GROUP 4: Line and Grade Specialist

GROUP 5: Blaster; powderman

GROUP 6: Flagperson; Traffic Control

LAB00464-003 06/03/2024

DANE COUNTY

	Rates	Fringes
LABORER		
Group 1.....	\$ 40.85	19.45
Group 2.....	\$ 40.95	19.45
Group 3.....	\$ 41.00	19.45
Group 4.....	\$ 41.20	19.45
Group 5.....	\$ 41.05	19.45
Group 6.....	\$ 37.20	19.45

LABORERS CLASSIFICATIONS:

GROUP 1: General Laborer; Tree Trimmer; Conduit Layer;
Demolition and Wrecking Laborer; Guard Rail, Fence, and
Bridge Builder; Landscaper; Multiplate Culvert Assembler;

Stone Handler; Bituminous Worker (Shoveler, Loader, and Utility Man); Batch Truck Dumper or Cement Handler; Bituminous Worker (Dumper, Ironer, Smoother, and Tamper); Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawyer and Filler (Pavement); Vibrator or Tamper Operator (Mechanical Hand Operated); Chain Saw Operator; Demolition Burning Torch Laborer

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter (Curb, Sidewalk, and Pavement); Strike Off Man

GROUP 4: Line and Grade Specialist

GROUP 5: Blaster; Powderman

GROUP 6: Flagperson and Traffic Control Person

PAIN0106-008 05/06/2024

ASHLAND, BAYFIELD, BURNETT, AND DOUGLAS COUNTIES

	Rates	Fringes
Painters:		
New:		
Brush, Roller.....	\$ 36.16	26.27
Spray, Sandblast, Steel....	\$ 36.76	26.27
Repaint:		
Brush, Roller.....	\$ 34.66	26.27
Spray, Sandblast, Steel....	\$ 35.26	26.27

PAIN0108-002 06/01/2023

RACINE COUNTY

	Rates	Fringes
Painters:		
Brush, Roller.....	\$ 41.04	21.95
Spray & Sandblast.....	\$ 42.04	21.95

PAIN0259-002 05/01/2008

BARRON, CHIPPEWA, DUNN, EAU CLAIRE, PEPIN, PIERCE, POLK, RUSK, SAWYER, ST. CROIX, AND WASHBURN COUNTIES

	Rates	Fringes
PAINTER.....	\$ 24.11	12.15

PAIN0259-004 05/01/2015

BUFFALO, CRAWFORD, JACKSON, LA CROSSE, MONROE, TREMPLEAU, AND VERNON COUNTIES

	Rates	Fringes
PAINTER.....	\$ 22.03	12.45

PAIN0781-002 06/01/2024

JEFFERSON, MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
Painters:		
Bridge.....	\$ 41.39	24.92
Brush.....	\$ 40.64	24.92
Spray & Sandblast.....	\$ 41.39	24.92

PAIN0802-002 06/01/2024

COLUMBIA, DANE, DODGE, GRANT, GREEN, IOWA, LAFAYETTE, RICHLAND,
ROCK, AND SAUK COUNTIES

	Rates	Fringes
PAINTER		
Brush.....	\$ 36.35	20.87

PREMIUM PAY:
Structural Steel, Spray, Bridges = \$1.00 additional per
hour.

PAIN0802-003 06/01/2024

ADAMS, BROWN, CALUMET, CLARK, DOOR, FOND DU LAC, FOREST, GREEN
LAKE, IRON, JUNEAU, KEWAUNEE, LANGLADE, LINCOLN, MANITOWOC,
MARATHON, MARINETTE, MARQUETTE, MENOMINEE, OCONTO, ONEIDA,
OUTAGAMIE, PORTAGE, PRICE, SHAWANO, SHEBOYGAN, TAYLOR, VILAS,
WAUSHARA, WAUPACA, WINNEBAGO, AND WOOD COUNTIES

	Rates	Fringes
PAINTER.....	\$ 36.35	20.87

PAIN0934-001 06/01/2022

KENOSHA AND WALWORTH COUNTIES

	Rates	Fringes
Painters:		
Brush.....	\$ 36.70	24.69
Spray.....	\$ 37.70	24.69
Structural Steel.....	\$ 36.85	24.69

PAIN1011-002 06/02/2024

FLORENCE COUNTY

	Rates	Fringes
Painters:.....	\$ 29.95	15.89

PLAS0599-002 06/01/2023

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER		
Area A.....	\$ 45.17	27.27
Area B.....	\$ 39.97	25.02

Area C.....	\$ 40.40	25.25
Area D.....	\$ 41.16	24.49
Area E.....	\$ 40.50	25.14
Area F.....	\$ 36.98	28.67

AREA DESCRIPTIONS

AREA A: ASHLAND, BURNETT, BAYFIELD, DOUGLAS, IRON, PRICE, SAWYER, AND WASHBURN COUNTIES

AREA B: ADAMS, BARRON, BROWN, CALUMET, CHIPPEWA, CLARK, COLUMBIA, DODGE, DOOR, DUNN, FLORENCE, FOND DU LAC, FOREST, GREEN LAKE, JEFFERSON, KEWAUNEE, LANGLADE, LINCOLN, MANITOWOC, MARATHON, MARINETTE, MARQUETTE, MENOMINEE, OCONTO, ONEIDA, OUTAGAMIE, POLK, PORTAGE, RUSK, ST. CROIX, SAUK, SHAWANO, SHEBOYGAN, TAYLOR, VILAS, WALWORTH, WAUPACA, WAUSHARA, WINNEBAGO, AND WOOD COUNTIES

AREA C: BUFFALO, CRAWFORD, EAU CLAIRE, JACKSON, JUNEAU, LA CROSSE, MONROE, PEPIN, PIERCE, RICHLAND, TREMPLEAU, AND VERNON COUNTIES

AREA D: MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

AREA E: DANE, GRANT, GREEN, IOWA, LAFAYETTE, AND ROCK COUNTIES

AREA F: KENOSHA AND RACINE COUNTIES

TEAM0039-001 06/01/2024

	Rates	Fringes
TRUCK DRIVER		
1 & 2 Axles.....	\$ 37.57	27.41
3 or more Axles; Euclids, Dumpton & Articulated, Truck Mechanic.....	\$ 37.72	27.41

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union

average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

State Adopted Rate Identifiers

Classifications listed under the "SA" identifier indicate that the prevailing wage rate set by a state (or local) government was adopted under 29 C.F.R. 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 01/03/2024 reflects the date on which the classifications and rates under the "SA" identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the

interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

Superseded General Decision Number: WI20230016

State: Wisconsin

Construction Type: Building

Counties: Calumet, Outagamie, Sheboygan and Winnebago
Counties in Wisconsin.

BUILDING CONSTRUCTION PROJECTS (does not include residential construction consisting of single family homes and apartments up to and including 4 stories)

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$17.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2024.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$12.90 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2024.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number	Publication Date
0	01/05/2024
1	01/12/2024
2	02/02/2024
3	02/16/2024
4	03/01/2024
5	04/12/2024
6	05/24/2024
7	06/14/2024
8	06/21/2024
9	06/28/2024

ASBE0127-001 06/01/2024

Rates	Fringes

Asbestos Removal
worker/hazardous material
handler (Includes
preparation, wetting,
stripping, removal,
scrapping, vacuuming, bagging
and disposing of all
insulation materials from
mechanical systems whether
they contain asbestos or not)....\$ 43.24 28.56

BOIL0107-001 01/01/2021

Rates	Fringes

BOILERMAKER
Boilermaker.....\$ 39.52 31.50
Small Boiler Repair (under
25,000 lbs/hr).....\$ 26.91 16.00

BRWI0011-003 06/01/2023

Rates	Fringes

BRICKLAYER
Bricklayer, Cement Mason,
Plasterer, Tile Layer.....\$ 40.00 26.06

CARP0731-007 06/05/2023

CALUMET (Eastern Portion of the County) AND SHEBOYGAN COUNTIES

Rates	Fringes

CARPENTER (Including Drywall
Hanging, Acoustical work,
Excluding Batt Insulation).....\$ 38.86 27.06
Soft Floor Layer,
Piledriverman.....\$ 39.43 27.02

CARP0955-005 06/05/2023

CALUMET (Western Portion of the County), OUTAGAMIE, AND
WINNEBAGO COUNTIES

Rates	Fringes

CARPENTER (Including Drywall

Hanging, Acoustical work, Excluding Batt Insulation).....\$ 38.86	27.06
Soft Floor Layer, Piledriverman.....\$ 39.43	27.02

CARP1056-001 06/01/2023

	Rates	Fringes
MILLWRIGHT.....\$ 40.00		27.77

ELEC0494-003 05/28/2023

	Rates	Fringes
Sound & Communications Installer.....\$ 34.65		18.36
Technician.....\$ 34.65		18.36

Installation, testing, maintenance, operation and servicing of all sound, intercom, telephone interconnect, closed circuit TV systems, radio systems, background music systems, language laboratories, electronic carillion, antenna distribution systems, clock and program systems and low-voltage systems such as visual nurse call, audio/visual nurse call systems, doctors entrance register systems. Includes all wire and cable carrying audio, visual, data, light and radio frequency signals. Includes the installation of conduit, wiremold, or raceways in existing structures that have been occupied for six months or more where required for the protection of the wire or cable, but does not mean a complete conduit or raceway system. work covered does not include the installation of conduit, wiremold or any raceways in any new construction, or the installation of power supply outlets by means of which external electric power is supplied to any of the foregoing equipment or products

ELEC0494-012 05/28/2023

CALUMET (New Holstein Twp.) & SHEBOYGAN COUNTIES

	Rates	Fringes
ELECTRICIAN.....\$ 41.40		23.90

ELEC0577-002 06/01/2023

CALUMET (Except Township of New Holstein), OUTAGAMIE, AND WINNEBAGO COUNTIES

	Rates	Fringes
ELECTRICIAN.....\$ 38.94		29.50%+10.00

ENGI0139-002 06/03/2024

	Rates	Fringes
OPERATOR: Power Equipment Group 1.....\$ 48.78		27.14
Group 2.....\$ 47.53		27.14
Group 3.....\$ 44.23		27.14

Group 4.....	\$ 43.70	27.14
Group 5.....	\$ 41.63	27.14
Group 6.....	\$ 40.10	27.14

HAZARDOUS WASTE PREMIUMS:

EPA Level ""A"" Protection: \$3.00 per hour

EPA Level ""B"" Protection: \$2.00 per hour

EPA Level ""C"" Protection: \$1.00 per hour

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Cranes, Tower Cranes and Derricks with or without attachments with a lifting capacity of over 100 tons; Cranes, Tower Cranes, and Derricks with boom, leads and/or jib lengths 176 ft or longer.

GROUP 2: Backhoes (Excavators) weighing 130,000 lbs & over; Cranes, Tower Cranes and Derricks with or without attachments with a lifting capacity of 100 tons or less; Cranes, Tower Cranes, and Derricks with boom, leads, and/or jib lengths 175 ft or less; Caisson Rigs; Pile Driver

GROUP 3: Backhoes (Excavators) weighing under 130,000 lbs; Travelling Crane (bridge type); Milling Machine; Concrete Paver over 27 E; Concrete Spreader and Distributor; Concrete Laser Screed; Concrete Grinder and Planing Machine; Slipform Curb and Gutter Machine; Boring Machine (Directional); Dredge Operator; Skid Rigs; Over 46 meter Concrete Pump.

GROUP 4: Hydraulic Backhoe (tractor or truck mounted); Hydraulic Crane, 10 tons or less; Tractor, Bulldozer, or End Loader (over 40 hp); Motor Patrol; Scraper Operator; Bituminous Plant and Paver Operator; Screed-Milling Machine; Roller over 5 tons; Concrete Pumps 46 meter & under; Grout Pumps; Rotec Type Machine; Hydro Blaster, 10,000 psi and over; Rotary Drill Operator; Percussion Drilling Machine; Air Track Drill with or without integral hammer; Blaster; Boring Machine (vertical or horizontal); Side Boom; Trencher, wheel type or chain type having 8 inch or larger bucket; Rail Leveling Machine (Railroad); Tie Placer; Tie Extractor; Tie Tamper; Stone Leveler; Straddle Carrier; Material Hoists; Stack Hoist; Man Hoists; Mechanic and Welder; Off Road Material Haulers

GROUP 5: Tractor, Bulldozer, or Endloader (under 40 hp); Tampers -Compactors, riding type; Stump Chipper, large; Roller, Rubber Tire; Backfiller; Trencher, chain type (bucket under 8 inch); Concrete Auto Breaker, large; Concrete Finishing Machine (road type); Concrete Batch Hopper; Concrete Conveyor Systems; Concrete Mixers, 14S or over; Pumps, Screw Type and Gypsum); Hydrohammers, small; Brooms and Sweepers; Lift Slab Machine; Roller under 5 tons; Industrial Locomotives; Fireman (Pile Drivers and Derricks); Pumps (well points); Hoists, automatic; A-Frames and Winch Trucks; Hoists (tuggers); Boats (Tug, Safety, Work Barges and Launches); Assistant Engineer

GROUP 6: Shouldering Machine Operator; Farm or Industrial Tractor mounted equipment; Post Hole Digger; Auger (vertical and horizontal); Skid Steer Loader with or without attachments; Robotic Tool Carrier with or without attachments; Power Pack Vibratory/Ultra Sound Driver and Extractor; Fireman (Asphalt Plants); Screed Operator; Stone Crushers and Screening Plants; Air, Electric, Hydraulic

Jacks (Slip Form); Prestress Machines; Air Compressor, 400 CFM or over; Refrigeration Plant/Freeze Machine; Boiler Operators (temporary heat); Forklifts; Welding Machines; Generators; Pumps over 3"; Compressors, under 400 CFM; Heaters, Mechanical; Combination small equipment operator; Winches, small electric; Oiler; Greaser; Rotary Drill Tender; Conveyor; Elevator Operator

IRON0008-001 06/01/2023

	Rates	Fringes
IRONWORKER.....	\$ 41.73	30.67

Paid Holidays: New Year's Day, Memorial Day, July 4th, Labor Day, Thanksgiving Day & Christmas Day.

LAB00330-004 06/03/2024

	Rates	Fringes
Asbestos Abatement/Hazardous Waste (Preparation, removal and Encapsulation of hazardous materials from non-mechanical systems).....	\$ 35.70	19.45
Laborer, General.....	\$ 35.30	19.45

NOTE: Mason Tender \$1.00 over general laborer.

* PAIN0802-008 06/01/2024

	Rates	Fringes
PAINTER		
Brush, Drywall Taper.....	\$ 36.35	20.87

* PAIN1204-001 06/01/2024

	Rates	Fringes
GLAZIER.....	\$ 38.00	20.16

PLUM0400-001 06/01/2024

	Rates	Fringes
PLUMBER/PIPEFITTER (Including HVAC work)		
(1) Small buildings (except industrial and power plants) where plumbing or heating is \$50,000 or less.....	\$ 45.86	21.73
(2) All other work.....	\$ 49.00	21.84

SFWI0669-002 04/01/2024

	Rates	Fringes
SPRINKLER FITTER.....	\$ 48.22	29.14

SHEE0018-025 06/01/2024

CALUMET & SHEBOYGAN COUNTIES

	Rates	Fringes
Sheet Metal Worker (Including HVAC duct work and Technician)...	\$ 40.76	31.62

SHEE0018-029 06/01/2024		

OUTAGAMIE AND WINNEBAGO COUNTIES

	Rates	Fringes
Sheet Metal Worker (Including HVAC duct work and Technician)...	\$ 44.47	29.35

TEAM0662-001 06/01/2024		

	Rates	Fringes
TRUCK DRIVER		
1 & 2 Axles.....	\$ 37.57	27.41
3 or more Axles.....	\$ 37.72	27.41

* SUWI2002-013 01/23/2002		

	Rates	Fringes
Asbestos Worker/Heat and Frost Insulator.....	\$ 25.36	8.37
Laborers:		
Concrete Worker.....	\$ 16.34 **	3.59
Landscape.....	\$ 8.73 **	4.90
ROOFER.....	\$ 18.01	3.28
Tile & Marble Finisher.....	\$ 13.89 **	8.36

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$17.20) or 13658 (\$12.90). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is

like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a

new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

State Adopted Rate Identifiers

Classifications listed under the ""SA"" identifier indicate that the prevailing wage rate set by a state (or local) government was adopted under 29 C.F.R. 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 01/03/2024 reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request

review and reconsideration from the Wage and Hour Administrator
(See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
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Washington, DC 20210

The request should be accompanied by a full statement of the
interested party's position and by any information (wage
payment data, project description, area practice material,
etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an
interested party may appeal directly to the Administrative
Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

NOTICE TO BIDDERS WAGE RATE DECISION

The wage rate decision of the Department of Labor which has been incorporated in these advertised specifications is incomplete in that the classifications may be omitted from the Department of Labor's decision.

Since the bidder is responsible, independently, for ascertaining area practice with respect to the necessity, or lack of necessity, for the use of these classifications in the prosecution of the work contemplated by this project, no inference may be drawn from the omission of these classifications concerning prevailing area practices relative to their use. Further, this omission will not, per se, be construed as establishing any governmental liability for increased labor cost if it is subsequently determined that such classifications are required.

There may be omissions and/or errors in the federal wage rates. The bidder is responsible for evaluating and determining the correct applicable rate.

If a project includes multiple types of construction (highway, bridge over navigable water, sanitary sewer and water main, building) and there is not a separate wage determination for this type of work included in the proposal, use the wage determination that is in the proposal.

If a project includes multiple types of construction, different wage rate determinations may be inserted into the contract (WI10/Highway = in all WisDOT highway contracts, WI15/Heavy = bridge over navigable water per USDOL and US Coast Guard designation, WI8/Heavy (Sewer & Water Line & Tunnel) = sanitary sewer and water main if the cost is more than 20% of the contract and/or at least \$1,000,000, and Building). If multiple wage rate determinations are inserted into the contract, use the classification in the wage determination for the work being done. Use WI15 wage rates when working on the bridge and/or structure from bank to bank. Use WI8 wage rates when working on any sanitary sewer or water main work. Use Building wage rates for all work done within the footprint of the building. Use WI10 wage rates for all other highway work in the contract and approaches to structures. For example, if a laborer is working within the footprint of a building, use the Laborer rate in the Building wage determination inserted in the contract. If a laborer is working on a bridge/structure within the banks, use the Laborer rate in the WI15/Heavy wage determination if inserted in the contract. If the laborer is working on the highway, use the Laborer rate in the WI10/Highway wage determination.



Proposal Schedule of Items

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Proposal ID: 20240813009 Project(s): 1130-44-74

Federal ID(s): WISC 2024402

SECTION: 0001

Contract Items

Alt Set ID:

Alt Mbr ID:

Proposal Line Number	Item ID Description	Approximate Quantity and Units	Unit Price	Bid Amount
0002	201.0205 Grubbing	11.000 STA	_____.	_____.
0004	203.0100 Removing Small Pipe Culverts	1.000 EACH	_____.	_____.
0006	203.0216.S Abatement of Asbestos Containing Material (project) 001. 1130-44-74	1.000 EACH	_____.	_____.
0008	204.0100 Removing Concrete Pavement	2,100.000 SY	_____.	_____.
0010	204.0110 Removing Asphaltic Surface	4,075.000 SY	_____.	_____.
0012	204.0150 Removing Curb & Gutter	65.000 LF	_____.	_____.
0014	204.0170 Removing Fence	560.000 LF	_____.	_____.
0016	204.0195 Removing Concrete Bases	10.000 EACH	_____.	_____.
0018	204.0225 Removing Septic Tanks	1.000 EACH	_____.	_____.
0020	204.0231 Removing Building (station) 001. STA 15+10'RE'	1.000 EACH	_____.	_____.
0022	204.0241 Site Clearance (parcel) 001. SWEF Site	1.000 EACH	_____.	_____.
0024	204.0265 Abandoning Wells	1.000 EACH	_____.	_____.
0026	204.9060.S Removing (item description) 001. Street Light Assembly	10.000 EACH	_____.	_____.
0028	204.9060.S Removing (item description) 002. Static Scale	1.000 EACH	_____.	_____.



Proposal Schedule of Items

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Proposal ID: 20240813009 Project(s): 1130-44-74

Federal ID(s): WISC 2024402

SECTION: 0001

Contract Items

Alt Set ID:

Alt Mbr ID:

Proposal Line Number	Item ID Description	Approximate Quantity and Units	Unit Price	Bid Amount
0030	204.9090.S Removing (item description) 001. Removing Electrical Conductors from Existing Conduit	1,910.000 LF	_____.	_____.
0032	204.9090.S Removing (item description) 002. Removing or Abandoning Conduit	1,815.000 LF	_____.	_____.
0034	205.0100 Excavation Common	10,000.000 CY	_____.	_____.
0036	208.0100 Borrow	16,143.000 CY	_____.	_____.
0038	210.2100 Backfill Structure Type B	3,300.000 CY	_____.	_____.
0040	213.0100 Finishing Roadway (project) 001. 1130- 44-74	1.000 EACH	_____.	_____.
0042	305.0110 Base Aggregate Dense 3/4-Inch	300.000 TON	_____.	_____.
0044	305.0120 Base Aggregate Dense 1 1/4-Inch	3,600.000 TON	_____.	_____.
0046	311.0110 Breaker Run	350.000 TON	_____.	_____.
0048	455.0605 Tack Coat	350.000 GAL	_____.	_____.
0050	460.2000 Incentive Density HMA Pavement	690.000 DOL	1.00000	690.00
0052	460.5223 HMA Pavement 3 LT 58-28 S	625.000 TON	_____.	_____.
0054	460.5224 HMA Pavement 4 LT 58-28 S	490.000 TON	_____.	_____.
0056	465.0315 Asphaltic Flumes	15.000 SY	_____.	_____.
0058	520.1012 Apron Endwalls for Culvert Pipe 12-Inch	1.000 EACH	_____.	_____.



Proposal Schedule of Items

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Proposal ID: 20240813009 Project(s): 1130-44-74

Federal ID(s): WISC 2024402

SECTION: 0001

Contract Items

Alt Set ID:

Alt Mbr ID:

Proposal Line Number	Item ID Description	Approximate Quantity and Units	Unit Price	Bid Amount
0060	520.1018 Apron Endwalls for Culvert Pipe 18-Inch	1.000 EACH	_____.	_____.
0062	520.1030 Apron Endwalls for Culvert Pipe 30-Inch	2.000 EACH	_____.	_____.
0064	520.3330 Culvert Pipe Class III-A 30-Inch	86.000 LF	_____.	_____.
0066	601.0557 Concrete Curb & Gutter 6-Inch Sloped 36-Inch Type D	126.000 LF	_____.	_____.
0068	601.0600 Concrete Curb Pedestrian	45.000 LF	_____.	_____.
0070	602.0405 Concrete Sidewalk 4-Inch	2,455.000 SF	_____.	_____.
0072	602.0505 Curb Ramp Detectable Warning Field Yellow	10.000 SF	_____.	_____.
0074	602.0810 Concrete Driveway 6-Inch	285.000 SY	_____.	_____.
0076	602.3010 Concrete Surface Drains	0.900 CY	_____.	_____.
0078	606.0100 Riprap Light	10.000 CY	_____.	_____.
0080	608.3012 Storm Sewer Pipe Class III-A 12-Inch	56.000 LF	_____.	_____.
0082	608.3015 Storm Sewer Pipe Class III-A 15-Inch	34.000 LF	_____.	_____.
0084	608.3018 Storm Sewer Pipe Class III-A 18-Inch	38.000 LF	_____.	_____.
0086	611.0612 Inlet Covers Type C	1.000 EACH	_____.	_____.
0088	611.0642 Inlet Covers Type MS	1.000 EACH	_____.	_____.



Proposal Schedule of Items

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Proposal ID: 20240813009 Project(s): 1130-44-74

Federal ID(s): WISC 2024402

SECTION: 0001

Contract Items

Alt Set ID:

Alt Mbr ID:

Proposal Line Number	Item ID Description	Approximate Quantity and Units	Unit Price	Bid Amount
0090	611.3003 Inlets 3-FT Diameter	1.000 EACH	_____.	_____.
0092	611.3901 Inlets Median 1 Grate	1.000 EACH	_____.	_____.
0094	612.0206 Pipe Underdrain Unperforated 6-Inch	41.000 LF	_____.	_____.
0096	612.0208 Pipe Underdrain Unperforated 8-Inch	62.000 LF	_____.	_____.
0098	612.0210 Pipe Underdrain Unperforated 10-Inch	80.000 LF	_____.	_____.
0100	612.0212 Pipe Underdrain Unperforated 12-Inch	60.000 LF	_____.	_____.
0102	616.0206 Fence Chain Link 6-FT	425.000 LF	_____.	_____.
0104	618.0100 Maintenance and Repair of Haul Roads (project) 001. 1130-44-74	1.000 EACH	_____.	_____.
0106	619.1000 Mobilization	1.000 EACH	_____.	_____.
0108	620.0200 Concrete Median Blunt Nose	135.000 SF	_____.	_____.
0110	624.0100 Water	135.000 MGAL	_____.	_____.
0112	625.0500 Salvaged Topsoil	12,000.000 SY	_____.	_____.
0114	627.0200 Mulching	32,000.000 SY	_____.	_____.
0116	628.1504 Silt Fence	625.000 LF	_____.	_____.
0118	628.1520 Silt Fence Maintenance	7,500.000 LF	_____.	_____.
0120	628.1905 Mobilizations Erosion Control	3.000 EACH	_____.	_____.



Proposal Schedule of Items

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Proposal ID: 20240813009 Project(s): 1130-44-74

Federal ID(s): WISC 2024402

SECTION: 0001

Contract Items

Alt Set ID:

Alt Mbr ID:

Proposal Line Number	Item ID Description	Approximate Quantity and Units	Unit Price	Bid Amount
0122	628.1910 Mobilizations Emergency Erosion Control	3.000 EACH	_____.	_____.
0124	628.2006 Erosion Mat Urban Class I Type A	7,500.000 SY	_____.	_____.
0126	628.2008 Erosion Mat Urban Class I Type B	1,000.000 SY	_____.	_____.
0128	628.6510 Soil Stabilizer Type B	3.000 ACRE	_____.	_____.
0130	628.7005 Inlet Protection Type A	2.000 EACH	_____.	_____.
0132	628.7504 Temporary Ditch Checks	260.000 LF	_____.	_____.
0134	628.7555 Culvert Pipe Checks	20.000 EACH	_____.	_____.
0136	628.7560 Tracking Pads	3.000 EACH	_____.	_____.
0138	629.0210 Fertilizer Type B	12.000 CWT	_____.	_____.
0140	630.0110 Seeding Mixture No. 10	275.000 LB	_____.	_____.
0142	630.0130 Seeding Mixture No. 30	125.000 LB	_____.	_____.
0144	630.0140 Seeding Mixture No. 40	15.000 LB	_____.	_____.
0146	630.0200 Seeding Temporary	250.000 LB	_____.	_____.
0148	630.0300 Seeding Borrow Pit	50.000 LB	_____.	_____.
0150	630.0500 Seed Water	500.000 MGAL	_____.	_____.
0152	632.0201 Shrubs (species, root, size) 001. Everlow Yew, CG, #5	6.000 EACH	_____.	_____.



Proposal Schedule of Items

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Proposal ID: 20240813009 Project(s): 1130-44-74

Federal ID(s): WISC 2024402

SECTION: 0001

Contract Items

Alt Set ID:

Alt Mbr ID:

Proposal Line Number	Item ID Description	Approximate Quantity and Units	Unit Price	Bid Amount
0154	632.9101 Landscape Planting Surveillance and Care Cycles	6.000 EACH	_____.	_____.
0156	633.5200 Markers Culvert End	4.000 EACH	_____.	_____.
0158	634.0612 Posts Wood 4x6-Inch X 12-FT	1.000 EACH	_____.	_____.
0160	634.0614 Posts Wood 4x6-Inch X 14-FT	2.000 EACH	_____.	_____.
0162	637.2210 Signs Type II Reflective H	17.930 SF	_____.	_____.
0164	638.2102 Moving Signs Type II	1.000 EACH	_____.	_____.
0166	638.4000 Moving Small Sign Supports	1.000 EACH	_____.	_____.
0168	643.0300 Traffic Control Drums	19,000.000 DAY	_____.	_____.
0170	643.0420 Traffic Control Barricades Type III	4,500.000 DAY	_____.	_____.
0172	643.0705 Traffic Control Warning Lights Type A	6,800.000 DAY	_____.	_____.
0174	643.0900 Traffic Control Signs	7,000.000 DAY	_____.	_____.
0176	643.0910 Traffic Control Covering Signs Type I	3.000 EACH	_____.	_____.
0178	643.1050 Traffic Control Signs PCMS	28.000 DAY	_____.	_____.
0180	643.3165 Temporary Marking Line Paint 6-Inch	600.000 LF	_____.	_____.
0182	643.5000 Traffic Control	1.000 EACH	_____.	_____.
0184	645.0130 Geotextile Type R	950.000 SY	_____.	_____.



Proposal Schedule of Items

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Proposal ID: 20240813009 Project(s): 1130-44-74

Federal ID(s): WISC 2024402

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Contract Items

Alt Set ID:

Alt Mbr ID:

Proposal Line Number	Item ID Description	Approximate Quantity and Units	Unit Price	Bid Amount
0186	646.1020 Marking Line Epoxy 4-Inch	1,710.000 LF	_____.	_____.
0188	646.5220 Marking Symbol Epoxy	1.000 EACH	_____.	_____.
0190	646.7020 Marking Diagonal Epoxy 6-Inch	200.000 LF	_____.	_____.
0192	646.8320 Marking Parking Stall Epoxy	1,000.000 LF	_____.	_____.
0194	650.4000 Construction Staking Storm Sewer	10.000 EACH	_____.	_____.
0196	650.4500 Construction Staking Subgrade	3,431.000 LF	_____.	_____.
0198	650.5000 Construction Staking Base	1,640.000 LF	_____.	_____.
0200	650.5500 Construction Staking Curb Gutter and Curb & Gutter	791.000 LF	_____.	_____.
0202	650.6000 Construction Staking Pipe Culverts	1.000 EACH	_____.	_____.
0204	650.8501 Construction Staking Electrical Installations (project) 001. 1130-44-74	1.000 EACH	_____.	_____.
0206	650.9000 Construction Staking Curb Ramps	1.000 EACH	_____.	_____.
0208	650.9500 Construction Staking Sidewalk (project) 001. 1130-44-74	1.000 EACH	_____.	_____.
0210	650.9911 Construction Staking Supplemental Control (project) 001. 1130-44-74	1.000 EACH	_____.	_____.
0212	650.9920 Construction Staking Slope Stakes	3,431.000 LF	_____.	_____.
0214	652.0225 Conduit Rigid Nonmetallic Schedule 40 2-Inch	1,510.000 LF	_____.	_____.



Proposal Schedule of Items

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Proposal ID: 20240813009 Project(s): 1130-44-74

Federal ID(s): WISC 2024402

SECTION: 0001

Contract Items

Alt Set ID:

Alt Mbr ID:

Proposal Line Number	Item ID Description	Approximate Quantity and Units	Unit Price	Bid Amount
0216	652.0235 Conduit Rigid Nonmetallic Schedule 40 3-Inch	60.000 LF	_____.	_____.
0218	652.0240 Conduit Rigid Nonmetallic Schedule 40 4-Inch	570.000 LF	_____.	_____.
0220	653.0164 Pull Boxes Non-Conductive 24x42-Inch	6.000 EACH	_____.	_____.
0222	653.0905 Removing Pull Boxes	6.000 EACH	_____.	_____.
0224	654.0105 Concrete Bases Type 5	4.000 EACH	_____.	_____.
0226	654.0230 Concrete Control Cabinet Bases Type L30	1.000 EACH	_____.	_____.
0228	655.0610 Electrical Wire Lighting 12 AWG	795.000 LF	_____.	_____.
0230	655.0620 Electrical Wire Lighting 8 AWG	4,622.000 LF	_____.	_____.
0232	657.0255 Transformer Bases Breakaway 11 1/2-Inch Bolt Circle	4.000 EACH	_____.	_____.
0234	657.0322 Poles Type 5-Aluminum	4.000 EACH	_____.	_____.
0236	657.0715 Luminaire Arms Truss Type 4 1/2-Inch Clamp 15-FT	5.000 EACH	_____.	_____.
0238	659.1120 Luminaires Utility LED B	5.000 EACH	_____.	_____.
0240	659.2130 Lighting Control Cabinets 120/240 30-Inch	1.000 EACH	_____.	_____.
0242	659.5000.S Lamp, Ballast, LED, Switch Disposal by Contractor	22.000 EACH	_____.	_____.



Proposal Schedule of Items

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Proposal ID: 20240813009 Project(s): 1130-44-74

Federal ID(s): WISC 2024402

SECTION: 0001

Contract Items

Alt Set ID:

Alt Mbr ID:

Proposal Line Number	Item ID Description	Approximate Quantity and Units	Unit Price	Bid Amount
0244	671.0300 Fiber Optic Cable Marker	6.000 EACH	_____.	_____.
0246	673.0105 Communication Vault Type 1	3.000 EACH	_____.	_____.
0248	673.0200 Tracer Wire Marker Posts	6.000 EACH	_____.	_____.
0250	678.0012 Install Fiber Optic Cable Outdoor Plant 12-CT	430.000 LF	_____.	_____.
0252	690.0150 Sawing Asphalt	485.000 LF	_____.	_____.
0254	690.0250 Sawing Concrete	45.000 LF	_____.	_____.
0256	ASP.1T0A On-the-Job Training Apprentice at \$5.00/HR	2,100.000 HRS	5.00000	10,500.00
0258	ASP.1T0G On-the-Job Training Graduate at \$5.00/HR	5,760.000 HRS	5.00000	28,800.00
0260	SPV.0035 Special 001. Washed Stone 3/4-Inch	225.000 CY	_____.	_____.
0262	SPV.0035 Special 002. Gray Granite Chips	60.000 CY	_____.	_____.
0264	SPV.0060 Special 001. Outlet Structure	1.000 EACH	_____.	_____.
0266	SPV.0060 Special 002. Secure Slide Type Class IV 18-FT Gate	2.000 EACH	_____.	_____.
0268	SPV.0060 Special 003. Trash Receptacles	5.000 EACH	_____.	_____.
0270	SPV.0060 Special 004. Fiber Optic Patch Panel	3.000 EACH	_____.	_____.
0272	SPV.0060 Special 005. Pipe Bollard	7.000 EACH	_____.	_____.



Proposal Schedule of Items

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Proposal ID: 20240813009 Project(s): 1130-44-74

Federal ID(s): WISC 2024402

SECTION: 0001

Contract Items

Alt Set ID:

Alt Mbr ID:

Proposal Line Number	Item ID Description	Approximate Quantity and Units	Unit Price	Bid Amount
0274	SPV.0060 Special 006. Concrete Wheel Stops	2.000 EACH	_____.	_____.
0276	SPV.0060 Special 010. SWEF\Post Building, Electrical Service	1.000 EACH	_____.	_____.
0278	SPV.0060 Special 011. SWEF\Post Building, Natural Gas Service	1.000 EACH	_____.	_____.
0280	SPV.0060 Special 020. Sanitary Sewer Manhole w/Casting 5-FT Diameter	1.000 EACH	_____.	_____.
0282	SPV.0060 Special 021. Construction Staking Sanitary Sewer	1.000 EACH	_____.	_____.
0284	SPV.0060 Special 022. Sanitary Sewer Cleanout	2.000 EACH	_____.	_____.
0286	SPV.0060 Special 023. Sanitary Manhole 8-Inch Core	1.000 EACH	_____.	_____.
0288	SPV.0060 Special 030. Connect to Existing Water Main	1.000 EACH	_____.	_____.
0290	SPV.0060 Special 031. Gate Valve and Box 6-inch	2.000 EACH	_____.	_____.
0292	SPV.0060 Special 032. Gate Valve and Box 8 -inch	1.000 EACH	_____.	_____.
0294	SPV.0060 Special 033. Remove and Replace Hydrant	1.000 EACH	_____.	_____.
0296	SPV.0060 Special 034. Furnish and Install Hydrant	1.000 EACH	_____.	_____.
0298	SPV.0060 Special 035. Construction Staking Water Main	1.000 EACH	_____.	_____.
0300	SPV.0060 Special 036. Maintain Water Service During Construction	1.000 EACH	_____.	_____.



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Proposal ID: 20240813009 Project(s): 1130-44-74

Federal ID(s): WISC 2024402

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Contract Items

Alt Set ID:

Alt Mbr ID:

Proposal Line Number	Item ID Description	Approximate Quantity and Units	Unit Price	Bid Amount
0302	SPV.0060 Special 050. Lighted Bollard	4.000 EACH	_____.	_____.
0304	SPV.0060 Special 100. SWEF\Post Building, General Construction	1.000 EACH	_____.	_____.
0306	SPV.0060 Special 101. SWEF\Post Building, Plumbing	1.000 EACH	_____.	_____.
0308	SPV.0060 Special 102. SWEF\Post Building, Heating & Ventilation (HVAC)	1.000 EACH	_____.	_____.
0310	SPV.0060 Special 103. SWEF\Post Building, Electrical	1.000 EACH	_____.	_____.
0312	SPV.0060 Special 104. SWEF\Post Building, Generator	1.000 EACH	_____.	_____.
0314	SPV.0060 Special 105. SWEF\Post Building, Lightning and Grounding Protection	1.000 EACH	_____.	_____.
0316	SPV.0060 Special 106. SWEF\Post Building, Fire Suppression	1.000 EACH	_____.	_____.
0318	SPV.0060 Special 200. Main Communications Tower	1.000 EACH	_____.	_____.
0320	SPV.0060 Special 201. Auxiliary Communications Tower	1.000 EACH	_____.	_____.
0322	SPV.0060 Special 202. Main Communications Tower Generator	1.000 EACH	_____.	_____.
0324	SPV.0060 Special 203. Main Communications Tower Electrical Service	1.000 EACH	_____.	_____.
0326	SPV.0090 Special 001. Concrete Curb and Gutter 24-Inch Type A	70.000 LF	_____.	_____.



Proposal Schedule of Items

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Proposal ID: 20240813009 Project(s): 1130-44-74

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Contract Items

Alt Set ID:

Alt Mbr ID:

Proposal Line Number	Item ID Description	Approximate Quantity and Units	Unit Price	Bid Amount
0328	SPV.0090 Special 002. Concrete Curb and Gutter 24-Inch Type D	665.000 LF	_____.	_____.
0330	SPV.0090 Special 003. 12-CT Fiber Optic Cable	395.000 LF	_____.	_____.
0332	SPV.0090 Special 004. Aluminum Landscape Edging	175.000 LF	_____.	_____.
0334	SPV.0090 Special 021. Sanitary Sewer Main 8-inch	322.000 LF	_____.	_____.
0336	SPV.0090 Special 022. Sanitary Sewer Service PVC 6-inch	59.000 LF	_____.	_____.
0338	SPV.0090 Special 023. Sanitary Sewer Lateral, 4- Inch	95.000 LF	_____.	_____.
0340	SPV.0090 Special 031. Water Main C900 6-inch	59.000 LF	_____.	_____.
0342	SPV.0090 Special 032. Water Main C900 8 -inch	322.000 LF	_____.	_____.
0344	SPV.0180 Special 001. Topsoil Stripping	9,700.000 SY	_____.	_____.
0346	SPV.0180 Special 002. Weed Barrier Fabric	520.000 SY	_____.	_____.
0348	SPV.0200 Special 020. Construct Outside Drop, 6- Inch	7.000 VF	_____.	_____.
0350	SPV.0200 Special 021. Construct Inside Drop, 8- Inch	8.000 VF	_____.	_____.
Section: 0001			Total:	_____.
			Total Bid:	_____.

PLEASE ATTACH ADDENDA HERE



Wisconsin Department of Transportation

August 7, 2024

**Division of Transportation Systems
Development**

Bureau of Project Development
4822 Madison Yards Way, 4th Floor South
Madison, WI 53705

Telephone: (608) 266-1631

Facsimile (FAX): (608) 266-8459

NOTICE TO ALL CONTRACTORS:

Federal Wage Rate Addendum #01

Letting of August 13, 2024

Attached is a copy of the revised WI 10 Highway Davis Bacon Prevailing Wage Rates that are included in proposals 03 – 06, 08 – 10, 13, 14, and 16. These wage rates are effective for all proposals they are included in in the August 13, 2024 letting. The updated wage rates are dated August 2, 2024 and are effective on or after August 12, 2024.

The responsibility for notifying potential subcontractors and suppliers of these changes remains with the prime contractors.

Sincerely,

Mike Coleman

Proposal Development Specialist
Proposal Management Section

"General Decision Number: WI20240010 08/02/2024

Superseded General Decision Number: WI20230010

State: Wisconsin

Construction Type: Highway

Counties: Wisconsin Statewide.

HIGHWAY, AIRPORT RUNWAY & TAXIWAY CONSTRUCTION PROJECTS (does not include bridges over navigable waters; tunnels; buildings in highway rest areas; and railroad construction)

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$17.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2024.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$12.90 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2024.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number Publication Date
0 01/05/2024

1	01/26/2024
2	02/02/2024
3	02/16/2024
4	03/15/2024
5	05/24/2024
6	06/21/2024
7	06/28/2024
8	07/05/2024
9	08/02/2024

BRWI0001-002 06/01/2023

CRAWFORD, JACKSON, JUNEAU, LA CROSSE, MONROE, TREMPPEALEAU, AND
VERNON COUNTIES

	Rates	Fringes
BRICKLAYER.....	\$ 40.18	25.88

BRWI0002-002 06/01/2023		

ASHLAND, BAYFIELD, DOUGLAS, AND IRON COUNTIES

	Rates	Fringes
BRICKLAYER.....	\$ 47.10	25.16

BRWI0002-005 06/01/2023		

ADAMS, ASHLAND, BARRON, BROWN, BURNETT, CALUMET, CHIPPEWA,
CLARK, COLUMBIA, DODGE, DOOR, DUNN, FLORENCE, FOND DU LAC,
FOREST, GREEN LAKE, IRON, JEFFERSON, KEWAUNEE, LANGLADE,
LINCOLN, MANITOWOC, MARATHON, MARINETTE, MARQUETTE, MENOMINEE,
OCONTO, ONEIDA, OUTAGAMIE, POLK, PORTAGE, RUSK, ST CROIX, SAUK,
SHAWANO, SHEBOYGAN, TAYLOR, VILAS, WALWORTH, WAUPACA, WAUSHARA,
WINNEBAGO, AND WOOD COUNTIES

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	\$ 39.97	25.02

BRWI0003-002 06/01/2023		

BROWN, DOOR, FLORENCE, KEWAUNEE, MARINETTE, AND OCONTO COUNTIES

	Rates	Fringes
BRICKLAYER.....	\$ 40.00	26.06

BRWI0004-002 06/01/2023		

KENOSHA, RACINE, AND WALWORTH COUNTIES

	Rates	Fringes
BRICKLAYER.....	\$ 44.50	26.96

BRWI0006-002 06/01/2023		

ADAMS, CLARK, FOREST, LANGLADE, LINCOLN, MARATHON, MENOMINEE,
ONEIDA, PORTAGE, PRICE, TAYLOR, VILAS AND WOOD COUNTIES

	Rates	Fringes

BRICKLAYER.....	\$ 40.08	25.98

BRWI0007-002 06/01/2023

GREEN, LAFAYETTE, AND ROCK COUNTIES

	Rates	Fringes

BRICKLAYER.....	\$ 40.95	26.80

BRWI0008-002 06/05/2023

MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes

BRICKLAYER.....	\$ 44.96	25.67

BRWI0011-002 06/01/2023

CALUMET, FOND DU LAC, MANITOWOC, AND SHEBOYGAN COUNTIES

	Rates	Fringes

BRICKLAYER.....	\$ 40.00	26.06

BRWI0019-002 06/01/2023

BARRON, BUFFALO, BURNETT, CHIPPEWA, DUNN, EAU CLAIRE, PEPIN,
PIERCE, POLK, RUSK, ST. CROIX, SAWYER AND WASHBURN COUNTIES

	Rates	Fringes

BRICKLAYER.....	\$ 39.32	26.74

BRWI0034-002 06/01/2023

COLUMBIA AND SAUK COUNTIES

	Rates	Fringes

BRICKLAYER.....	\$ 41.56	26.19

CARP0068-011 05/02/2022

BURNETT (W. of Hwy 48), PIERCE (W. of Hwy 29), POLK (W. of Hwys
35, 48 & 65), AND ST. CROIX (W. of Hwy 65) COUNTIES

	Rates	Fringes

Carpenter & Piledrivermen.....	\$ 41.19	27.05

* CARP0231-002 06/05/2023

KENOSHA, MILWAUKEE, OZAUKEE, RACINE, WASHINGTON, AND WAUKESHA
COUNTIES

	Rates	Fringes

CARPENTER.....	\$ 41.91	29.72

CARP0310-002 06/05/2023ADAMS, ASHLAND, BAYFIELD (Eastern 2/3), FOREST, IRON, JUNEAU,
LANGLADE, LINCOLN, MARATHON, ONEIDA, PORTAGE, PRICE, SHAWANO
(Western Portion of the County), TAYLOR, VILAS, AND WOOD
COUNTIES

	Rates	Fringes
CARPENTER.....	\$ 38.86	27.06
Piledriver.....	\$ 39.43	27.02

CARP0314-001 06/05/2023COLUMBIA, DANE, DODGE, GRANT, GREEN, IOWA, JEFFERSON,
LAFAYETTE, RICHLAND, ROCK, SAUK, AND WALWORTH COUNTIES

	Rates	Fringes
CARPENTER.....	\$ 38.86	27.06
Piledriver.....	\$ 39.43	27.02

CARP0361-004 05/01/2018

BAYFIELD (West of Hwy 63) AND DOUGLAS COUNTIES

	Rates	Fringes
CARPENTER.....	\$ 36.15	20.43

CARP0731-002 06/05/2023CALUMET (Eastern Portion of the County), FOND DU LAC (Eastern
Portion of the County), MANITOWOC, AND SHEBOYGAN COUNTIES

	Rates	Fringes
CARPENTER.....	\$ 38.86	27.06
Piledriver.....	\$ 39.43	27.02

CARP0955-002 06/05/2023CALUMET (Western Portion of the County), FOND DU LAC (Western
Portion of the County), GREEN LAKE, MARQUETTE, OUTAGAMIE,
WAUPACA, WAUSHARA, AND WINNEBAGO

	Rates	Fringes
CARPENTER.....	\$ 38.86	27.06
PILEDRIIVER.....	\$ 39.43	27.02

CARP1056-002 06/01/2023ADAMS, ASHLAND, BARRON, BAYFIELD , BROWN, BUFFALO, BURNETT
,CALUMET, CHIPPEWA, CLARK, COLUMBIA, CRAWFORD, DANE, DODGE,
DOOR, DUNN, EAU CLAIRE, FLORENCE, FOND DU LAC, FOREST, GRANT,
GREEN, GREEN LAKE, IOWA, IRON, JACKSON, JEFFERSON, JUNEAU,
KEWAUNEE, LA CROSSE, LAFAYETTE, LANGLADE, LINCOLN, MANITOWOC,
MARATHON, MARINETTE, MARQUETTE, MENOMINEE, MONROE, OCONTO,
ONEIDA, OUTAGAMIE, PEPIN, PIERCE (E. of Hwy. 29 & 65), POLK (E.

of Hwy. 35, 48 & 65), PORTAGE, PRICE, RICHLAND, ROCK, RUSK, SAUK, SAWYER, SHAWANO, SHEBOYGAN, ST. CROIX (E. of Hwy. 65), TAYLOR, TREMPLEAU, VERNON, VILAS, WALWORTH, WASHBURN, WAUPACA, WAUSHARA, WINNEBAGO, AND WOOD COUNTIES

	Rates	Fringes
MILLWRIGHT.....	\$ 40.00	27.77

CARP1074-002 06/05/2023

BARRON, BURNETT, CHIPPEWA, CLARK, DUNN, EAU CLAIRE, PEPIN, PIERCE (E. of Hwy. 29 & 65), POLK (E. of Hwy. 35, 48 & 65), RUSK, SAWYER, ST. CROIX (E. of Hwy. 65), AND WASHBURN

	Rates	Fringes
CARPENTER.....	\$ 38.86	27.06
PILEDRIIVER.....	\$ 39.43	27.02

CARP1143-002 06/05/2023

BUFFALO, CRAWFORD, JACKSON, LA CROSSE, MONROE, TREMPLEAU AND VERNON COUNTIES

	Rates	Fringes
CARPENTER.....	\$ 38.86	27.06
PILEDRIIVER.....	\$ 39.43	27.02

CARP1146-002 06/05/2023

BROWN, DOOR, FLORENCE, KEWAUNEE, MARINETTE, MENOMINEE, OCONTO, AND SHAWANO (Western Portion of the County) COUNTIES

	Rates	Fringes
CARPENTER.....	\$ 38.86	27.06
PILEDRIIVER.....	\$ 39.43	27.02

CARP2337-009 06/05/2023

KENOSHA, MILWAUKEE, OZAUKEE, RACINE, WASHINGTON, AND WAUKESHA

	Rates	Fringes
PILEDRIIVERMAN.....	\$ 39.22	34.01

ELEC0014-002 05/26/2024

ASHLAND, BARRON, BAYFIELD, BUFFALO, BURNETT, CHIPPEWA, CLARK (except Maryville, Colby, Unity, Sherman, Fremont, Lynn & Sherwood), CRAWFORD, DUNN, EAU CLAIRE, GRANT, IRON, JACKSON, LA CROSSE, MONROE, PEPIN, PIERCE, POLK, PRICE, RICHLAND, RUSK, ST CROIX, SAWYER, TAYLOR, TREMPLEAU, VERNON, AND WASHBURN COUNTIES

	Rates	Fringes
Electricians:.....	\$ 42.73	23.99

ELEC0014-007 05/26/2024

REMAINING COUNTIES

	Rates	Fringes
Teledata System Installer		
Installer/Technician.....	\$ 30.27	19.11

Low voltage construction, installation, maintenance and removal of teledata facilities (voice, data, and video) including outside plant, telephone and data inside wire, interconnect, terminal equipment, central offices, PABX, fiber optic cable and equipment, micro waves, V-SAT, bypass, CATV, WAN (wide area networks), LAN (local area networks), and ISDN (integrated systems digital network).

ELEC0127-002 06/01/2023

KENOSHA COUNTY

	Rates	Fringes
Electricians:.....	\$ 46.05	30%+13.15

ELEC0158-002 05/30/2021

BROWN, DOOR, KEWAUNEE, MANITOWOC (except Schleswig), MARINETTE (Wausaukee and area South thereof), OCONTO, MENOMINEE (East of a line 6 miles West of the West boundary of Oconto County), SHAWANO (Except Area North of Townships of Aniwa and Hutchins) COUNTIES

	Rates	Fringes
ELECTRICIAN.....	\$ 36.14	29.75%+10.26

ELEC0159-003 05/30/2021

COLUMBIA, DANE, DODGE (Area West of Hwy 26, except Chester and Emmet Townships), GREEN, LAKE (except Townships of Berlin, Seneca, and St. Marie), IOWA, MARQUETTE (except Townships of Neshkoka, Crystal Lake, Newton, and Springfield), and SAUK COUNTIES

	Rates	Fringes
ELECTRICIAN.....	\$ 43.38	23.13

ELEC0219-004 06/01/2019

FLORENCE COUNTY (Townships of Aurora, Commonwealth, Fern, Florence and Homestead) AND MARINETTE COUNTY (Township of Niagara)

	Rates	Fringes
Electricians:		
Electrical contracts over		
\$180,000.....	\$ 33.94	21.80

Electrical contracts under

\$180,000.....\$ 31.75 21.73

ELEC0242-005 05/30/2021

DOUGLAS COUNTY

Rates Fringes

Electricians:.....\$ 41.37 69.25%

ELEC0388-002 06/01/2023

ADAMS, CLARK (Colby, Freemont, Lynn, Mayville, Sherman, Sherwood, Unity), FOREST, JUNEAU, LANGLADE, LINCOLN, MARATHON, MARINETTE (Beecher, Dunbar, Goodman & Pembine), MENOMINEE (Area West of a line 6 miles West of the West boundary of Oconto County), ONEIDA, PORTAGE, SHAWANO (Aniwa and Hutchins), VILAS AND WOOD COUNTIES

Rates Fringes

Electricians:.....\$ 38.74 26%+11.76

ELEC0430-002 06/01/2023

RACINE COUNTY (Except Burlington Township)

Rates Fringes

Electricians:.....\$ 46.70 25.02

ELEC0494-005 05/28/2023

MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

Rates Fringes

Electricians:.....\$ 47.75 26.72

ELEC0494-006 05/28/2023

CALUMET (Township of New Holstein), DODGE (East of Hwy 26 including Chester Township), FOND DU LAC, MANITOWOC (Schleswig), and SHEBOYGAN COUNTIES

Rates Fringes

Electricians:.....\$ 41.40 23.90

ELEC0494-013 05/28/2023

DODGE (East of Hwy 26 including Chester Twp, excluding Emmet Twp), FOND DU LAC (Except Waupin), MILWAUKEE, OZAUKEE, MANITOWOC (Schleswig), WASHINGTON, AND WAUKESHA COUNTIES

Rates Fringes

Sound & Communications

Installer.....\$ 34.65 18.36

Technician.....\$ 34.65 18.36

Installation, testing, maintenance, operation and servicing of all sound, intercom, telephone interconnect, closed circuit TV systems, radio systems, background music systems, language laboratories, electronic carillon, antenna distribution systems, clock and program systems and low-voltage systems such as visual nurse call, audio/visual nurse call systems, doctors entrance register systems. Includes all wire and cable carrying audio, visual, data, light and radio frequency signals. Includes the installation of conduit, wiremold, or raceways in existing structures that have been occupied for six months or more where required for the protection of the wire or cable, but does not mean a complete conduit or raceway system. work covered does not include the installation of conduit, wiremold or any raceways in any new construction, or the installation of power supply outlets by means of which external electric power is supplied to any of the foregoing equipment or products

ELEC0577-003 06/01/2023

CALUMET (except Township of New Holstein), GREEN LAKE (N. part including Townships of Berlin, St Marie, and Seneca), MARQUETTE (N. part including Townships of Crystal Lake, Neshkoro, Newton, and Springfield), OUTAGAMIE, WAUPACA, WAUSHARA, AND WINNEBAGO COUNTIES

	Rates	Fringes
Electricians:.....	\$ 38.94	29.50%+10.00

ELEC0890-003 06/01/2024

DODGE (Emmet Township only), GREEN, JEFFERSON, LAFAYETTE, RACINE (Burlington Township), ROCK AND WALWORTH COUNTIES

	Rates	Fringes
Electricians:.....	\$ 43.65	25.95%+12.26

ELEC0953-001 06/02/2019

	Rates	Fringes
Line Construction:		
(1) Lineman.....	\$ 47.53	21.43
(2) Heavy Equipment Operator.....	\$ 42.78	19.80
(3) Equipment Operator.....	\$ 38.02	18.40
(4) Heavy Groundman Driver..	\$ 33.27	16.88
(5) Light Groundman Driver..	\$ 30.89	16.11
(6) Groundsman.....	\$ 26.14	14.60

ENGI0139-005 06/01/2023

	Rates	Fringes
Power Equipment Operator		
Group 1.....	\$ 43.77	27.40
Group 2.....	\$ 43.27	27.40
Group 3.....	\$ 42.77	27.40
Group 4.....	\$ 42.51	27.40

Group 5.....	\$ 42.22	27.40
Group 6.....	\$ 36.32	27.40

HAZARDOUS WASTE PREMIUMS:

EPA Level ""A"" protection - \$3.00 per hour
 EPA Level ""B"" protection - \$2.00 per hour
 EPA Level ""C"" protection - \$1.00 per hour

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Cranes, tower cranes, and derricks with or without attachments with a lifting capacity of over 100 tons; or cranes, tower cranes, and derricks with boom, leads and/or jib lengths measuring 176 feet or longer.

GROUP 2: Cranes, tower cranes and derricks with or without attachments with a lifting capacity of 100 tons or less; or cranes, tower cranes, and derricks with boom, leads, and/or jibs lengths measuring 175 feet or under and Backhoes (excavators) weighing 130,000 lbs and over; caisson rigs; pile driver; dredge operator; dredge engineer; Boat Pilot.

GROUP 3: Mechanic or welder - Heavy duty equipment; cranes with a lifting capacity of 25 tons or under; concrete breaker (manual or remote); vibratory/sonic concrete breaker; concrete laser screed; concrete slipform paver; concrete batch plant operator; concrete pvt. spreader - heavy duty (rubber tired); concrete spreader & distributor; automatic subgrader (concrete); concrete grinder & planing machine; concrete slipform curb & gutter machine; slipform concrete placer; tube finisher; hydro blaster (10,000 psi & over); bridge paver; concrete conveyor system; concrete pump; Rotec type Conveyor; stabilizing mixer (self-propelled); shoulder widener; asphalt plant engineer; bituminous paver; bump cutter & grooving machine; milling machine; screed (bituminous paver); asphalt heater, planer & scarifier; Backhoes (excavators) weighing under 130,000 lbs; grader or motor patrol; tractor (scraper, dozer, pusher, loader); scraper - rubber tired (single or twin engine); endloader; hydraulic backhoe (tractor type); trenching machine; skid rigs; tractor, side boom (heavy); drilling or boring machine (mechanical heavy); roller over 5 tons; percussion or rotary drilling machine; air track; blaster; loading machine (conveyor); tugger; boatmen; winches & A-frames; post driver; material hoist.

GROUP 4: Greaser, roller steel (5 tons or less); roller (pneumatic tired) - self propelled; tractor (mounted or towed compactors & light equipment); shouldering machine; self-propelled chip spreader; concrete spreader; finishing machine; mechanical float; curing machine; power subgrader; joint sawer (multiple blade) belting machine; burlap machine; texturing machine; tractor endloader (rubber tired) - light; jeep digger; forklift; mulcher; launch operator; fireman, environmental burner

GROUP 5: Air compressor; power pack; vibrator hammer and extractor; heavy equipment, leadman; tank car heaters; stump chipper; curb machine operator; Concrete proportioning plants; generators; mudjack operator; rock breaker; crusher or screening plant; screed (milling machine); automatic belt conveyor and surge bin; pug mill operator; Oiler, pump (over 3 inches); Drilling Machine Tender, day light machine

GROUP 6: Off-road material hauler with or without ejector.

IRON0008-002 06/01/2023

BROWN, CALUMET, DOOR, FOND DU LAC, KEWAUNEE, MANITOWOC,
MARINETTE, OCONTO, OUTAGAMI, SHAWANO, SHEBOYGAN, AND WINNEBAGO
COUNTIES:

	Rates	Fringes
IRONWORKER.....	\$ 41.73	30.67

Paid Holidays: New Year's Day, Memorial Day, July 4th, Labor
Day, Thanksgiving Day & Christmas Day.

IRON0008-003 06/01/2023

KENOSHA, MILWAUKEE, OZAUCKEE, RACINE, WALWORTH (N.E. 2/3),
WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes
IRONWORKER.....	\$ 43.40	30.67

Paid Holidays: New Year's Day, Memorial Day, July 4th, Labor
Day, Thanksgiving Day & Christmas Day.

IRON0383-001 06/02/2024

ADAMS, COLUMBIA, CRAWFORD, DANE, DODGE, FLORENCE, FOREST,
GRANT, GREENE, (Excluding S.E. tip), GREEN LAKE, IOWA,
JEFFERSON, JUNEAU, LA CROSSE, LAFAYETTE, LANGLADE, MARATHON,
MARQUETTE, MENOMINEE, MONROE, PORTAGE, RICHLAND, ROCK (Northern
area, vicinity of Edgerton and Milton), SAUK, VERNON, WAUPACA,
WAUSHARA, AND WOOD COUNTIES

	Rates	Fringes
IRONWORKER.....	\$ 42.00	31.93

IRON0498-005 06/01/2023

GREEN (S.E. 1/3), ROCK (South of Edgerton and Milton), and
WALWORTH (S.W. 1/3) COUNTIES:

	Rates	Fringes
IRONWORKER.....	\$ 45.18	47.08

IRON0512-008 04/30/2023

BARRON, BUFFALO, CHIPPEWA, CLARK, DUNN, EAU CLAIRE, JACKSON,
PEPIN, PIERCE, POLK, RUSK, ST CROIX, TAYLOR, AND TREMPLEAU
COUNTIES

	Rates	Fringes

IRONWORKER.....\$ 43.00 34.11

IRON0512-021 04/30/2023

ASHLAND, BAYFIELD, BURNETT, DOUGLAS, IRON, LINCOLN, ONEIDA,
PRICE, SAWYER, VILAS AND WASHBURN COUNTIES

Rates Fringes

IRONWORKER.....\$ 39.14 34.00

LAB00113-002 06/03/2024

MILWAUKEE AND WAUKESHA COUNTIES

Rates Fringes

LABORER

Group 1.....	\$ 35.61	25.01
Group 2.....	\$ 35.76	25.01
Group 3.....	\$ 35.96	25.01
Group 4.....	\$ 36.11	25.01
Group 5.....	\$ 36.26	25.01
Group 6.....	\$ 32.10	25.01

LABORERS CLASSIFICATIONS

GROUP 1: General Laborer; Tree Trimmer; Conduit Layer;
Demolition and Wrecking Laborer; Guard Rail, Fence, and
Bridge Builder; Landscaper; Multiplate Culvert Assembler;
Stone Handler; Bituminous Worker (Shoveler, Loader, and
Utility Man); Batch Truck Dumper or Cement Handler;
Bituminous Worker (Dumper, Ironer, Smoother, and Tamper);
Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawyer and Filler
(Pavement); Vibrator or Tamper Operator (Mechanical Hand
Operated); Chain Saw Operator; Demolition Burning Torch
Laborer

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter
(Curb, Sidewalk, and Pavement); Strike Off Man

GROUP 4: Line and Grade Specialist

GROUP 5: Blaster and Powderman

GROUP 6: Flagperson; traffic control person

LAB00113-003 06/03/2024

OZAUKEE AND WASHINGTON COUNTIES

Rates Fringes

LABORER

Group 1.....	\$ 34.86	25.01
Group 2.....	\$ 34.96	25.01
Group 3.....	\$ 35.01	25.01
Group 4.....	\$ 35.21	25.01
Group 5.....	\$ 35.06	25.01
Group 6.....	\$ 31.95	25.01

LABORERS CLASSIFICATIONS

GROUP 1: General Laborer; Tree Trimmer; Conduit Layer; Demolition and Wrecking Laborer; Guard Rail, Fence, and Bridge Builder; Landscaper; Multiplate Culvert Assembler; Stone Handler; Bituminous Worker (Shoveler, Loader, and Utility Man); Batch Truck Dumper or Cement Handler; Bituminous Worker (Dumper, Ironer, Smoother, and Tamper); Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawyer and Filler (Pavement); Vibrator or Tamper Operator (Mechanical Hand Operated);

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter (Curb, Sidewalk, and Pavement); Strike Off Man

GROUP 4: Line and Grade Specialist

GROUP 5: Blaster; powderman

GROUP 6: Flagperson and Traffic Control Person

LAB00113-011 06/03/2024

KENOSHA AND RACINE COUNTIES

	Rates	Fringes
LABORER		
Group 1.....	\$ 34.67	25.01
Group 2.....	\$ 34.82	25.01
Group 3.....	\$ 35.02	25.01
Group 4.....	\$ 34.99	25.01
Group 5.....	\$ 35.52	25.01
Group 6.....	\$ 31.81	25.01

LABORERS CLASSIFICATIONS:

GROUP 1: General laborer; Tree Trimmer; Conduit Layer; Demolition and Wrecking Laborer; Guard Rail, Fence, and Bridge Builder; Landscaper; Multiplate Culvert Assembler; Stone Handler; Bituminous Worker (Shoveler, Loader, and Utility Man); Batch Truck Dumper or Cement Handler; Bituminous worker (Dumper, Ironer, Smoother, and Tamper); Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawyer and Filler (Pavement); Vibrator or Tamper Operator (Mechanical Hand Operated); Chain Saw Operator; Demolition Burning Torch Laborer

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter (Curb, Sidewalk, and Pavement); Strike Off Man

GROUP 4: Line and Grade Specialist

GROUP 5: Blaster and Powderman

GROUP 6: Flagman; traffic control person

LAB00140-002 06/03/2024

ADAMS, ASHLAND, BARRON, BAYFIELD, BROWN, BUFFALO, BURNETT, CALUMET, CHIPPEWA, CLARK, COLUMBIA, CRAWFORD, DODGE, DOOR, DOUGLAS, DUNN, EAU CLAIRE, FLORENCE, FOND DU LAC, FOREST, GRANT, GREEN, GREEN LAKE, IRON, JACKSON, JUNEAU, IOWA, JEFFERSON, KEWAUNEE, LA CROSSE, LAFAYETTE, LANGLADE, LINCOLN, MANITOWOC, MARATHON, MARINETTE, MARQUETTE, MENOMINEE, MONROE, OCONTO, ONEIDA, OUTAGAMIE, PEPIN, PIERCE, POLK, PORTAGE, PRICE, RICHLAND, ROCK, RUSK, SAUK, SAWYER, SHAWANO, SHEBOYGAN, ST. CROIX, TAYLOR, TREMPLEAU, VERNON, VILLAS, WALWORTH, WASHBURN, WAUPACA, WAUSHARA, WINNEBAGO, AND WOOD COUNTIES

	Rates	Fringes
LABORER		
Group 1.....	\$ 40.57	19.45
Group 2.....	\$ 40.67	19.45
Group 3.....	\$ 40.72	19.45
Group 4.....	\$ 40.92	19.45
Group 5.....	\$ 40.77	19.45
Group 6.....	\$ 37.20	19.45

LABORER CLASSIFICATIONS

GROUP 1: General Laborer; Tree Trimmer; Conduit Layer; Demolition and Wrecking Laborer; Guard Rail, Fence, and Bridge Builder; Landscaper; Multiplate Culvert Assembler; Stone Handler; Bituminous Worker (Shoveler, Loader, and Utility Man); Batch Truck Dumper or Cement Handler; Bituminous Worker (Dumper, Ironer, Smoother and Tamper); Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawyer and Filler (Pavement); Vibrator or Tamper Operator (Mechanical Hand Operated); Chain Saw Operator, Demolition Burning Torch Laborer

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter (Curb, Sidewalk and Pavement); Strike Off Man

GROUP 4: Line and Grade Specialist

GROUP 5: Blaster; powderman

GROUP 6: Flagperson; Traffic Control

LAB00464-003 06/03/2024

DANE COUNTY

	Rates	Fringes
LABORER		
Group 1.....	\$ 40.85	19.45
Group 2.....	\$ 40.95	19.45
Group 3.....	\$ 41.00	19.45
Group 4.....	\$ 41.20	19.45
Group 5.....	\$ 41.05	19.45
Group 6.....	\$ 37.20	19.45

LABORERS CLASSIFICATIONS:

GROUP 1: General Laborer; Tree Trimmer; Conduit Layer; Demolition and Wrecking Laborer; Guard Rail, Fence, and

Bridge Builder; Landscaper; Multiplate Culvert Assembler;
 Stone Handler; Bituminous Worker (Shoveler, Loader, and
 Utility Man); Batch Truck Dumper or Cement Handler;
 Bituminous Worker (Dumper, Ironer, Smoother, and Tamper);
 Concrete Handler

GROUP 2: Air Tool Operator; Joint Sawyer and Filler
 (Pavement); Vibrator or Tamper Operator (Mechanical Hand
 Operated); Chain Saw Operator; Demolition Burning Torch
 Laborer

GROUP 3: Bituminous Worker (Raker and Luteman); Formsetter
 (Curb, Sidewalk, and Pavement); Strike Off Man

GROUP 4: Line and Grade Specialist

GROUP 5: Blaster; Powderman

GROUP 6: Flagperson and Traffic Control Person

 PAIN0106-008 05/06/2024

ASHLAND, BAYFIELD, BURNETT, AND DOUGLAS COUNTIES

	Rates	Fringes

Painters:

New:

Brush, Roller.....	\$ 36.16	26.27
Spray, Sandblast, Steel....	\$ 36.76	26.27

Repaint:

Brush, Roller.....	\$ 34.66	26.27
Spray, Sandblast, Steel....	\$ 35.26	26.27

 * PAIN0108-002 06/01/2024

RACINE COUNTY

	Rates	Fringes

Painters:

Brush, Roller.....	\$ 42.04	22.95
Spray & Sandblast.....	\$ 43.04	22.95

 PAIN0259-002 05/01/2008

BARRON, CHIPPEWA, DUNN, EAU CLAIRE, PEPIN, PIERCE, POLK, RUSK,
 SAWYER, ST. CROIX, AND WASHBURN COUNTIES

	Rates	Fringes

PAINTER.....	\$ 24.11	12.15

 PAIN0259-004 05/01/2015

BUFFALO, CRAWFORD, JACKSON, LA CROSSE, MONROE, TREMPLEAU, AND
 VERNON COUNTIES

	Rates	Fringes

PAINTER.....	\$ 22.03	12.45

PAIN0781-002 06/01/2024

JEFFERSON, MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

	Rates	Fringes

Painters:

Bridge.....	\$ 41.39	24.92
Brush.....	\$ 40.64	24.92
Spray & Sandblast.....	\$ 41.39	24.92

PAIN0802-002 06/01/2024COLUMBIA, DANE, DODGE, GRANT, GREEN, IOWA, LAFAYETTE, RICHLAND,
ROCK, AND SAUK COUNTIES

	Rates	Fringes

PAINTER

Brush.....	\$ 36.35	20.87

PREMIUM PAY:

Structural Steel, Spray, Bridges = \$1.00 additional per
hour.-----
PAIN0802-003 06/01/2024ADAMS, BROWN, CALUMET, CLARK, DOOR, FOND DU LAC, FOREST, GREEN
LAKE, IRON, JUNEAU, KEWAUNEE, LANGLADE, LINCOLN, MANITOWOC,
MARATHON, MARINETTE, MARQUETTE, MENOMINEE, OCONTO, ONEIDA,
OUTAGAMIE, PORTAGE, PRICE, SHAWANO, SHEBOYGAN, TAYLOR, VILAS,
WAUSHARA, WAUPACA, WINNEBAGO, AND WOOD COUNTIES

	Rates	Fringes

PAINTER.....	\$ 36.35	20.87

* PAIN0934-001 06/01/2024

KENOSHA AND WALWORTH COUNTIES

	Rates	Fringes

Painters:

Brush.....	\$ 38.67	26.32
Spray.....	\$ 39.67	26.32
Structural Steel.....	\$ 38.82	26.32

PAIN1011-002 06/02/2024

FLORENCE COUNTY

	Rates	Fringes

Painters:.....	\$ 29.95	15.89

PLAS0599-002 06/01/2023

	Rates	Fringes

CEMENT MASON/CONCRETE FINISHER

Area A.....	\$ 45.17	27.27

Area B.....	\$ 39.97	25.02
Area C.....	\$ 40.40	25.25
Area D.....	\$ 41.16	24.49
Area E.....	\$ 40.50	25.14
Area F.....	\$ 36.98	28.67

AREA DESCRIPTIONS

AREA A: ASHLAND, BURNETT, BAYFIELD, DOUGLAS, IRON, PRICE, SAWYER, AND WASHBURN COUNTIES

AREA B: ADAMS, BARRON, BROWN, CALUMET, CHIPPEWA, CLARK, COLUMBIA, DODGE, DOOR, DUNN, FLORENCE, FOND DU LAC, FOREST, GREEN LAKE, JEFFERSON, KEWAUNEE, LANGLADE, LINCOLN, MANITOWOC, MARATHON, MARINETTE, MARQUETTE, MENOMINEE, OCONTO, ONEIDA, OUTAGAMIE, POLK, PORTAGE, RUSK, ST. CROIX, SAUK, SHAWANO, SHEBOYGAN, TAYLOR, VILAS, WALWORTH, WAUPACA, WAUSHARA, WINNEBAGO, AND WOOD COUNTIES

AREA C: BUFFALO, CRAWFORD, EAU CLAIRE, JACKSON, JUNEAU, LA CROSSE, MONROE, PEPIN, PIERCE, RICHLAND, TREMPLEAU, AND VERNON COUNTIES

AREA D: MILWAUKEE, OZAUKEE, WASHINGTON, AND WAUKESHA COUNTIES

AREA E: DANE, GRANT, GREEN, IOWA, LAFAYETTE, AND ROCK COUNTIES

AREA F: KENOSHA AND RACINE COUNTIES

TEAM0039-001 06/01/2024

	Rates	Fringes
TRUCK DRIVER		
1 & 2 Axles.....	\$ 37.57	27.41
3 or more Axles; Euclids, Dumpton & Articulated, Truck Mechanic.....	\$ 37.72	27.41

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

=====

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010

08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

State Adopted Rate Identifiers

Classifications listed under the "SA" identifier indicate that the prevailing wage rate set by a state (or local) government was adopted under 29 C.F.R. 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 01/03/2024 reflects the date on which the classifications and rates under the SA identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

=====

END OF GENERAL DECISION"



Wisconsin Department of Transportation

August 7, 2024

Division of Transportation Systems Development

Bureau of Project Development
4822 Madison Yards Way, 4th Floor South
Madison, WI 53705

Telephone: (608) 266-1631

Facsimile (FAX): (608) 266-8459

NOTICE TO ALL CONTRACTORS:

Proposal #09: 1130-44-74, WISC 2024402
Appleton – Green Bay
Wrightstown SWEF 34/Post-Bldg
IH 41
Outagamie County

Letting of August 13, 2024

This is Addendum No.01, which provides for the following:

Special Provisions:

Revised Special Provisions	
Article No.	Description
58	SWEF/Post Building, General Construction, Item SPV.0060.100
65	Main Communications Tower, Item SPV.0060.200

Schedule of Items:

Revised Bid Item Quantities					
Bid Item	Item Description	Unit	Proposal Total Prior to Addendum	Proposal Quantity Change (-)	Proposal Total After Addendum
SPV.200.020	Construct Outside Drop, 6-Inch	VF	7	7	14

Plan Sheets:

Revised Plan Sheets	
Plan Sheet	Plan Sheet Title (brief description of changes to sheet)
49	Label inside drops
94	Revised propane detail setup to include single regulator.
125	Revised window callouts to match elevation view
128	Revised window callouts to match elevation view
233	Revised Detail 4 on S801
234	Added note on Detail 5
353	Revised Construct Inside Drop 6-Inch quantity

The responsibility for notifying potential subcontractors and suppliers of these changes remains with the prime contractor.

Sincerely,

Mike Coleman

Proposal Development Specialist
Proposal Management Section

ADDENDUM NO. 01

1130-44-74

August 7, 2024

Special Provisions

58. SWEF\Post Building, General Construction, Item SPV.0060.100.

*Replace subsection titled 3.2 FIELD OFFICE under subsection titled **PART 3 – EXECUTION** under section **SECTION 01 56 10 – Temporary Facilities & Installations** with the following:*

3.2 FIELD OFFICE

- A. The General Building Contractor shall provide and maintain a field office during the entire duration of the construction project.
- C. Each office area shall be provided with a large, smooth-top worktable, one office desk w/lock, four chairs, a four drawer file with lock, including janitorial service.
- D. A Large room for project meetings shall be provided as well.
- E. The General Building Contractor shall coordinate additional field offices with subcontractors and vendors.

*Add the following to **Section 3.10 INTERIOR PAINT SCHEDULE** under section titled **Section 09 91 00 Painting**:*

- A. Concrete and Masonry (other than Concrete Masonry Units) to include:

5. Concrete floor slabs:

a. Semi-Gloss, fast cure epoxy:

- 1. 2 coats.**
- 2. Minimum DFT: 5.0 – 10.0 mils.**
- 3. Minimum VS: 72 percent.**
- 4. Surface Preparation: SSPC-SP 14 to a CSP 1-3.**
- 5. Color as selected by E/A.**
- 6. S-W: Macropoxy 646.**

65. Main Communications Tower, Item SPV.0060.200.

Section 33 81 00 – Communication Towers

Part 1 – General

Add the following after FIELD CONDITIONS last paragraph:

QUALIFICATIONS:

Approved tower manufacturers include:

- 1. Sabre Industries – Alvarado, TX
- 2. Valmont Industries – Omaha, NE
- 3. Rohn Products – Peoria, IL

Part 2 – PRODUCTS, SELF-SUPPORT TOWERS

Revise the first sentence to the following:

Self-support towers shall be a free standing, three legged, structures constructed of galvanized steel

and of the general profile as shown in the drawings.

Schedule of Items

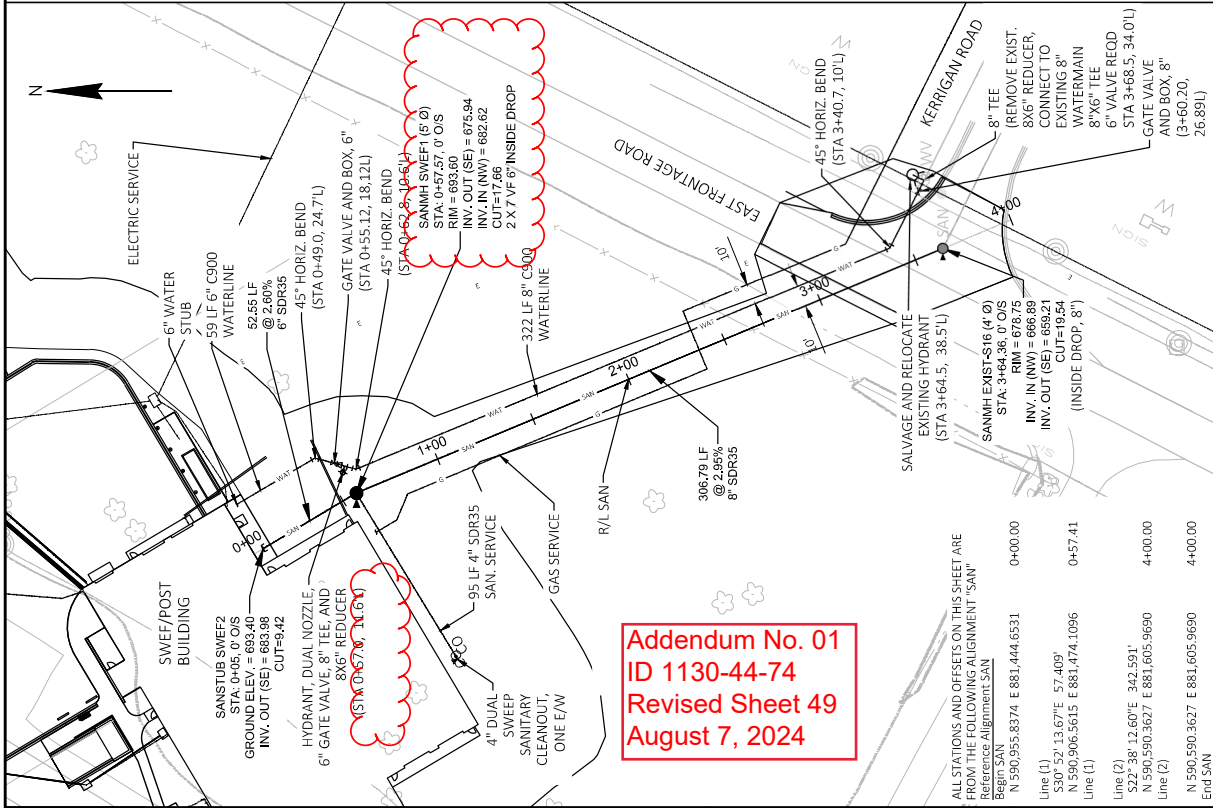
Attached, dated August 7, 2024, are the revised Schedule of Items Page 12.

Plan Sheets

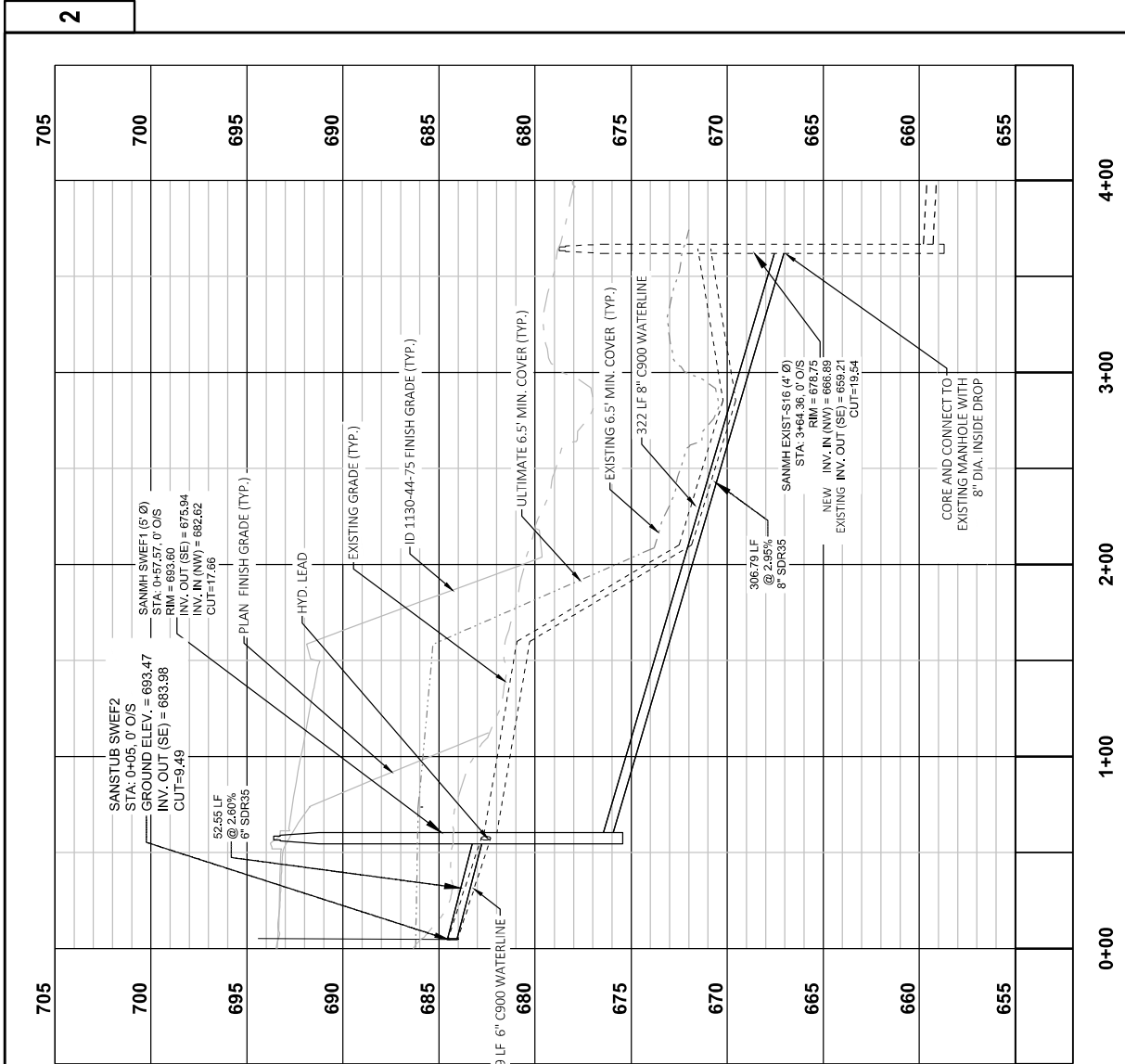
The following 8½ x 11-inch sheets are attached and made part of the plans for this proposal:

Revised: 49, 94, 125, 128, 233, 234, 353

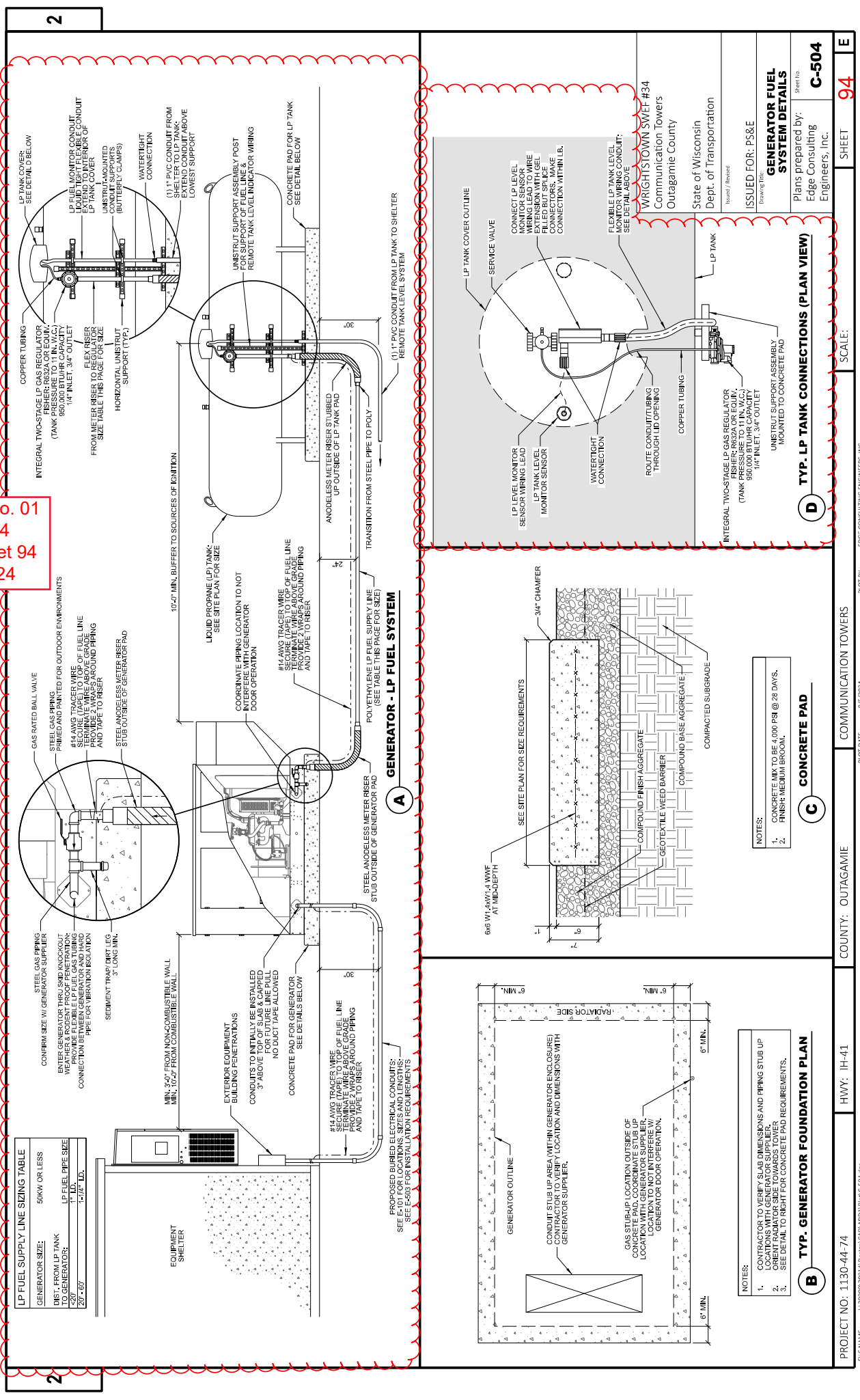
END OF ADDENDUM



Addendum No. 01
ID 1130-44-74
Revised Sheet 49
August 7, 2024



Addendum No. 01
ID 1130-44-74
Revised Sheet 94
August 7, 2024



KEY PLAN

6. GC SHALL SUBMIT INDICATES PRE-EXISTING CEILING PROPOSALS TO BUILDING DEPARTMENT FOR REVIEW PRIOR TO PROCEEDING WITH WORK.
7. FOR TYPICAL CMU CONCRETE PARTITIONS AND BURNISH FINISHES, SEE 2 / A522
8. SEE STRUCTURAL, FOR ADDITIONAL REQUIREMENTS FOR PRECAST ELEMENTS.
9. WALL-MOUNTED MOUNTS AND MONITORS BY OWNER, CONTRACTOR TO PROVIDE BLOODING/STAPLING AS REQUIRED AT FRAMED WALLS CAPABLE OF SUPPORTING 125 LBS MINIMUM COORDINATE WITH POWER AND IT REQUIREMENTS, SEE E-SERIES SHEETS.
10. AT ALL WALL TELECOMS, CONTRACTOR SHALL PROVIDE CEILING/CANALS BACKBOARD SUBSTRATE, NEST OF OPS/BM BOARD AND INSTAL PER COM.

PLAN

AREA A
1 / A106

AREA B
1 / A107

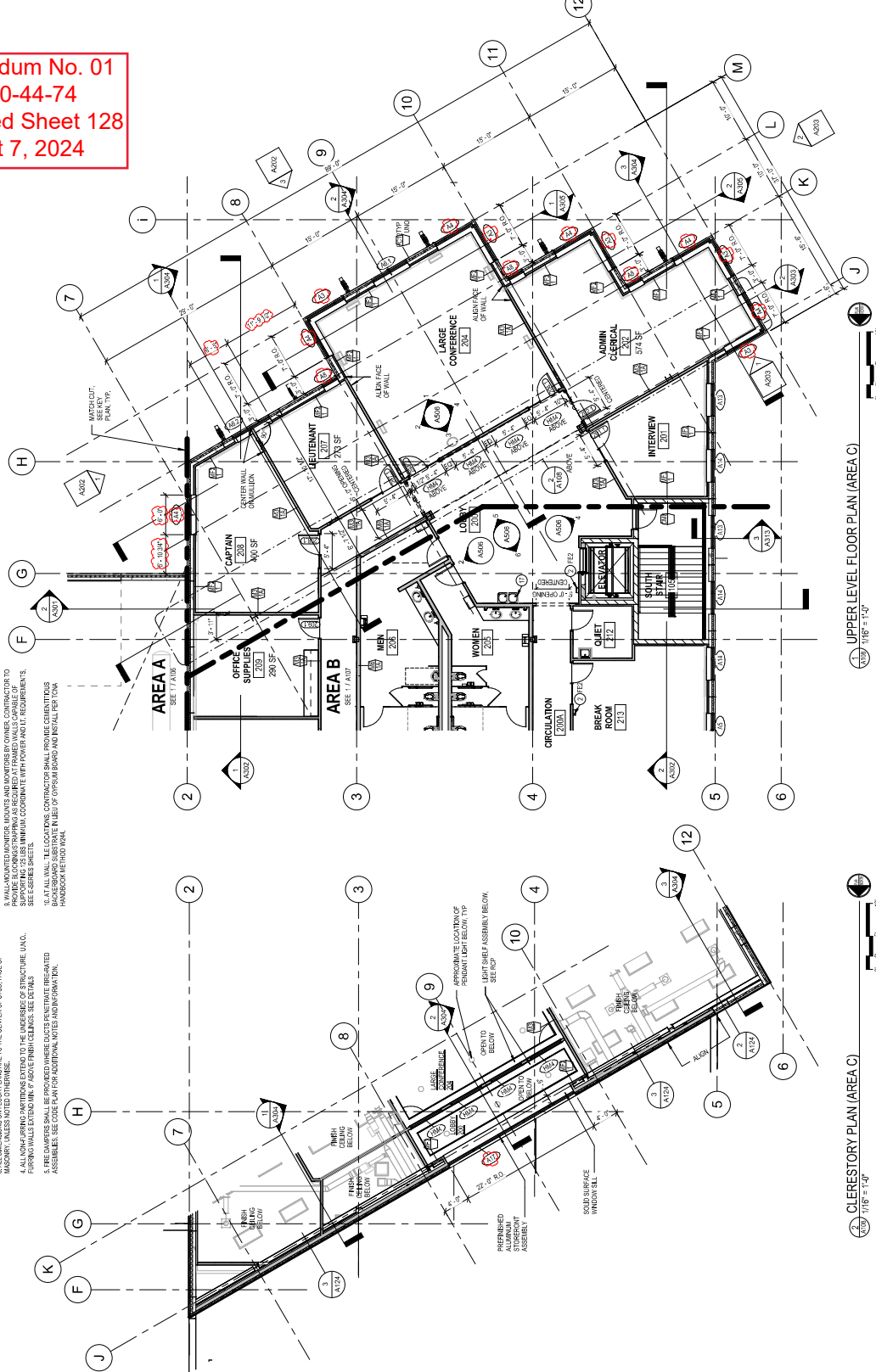
AREA C
1 / A108

PLAN NORTH
TRUE NORTH

100' (30.48m)

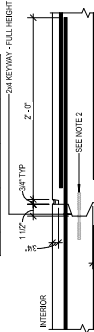
FLOOR PLAN KEYNOTES

- [illegible]



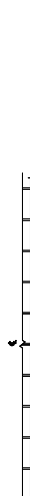
PLANS PREPARED BY: CBS SQUARED, INC., CHIPPEWA FALLS, WI	COUNTY: OUTAGAMIE	UPPER LEVEL FLOOR PLAN (AREA C)	DATE 5/1/24	SCALE FINAL
PROJECT NO: 1130-44-74	HWY: IH 41	WRIGHTSTOWN SWEEF & STATE PATROL POST FACILITY	DATE A108	SCALE 128

Diagram illustrating the relationship between hook and original dimensions. The diagram shows a horizontal line with a hook at the end. The hook is labeled 'HOOK'. The original dimension is labeled 'A OR G'. The detailing dimension is labeled 'DETAILING DIMENSION'.



PROVIDE CONTINUOUS PVC WATERSTOP CENTERED IN CJ OF WALLS IN LIQUID RETAINING STRUCTURES

1 TYPICAL FOOTING AND FOUNDATION WALL DETAIL



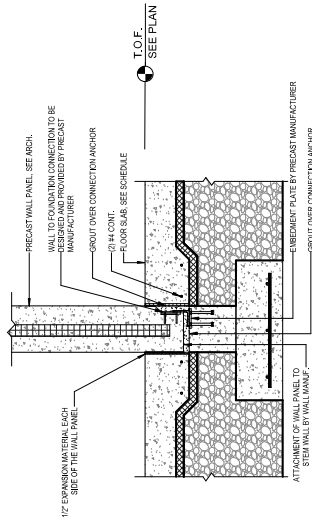
7 OPENINGS DETAIL



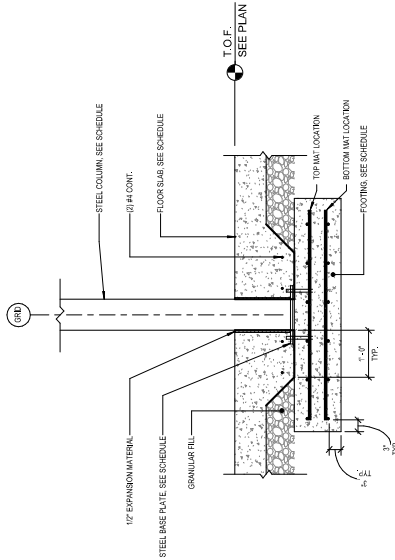
TYPICAL DIAGONAL REINFORCING AT CONCRETE WALL AND SLAB OPENINGS DETAIL



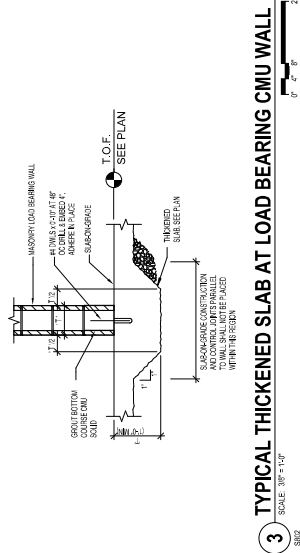
PLANS PREPARED BY: CBS SQUARED, INC., CHIPPEWA FALLS, WI	STRUCTURAL FOUNDATION DETAILS	5/1/24	FINAL
PROJECT NO: 1130-44-74	COUNTY: OUTAGAMIE	WRIGHTSTOWN SWEEP & STATE PATROL POST FACILITY	233



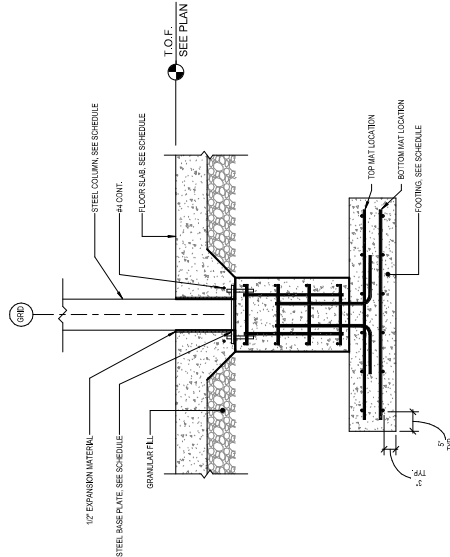
1 INTERIOR PRECAST WALL FOUNDATION DETAIL
SCALE: 3/8" = 1'-0"
S802



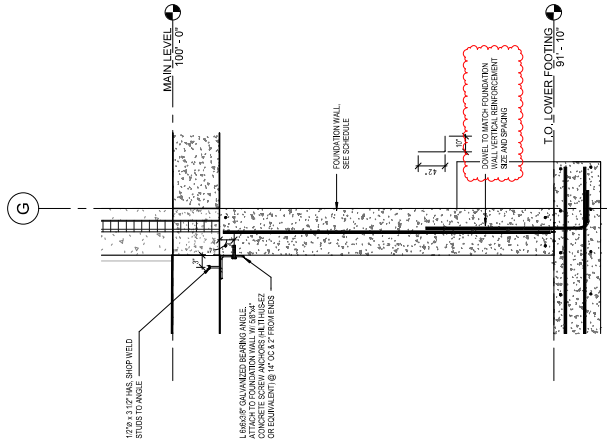
2 INTERIOR COLUMN FOUNDATION DETAIL
SCALE: 3/8" = 1'-0"
S802



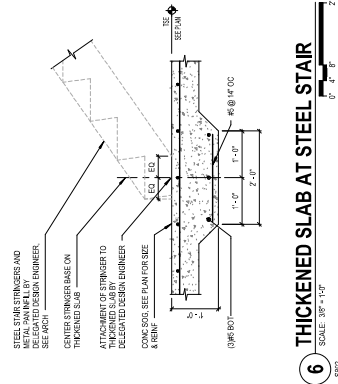
3 TYPICAL THICKENED SLAB AT LOAD BEARING CMU WALL
SCALE: 3/8" = 1'-0"
S802



4 TYPICAL CONCRETE PIER DETAIL
SCALE: 3/8" = 1'-0"
S802



5 INSPECTION PIT DETAIL
SCALE: 3/8" = 1'-0"
S802



6 THICKENED SLAB AT STEEL STAIR
SCALE: 3/8" = 1'-0"
S802

Addendum No. 01
ID 1130-44-74
Revised Sheet 234
August 7, 2024

PLANS PREPARED BY: CBS SQUARED, INC., CHIPPEWA FALLS, WI		STRUCTURAL FOUNDATION DETAILS	5/1/24	FINAL
PROJECT NO: 1130-44-74		WRIGHTSTOWN SWEF & STATE PATROL POST FACILITY	S802	234
COUNTY: OUTAGAMIE				
HWY: IH 41				
PLOT DATE: 8/6/2024 11:09:38 AM				

ALL ITEMS IN THIS TABLE ARE CAT 0030

SANITARY

LOCATION	SPV.0060.030 SANITARY SEWER MANHOLE W/CASTING 5-FT DIAMETER EACH	SPV.0060.022 SANITARY SEWER CLEANOUT EACH	SPV.0060.023 SANITARY MANHOLE 8-INCH CORE EACH	SPV.0090.021 SANITARY SEWER MAIN 8-INCH LF	SPV.0090.022 SANITARY SEWER SERVICE PVC 6-INCH LF	SPV.0090.023 SANITARY SEWER LATERAL 4-INCH LF	SPV.200.020 CONSTRUCT INSIDE DROP, 6-INCH VF	SPV.0200.021 CONSTRUCT INSIDE DROP, 8-INCH VF
WRIGHTSTOWN SWEF/POST	1	2	1	322	59	95	14	8
PROJECT 1130-44-74 TOTAL	1	2	1	322	59	95	14	8

ALL ITEMS IN THIS TABLE ARE CAT 0030

WATER

LOCATION	SPV.0060.030 CONNECT TO EXISTING WATER MAIN EACH	SPV.0060.031 GATE VALVE AND BOX 6-INCH EACH	SPV.0060.032 GATE VALVE AND BOX 8-INCH EACH	SPV.0060.033 REMOVE AND REPLACE HYDRANT EACH	SPV.0060.034 FURNISH AND INSTALL HYDRANT EACH	SPV.0060.035 CONSTRUCTION STAKING WATER MAIN EACH	SPV.0060.036 MAINTAIN WATER SERVICE DURING CONSTRUCTION EACH	SPV.0090.031 WATER MAIN CROSS 6-INCH LF	SPV.0090.032 WATER MAIN CROSS 8-INCH LF
WRIGHTSTOWN SWEF/POST	1	2	1	1	1	1	1	59	322
PROJECT 1130-44-74 TOTAL	1	2	1	1	1	1	1	59	322

*WATER MAIN FITTINGS

FITTING LOCATION	* FITTING TYPE
STA 0+49.0, 24.7' LT	6-INCH 45 DEG. HORIZONTAL BEND
STA 0+57.0, 11.6' LT	6-INCH 90 DEG. HYDRANT LEAD BEND
STA 0+57.0, 16.0' LT	8-INCH X 6-INCH REDUCER
STA 0+58.5, 14.1' LT	8-INCH X 6-INCH TEE
STA 0+62.8, 10.6' LT	8-INCH 45 DEG. HORIZONTAL BEND
STA 3+40.7, 10.0' LT	8-INCH 45 DEG. HORIZONTAL BEND
STA 3+68.5, 34.0' LT	8-INCH X 6-INCH TEE
STA 3+64.5, 38.5' LT	6-INCH 90 DEG. HYDRANT LEAD BEND
*FITTINGS INCIDENTAL TO WATER MAIN CONSTRUCTION	

Addendum No. 01
ID 1130-44-74
Revised Sheet 353
August 7, 2024



Proposal Schedule of Items

Page 12 of 12

Proposal ID: 20240813009 Project(s): 1130-44-74

Federal ID(s): WISC 2024402

SECTION: 0001

Contract Items

Alt Set ID:

Alt Mbr ID:

Proposal Line Number	Item ID Description	Approximate Quantity and Units	Unit Price	Bid Amount
0328	SPV.0090 Special 002. Concrete Curb and Gutter 24-Inch Type D	665.000 LF	_____.	_____.
0330	SPV.0090 Special 003. 12-CT Fiber Optic Cable	395.000 LF	_____.	_____.
0332	SPV.0090 Special 004. Aluminum Landscape Edging	175.000 LF	_____.	_____.
0334	SPV.0090 Special 021. Sanitary Sewer Main 8-inch	322.000 LF	_____.	_____.
0336	SPV.0090 Special 022. Sanitary Sewer Service PVC 6-inch	59.000 LF	_____.	_____.
0338	SPV.0090 Special 023. Sanitary Sewer Lateral, 4- Inch	95.000 LF	_____.	_____.
0340	SPV.0090 Special 031. Water Main C900 6-inch	59.000 LF	_____.	_____.
0342	SPV.0090 Special 032. Water Main C900 8 -inch	322.000 LF	_____.	_____.
0344	SPV.0180 Special 001. Topsoil Stripping	9,700.000 SY	_____.	_____.
0346	SPV.0180 Special 002. Weed Barrier Fabric	520.000 SY	_____.	_____.
0348	SPV.0200 Special 020. Construct Outside Drop, 6- Inch	14.000 VF	_____.	_____.
0350	SPV.0200 Special 021. Construct Inside Drop, 8- Inch	8.000 VF	_____.	_____.
Section: 0001			Total:	_____.
			Total Bid:	_____.



Wisconsin Department of Transportation

August 9, 2024

**Division of Transportation Systems
Development**

Bureau of Project Development
4822 Madison Yards Way, 4th Floor South
Madison, WI 53705

Telephone: (608) 266-1631
Facsimile (FAX): (608) 266-8459

NOTICE TO ALL CONTRACTORS:

Proposal #09: 1130-44-74, WISC 2024402
Appleton – Green Bay
Wrightstown SWEF 34/Post-Bldg
IH 41
Outagamie County

Letting of August 13, 2024

This is Addendum No.02, which provides for the following:

Plan Sheets:

Revised Plan Sheets	
Plan Sheet	Plan Sheet Title (brief description of changes to sheet)
297	Revised piping detail
302	Revised mechanical room layout detail
311	Revised hot water system detail

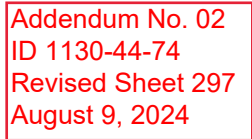
The responsibility for notifying potential subcontractors and suppliers of these changes remains with the prime contractor.

Sincerely,

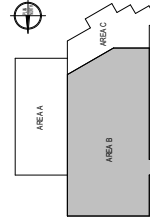
Mike Coleman

Proposal Development Specialist
Proposal Management Section

END OF ADDENDUM



1 MECHANICAL MAIN LEVEL FLOOR PLAN - AREA B
M207 1/16" = 1'-0" PIPING



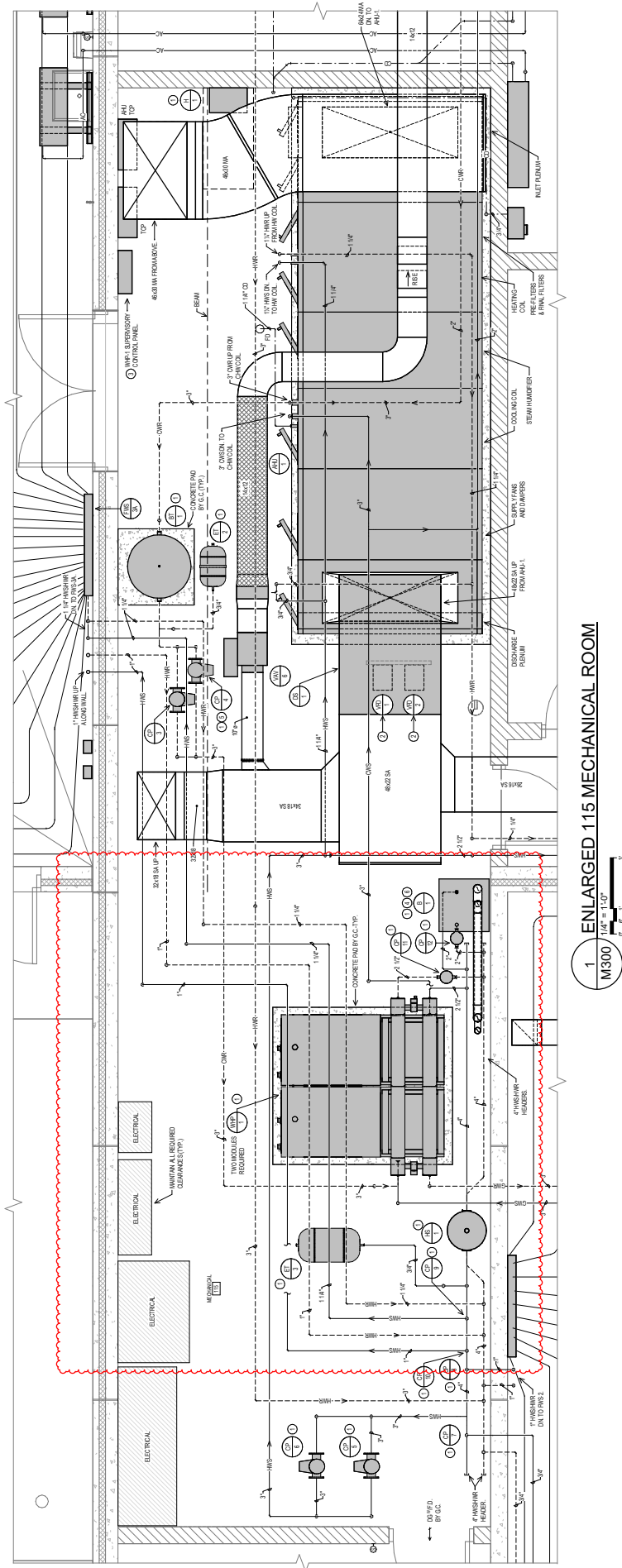
KEY PLAN

PLANS PREPARED BY: CBS SQUARED, INC., CHIPPEWA FALLS, WI				
PROJECT NO: 1130-44-74	HWY: IH 41	COUNTY: OUTAGAMIE	MECHANICAL MAIN LEVEL FLOOR PLAN - AREA B PIPING	DATE 5/1/24
			WRIGHTSTOWN SWEET & STATE PATROL POST FACILITY	DATE M207
				DATE 297

Autodesk Docs://KLENG 21001 - SWEF/21107 MECH R21_mikeAPV/MK.rvt

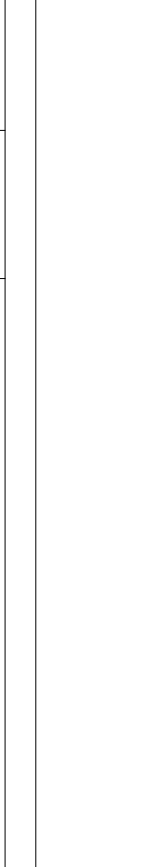
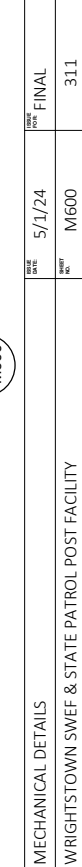
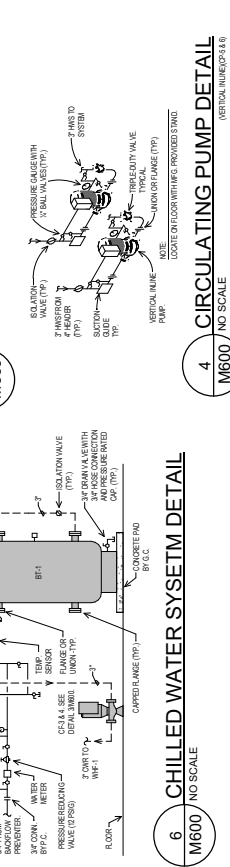
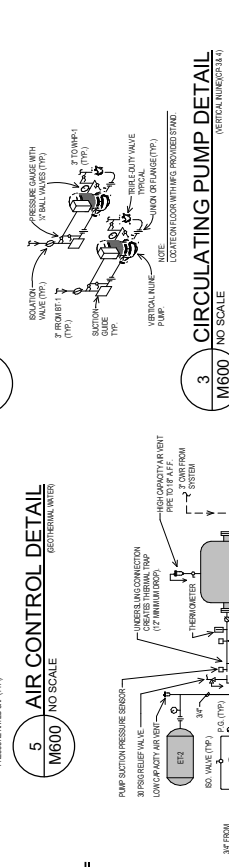
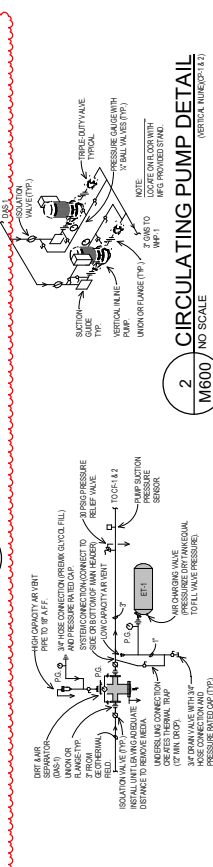
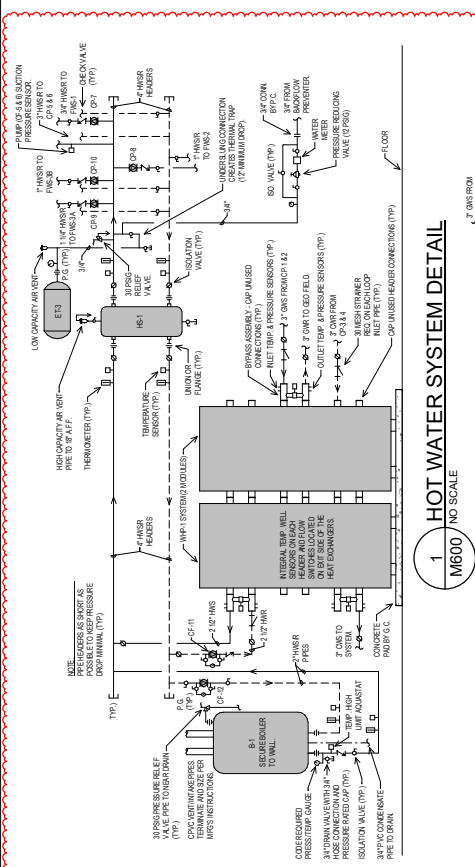
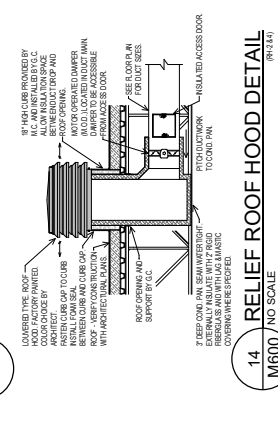
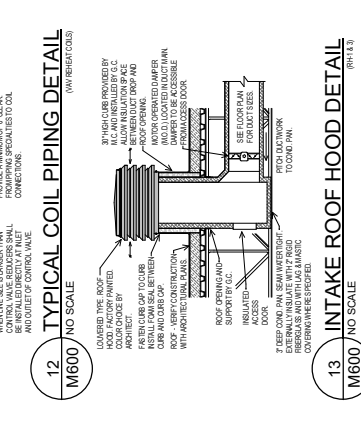
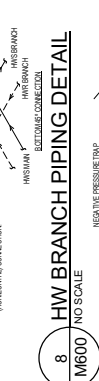
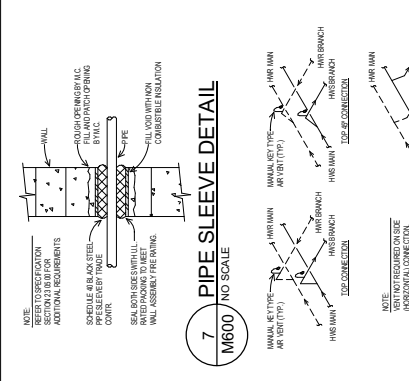
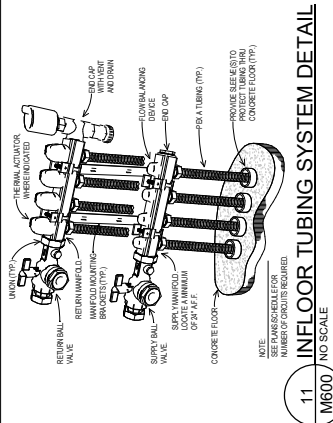
Addendum No. 02
ID 1130-44-74
Revised Sheet 302
August 9, 2024

MECHANICAL KEYNOTES - M300	
1	SEE DETAILS
2	DO NOT SCALE
3	DO NOT SCALE
4	DO NOT SCALE
5	DO NOT SCALE
6	DO NOT SCALE
7	DO NOT SCALE
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1 ENLARGED 115 MECHANICAL ROOM
M300

PLANS PREPARED BY: CBS SQUARED, INC., CHIPPEWA FALLS, WI	ENLARGED 115 MECHANICAL ROOM	DATE: 5/1/24	FINAL
PROJECT NO: 1130-44-74	WRIGHTSTOWN SWEET & STATE PATROL POST FACILITY	DATE: M300	302
AUTODESK DOC: KLENC 2.001 - SWEET/1107 MECH R21_mhkbapvnr.rvt	COUNTY: OUTAGAMIE	DATE: 8/8/2024 8:50:44 AM	
	HWY: IH 41		



Addendum No. 02
ID 1130-44-74
Revised Sheet 311
August 9, 2024

MECHANICAL DETAILS	DATE	NO.	FINAL
WRIGHTSTOWN SWEF & STATE PATROL POST FACILITY	5/1/24	M600	311

PLANS PREPARED BY: CBS SQUARED, INC., CHIPPEWA FALLS, WI
PROJECT NO: 1130-44-74
HWY: IH 41

AUDIT: 8/8/2024 8:50:44 AM