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| **ANCILLARY STRUCTURES PRE-INSTALLATION VERIFICATION TEST OF HIGH STRENGTH BOLTS**DT2322 3/2025 | Wisconsin Department of Transportation |

*This form should be filed with the completed project file as a permanent record. This form should* ***not*** *be used for highway bridges.*

**Purpose of Test**: Establish individual installation requirements for structural fasteners and Direct Tension Indicators (DTI) by performing and verifying that tension obtained in (3) samples of each fastener assembly lot is at least 5% above the minimum installation tension. Perform prior to installing fasteners in ancillary structures and record the results along with the fastener assembly lot information. Complete for all structures using the same combination of fastener assembly and DTI, furnish a copy for each structure.

**Note:** If bolt assemblies are kept clean and dry, the preinstallation test only needs to be performed per lot / per year. A copy of this test must be kept with the lot until the entire lot is used up. Calibration dates of torque and tension equipment must be within 1 calendar year of pre-installation test date.

**Testing Instructions:**

*DTI under head, turn nut to tighten, bolt head held.*

*Preferred method,*

*shown for informational purposes only.*

1. Fill in the information regarding the Project Data and Table 1 for each lot bolt assembly combination. Note that each combination to be used requires a separate test (Table 1).
2. Test 3 fastener assemblies (A325 Bolt, A563 Nut, F436 Washer\*) from a lot previously tested with a rotational capacity (RoCap) test and ASTM F959 DTI. Test in the same configuration as the bolts and DTIs are being installed in the structure (check box to indicate tested orientation). **\*Note: Special washers may be required for larger bolts.**
3. Clean and Lubricate bolt and nut (face and threads) with wax-based lubricant. Note type of lubricant used in test.
4. Tension with a calibrated torque wrench until reaching the minimum number of refusals from Table 2, measured with a tapered 0.005" feeler gauge. If 100% of refusals are obtained prior to reaching the tension in Table 3, the DTI fails.
5. Record the measured torque and tension in Table 4. Verify the torque is below the maximum and the tension meets the minimum in Table 3. **Note: Torque used to approximate installation and size tools for installation, actual installation is done by measuring DTI refusals.**
6. Repeat steps 3 through 6 and record the information in Table 4 below.
7. Average the number of Refusals and the Measured Torque and add to Table 4 to document installation values.

**Short Bolts:** For bolts too short to fit in typical Bolt-Tension Measuring device (BTMD), perform the preinstallation testing following these instructions for bolts that a RoCap was received from the manufacturer. If no RoCAP received, contractor will need 2 additional bolt assemblies to perform RoCap using a steel plate, performing the required total rotations, and checking for thread damage prior to performing the preinstallation test below.

1. Procure (3) bolts of the same diameter, finish, & grade that are long enough to fit in the BTMD, enter information in Table 5.
2. Use the longer bolts to test the DTI for refusals at the required minimum tension.
3. Mark the number of DTI refusals in Table 4 and check the box that the short bolt procedure was used.
4. Install short bolts in structure using tested DTI to indicate bolt is tensioned properly.

**Dead Panned DTIs:** For bolts that test to within 1 of the maximum number of refusals (dead panned), perform the following alternate test to ensure bolt is not close to failure at deadpan. The test is a continuation of the PIV test, once tension is reached and refusals have been noted.

1. Match mark bolt and continue turning bolt until the bolt reaches 95% of the average tension of the RoCap test.
2. Note additional rotation past dead pan in Table 6.
3. Check bolt threads for damage; the nut should run freely up to the tested position. The assembly is rejected if damage is noted, or the nut does not turn freely to the tested position.

**Installation Instructions:** Once the pre-installation test has been performed the following steps should be performed for installation:

1. Clean and lubricate each bolt and nut (face and threads) with wax-based lubricant just prior to installation.
2. Install bolts with the same configuration as noted under the Tested Bolt Orientation field on the form.
3. Snug connection, alternating bolts like the star pattern used on DT2321 until the plies are in firm contact at each bolt.
4. Tension the bolt until each DTI reaches the Installation Refusals noted in Table 3.
5. If a DTI is inspected and does not meet the refusals in Table 3 the contractor may continue tightening the bolt to meet the number of refusals. The bolt does not need to be replaced if it can be inspected and tension work competed within 2 weeks of erection.

**Quality Control:** The contractors QC should check the following items for each connection of each structure.

1. Check that the assembly of bolts, nuts, and washers match the data provided in Table 1 and are clean, free of corrosion, damage.
2. Check that the washers for bolts over 1-1/8" conform to DTI manufacturer's recommendations. This may require special washers where the hole is 1/16" diameter larger ID than the bolt diameter.
3. Check the configuration of the bolt assembles is the same as the preinstallation noted under the Tested Bolt Orientation.
4. Check the plies are in firm contact at each bolt prior to tensioning. Contact BOS if this cannot be achieved during snugging.
5. Check that DTIs installed in the field are compressed to Installation Refusals found in Table 4 using a tapered 0.005” feeler gauge.

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| **Testing Contractor/Firm Name**       | **Contractor Job #** | **State Project ID** | **Structure ID** |
|       |       |       |
| **Installing Contractor/Firm Name**      |

**Project Data:**

**Table 1: Bolt Assembly and Calibration**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Bolt** | **Nut** | **Washer** | **DTI** |
| **Manufacturer** |       |       |       |       |
| **Lot Number** |       |       |       |       |
| **Diameter/Length** |       | **Note:** Each fastener assembly lot requires a separate worksheet. |
| **Lubricant Used** |       |       |       |
| Bolt-Tension Measuring Device – Make, Model and Serial Number       | Calibration Date (mm/dd/yyyy)      |
| Torque Wrench (for PIV test) – Make, Model and Serial Number      | Calibration Date (mm/dd/yyyy)      |
| Torque Wrench (for Installation) – Make, Model and Serial Number      | Calibration Date (mm/dd/yyyy)      |

**Tested Bolt Orientation**

[ ]  DTI Under Head, Dimples Facing Head, Turn Nut (preferred)

[ ]  DTI Under Head, Dimples Facing Washer, Turn Head

[ ]  DTI Under Nut, Dimples Facing Washer, Turn Nut

[ ]  DTI Under Nut, Dimples Facing Nut, Turn Head

**Table 2: Minimum DTI Refusal Reference Table.** Circle the applicable value.

|  |  |  |  |
| --- | --- | --- | --- |
| **Number of Gaps** | 4 | 5 or 6 | 7 or 8 |
| **Minimum Number of Refusals** | 2 | 3 | 4 |

**Table 3: Minimum Tension/Maximum Torque Reference Table.** Circle the applicable value.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Bolt Dia.** | **1/2”** | **5/8”** | **3/4"** | **7/8”** | **1”** | **1 1/8”** | **1 1/4"** | **1 3/8”** | **1 1/2"** |
| **120/A325 (k)** | 12 | 19 | 28 | 39 | 51 | 64 | 81 | 97 | 118 |
| **\*\*Max. Torque (ft-lb)** | 125 | 247 | 437 | 711 | 1062 | 1500 | 2109 | 2779 | 3687 |

\*\*Max torque can be calculated using the following equation: Torque (ft-lb) = Tension (k) x Bolt Diameter (in) x 20.833

**Table 4: Measured Tension/Torque Table.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sample** | **Measured Tension** | **Tension Acquired?** | **Measured Torque** | **Torque Below MAX?** | **Number of Refusals** | **Refusals Acceptable?** | **Installation Refusals (Avg. + 1)** | **\*\*Installation Torque****(ft-lbs)** |
| **1** |       | [ ]  |       | [ ]  |       | [ ]  |       |       |
| **2** |       | [ ]  |       | [ ]  |       | [ ]  |
| **3** |       | [ ]  |       | [ ]  |       | [ ]  |

[ ]  Short Bolt Test Used | **\*\* Torque for information only to size equipment, use refusals to install bolt assembly.**

**Table 5:** **Short Bolt Pre-Installation Test:** Test Used – enter substitute test bolt information below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Bolt Manufacturer** | **Bolt Diameter** | **Bolt Length** | **Bolt Lot Number** |

**Table 6: Dead Panned DTI RoCap Test**

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| --- | --- | --- | --- |
| **Sample** | **95% RoCap Tension** | **Rotation Past Dead Pan** | **Bolt and Thread Condition** |
| **1** |       |       | [ ]  Pass | [ ]  Fail |
| **2** |       |       | [ ]  Pass | [ ]  Fail |
| **3** |       |       | [ ]  Pass | [ ]  Fail |

**Signature Table (Test & Install):**

|  |  |  |  |
| --- | --- | --- | --- |
| **Pre-Install Test** | Date (mm/dd/yyyy)      | Testing Contractor’s Representative (QC) Name      | Contractor’s Representative (QC) Signature      |
| Date (mm/dd/yyyy)      | WisDOT Representative (QA) Name      | WisDOT Representative (QA) Signature      |
| **Install** | Date (mm/dd/yyyy)      | Installing Contractor’s Representative (QC) Name      | Contractor’s Representative (QC) Signature      |
| Date (mm/dd/yyyy)      | WisDOT Representative (QA) Name      | WisDOT Representative (QA) Signature      |