

## SECTION 838 Ride Quality

### 838.1 Profile Testing for Ride Quality

Under [standard spec 740](#), the contractor is required to measure ride quality on all mainline travel lanes of all roadway classifications. This ride quality specification applies to all project types, including rehabilitation and maintenance projects, unless the contract includes a special provision intentionally removing the ride quality specification. Guidance in [FDM 19-21](#) gives situations where using the ride spec may not be appropriate.

The contractor measures ride with an inertial profiler to determine the International Roughness Index (IRI) for each wheel path of each driving lane. Profile all mainline riding surfaces that are greater than 1500 feet in continuous length including bridge decks, bridge approaches, intersections, railroad crossings, and pavement gaps. If an area, such as a bridge deck, is not constructed under the contract and is excluded from localized roughness, the area is still profiled as the data is necessary to compute segment IRI ride quality and subsequent pay adjustments.

Profiling is done at a constant speed, so profilers need a minimum run-in length to reach that test speed. They also need a run-out after the profile run to slow the vehicle; 150 feet is the typical run-in and run-out length. A minimum continuous pavement length of greater than 1500 feet was established since that would provide the required 300-foot run-in and run-out lengths and still have at least 1200 feet of pavement between them to profile. Accelerating or decelerating during data collection will adversely affect results; consequently, roundabouts, entry and exit curves leading to and from roundabouts, ramps, turn lanes, and other areas that typically involve accelerating or decelerating are excluded from ride quality testing.

Auxiliary lanes longer than 1500 foot need to be profiled. Other locations, such as high-speed connection ramps, need to be profiled if specified in the contract special provisions.

Bike lanes and shoulders are not driving lanes and are not typically profiled.

### 838.2 Equipment and Personnel

The contractor is required to use a profiler on the department's list of approved devices and operated by a person who is certified under the department's highway technician certification program. A profiling device should be re-approved whenever changes or repairs are made to the device that may affect data collection or analysis, including repairs made to the profiler components or software. The contractor should provide the engineer with documentation related to recent calibration activities the contractor has performed with their profiler. Components to be calibrated include the height sensors, accelerometers, and distance measuring instruments. The engineer should verify that the profiler and operator are certified, the device has been properly calibrated, and daily calibration verification has been performed. The engineer should also verify proper use of the profiler on the project (correct wheel path locations, etc.).

### 838.3 Testing

The schedule for acceptance testing is at the contractor's discretion and is coordinated with the engineer. The anticipated acceptance testing schedule, along with any traffic control and lane closure needs, should be included in the contractor's quality control plan; deviations from the plan must be submitted in writing. The department prefers that acceptance testing of the ride quality be performed in a single run from one end of the project to the other, but this is not required.

If there is phased construction or other traffic control issues allowing public traffic onto portions of the roadway, the engineer may direct the contractor to profile those portions of a project separately. When performing acceptance profiling on portions of a project rather than an entire run, be sure to collect the data for whole segments at a time to allow for easy compilation of the data for the entire profile run. Trail vehicles should be used when profiling live traffic lanes to enhance visibility, provide a buffer zone, and promote safe data collection. The contractor should discuss any additional traffic control needs with the engineer.

Operators and field staff should be aware that the profile run distances and project stationing distances may not match as testing is performed. The project stationing is a horizontal distance on a specific reference line, while the measured profile distance is a traveled distance affected by vertical and horizontal curves along each wheel path location. The tester should start each profile at either the beginning or ending project station, depending on the direction of travel. It is important to keep proper documentation to ensure that necessary field-locates can be performed after data analysis is completed.

It is important that the operator follow the manufacturer's recommendations for proper run-in and run-out distances at the beginning and end of each run. Mark the profile start and end locations and conduct a 'dry' practice run, when possible.

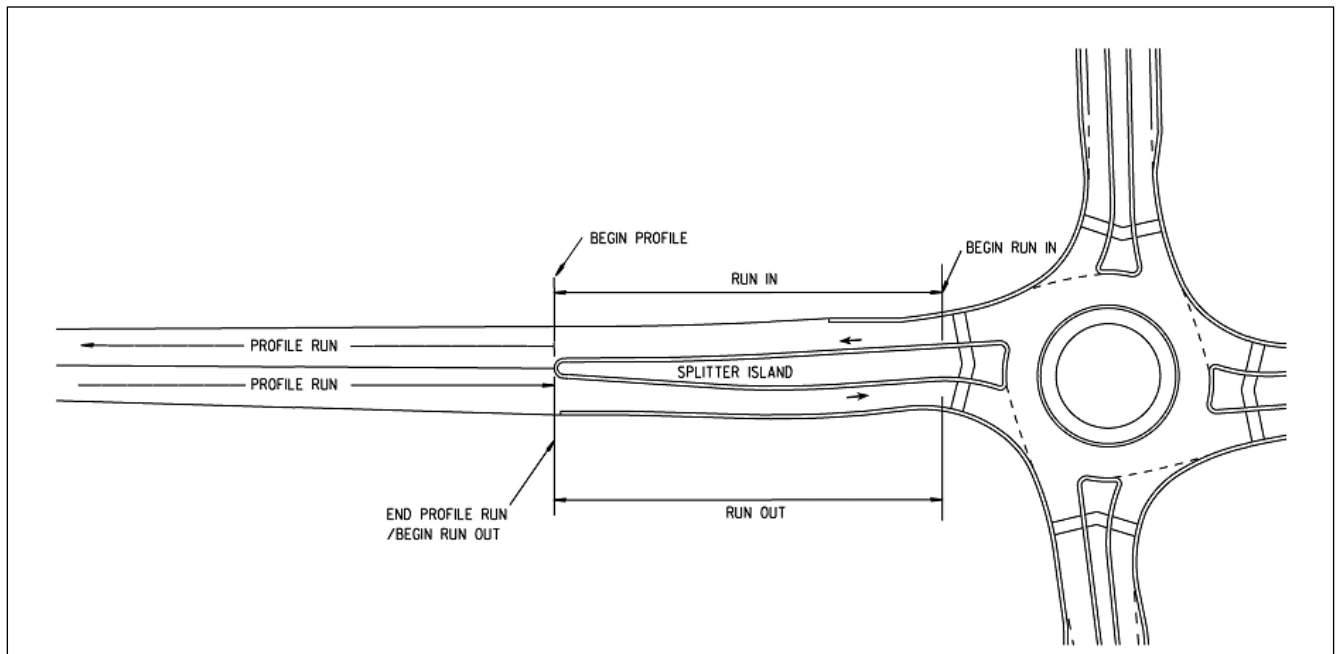
It is highly recommended that the contractor perform process control testing of the ride periodically during construction to identify problems and ensure that the end result will be a smooth pavement. Process control testing is not required by the contract, nor is the contractor required to have a profiler on site during paving operations. However, the engineer can request ride information if there appears to be a ride-related problem during construction of the pavement, and the contractor should provide the ride information in a timely manner to ensure that corrections can be made to the construction operations. Most contractors will be reluctant to assume the risk of a substantial disincentive pay deduction for ride at the end of the project and will want to measure ride frequently during construction to avoid that risk.

### 838.3.1 Profiling Pavements To and From a Roundabout

Pavements leading to roundabouts have entry curves to slow traffic as it approaches the circulatory roadway. Entry curves are designed to provide sufficient space for traffic to safely decelerate. Splitter islands typically extend to the beginning of entry curves, the point at which drivers are expected to begin decelerating and are usually a minimum of 200 feet in length. When profiling a lane leading to a roundabout, end the profile run at the end of the splitter island. The length of pavement alongside the splitter island will serve as the profiler run-out.

Many roundabouts, particularly those on high-speed roads, do not have exit curves or they have exit curves with very large radii. In most cases, the run-in can begin shortly after exiting the circulatory roadway and after any pedestrian crossings. Begin the profile run at the end of the splitter island if the manufacturer's recommended run-in length is met.

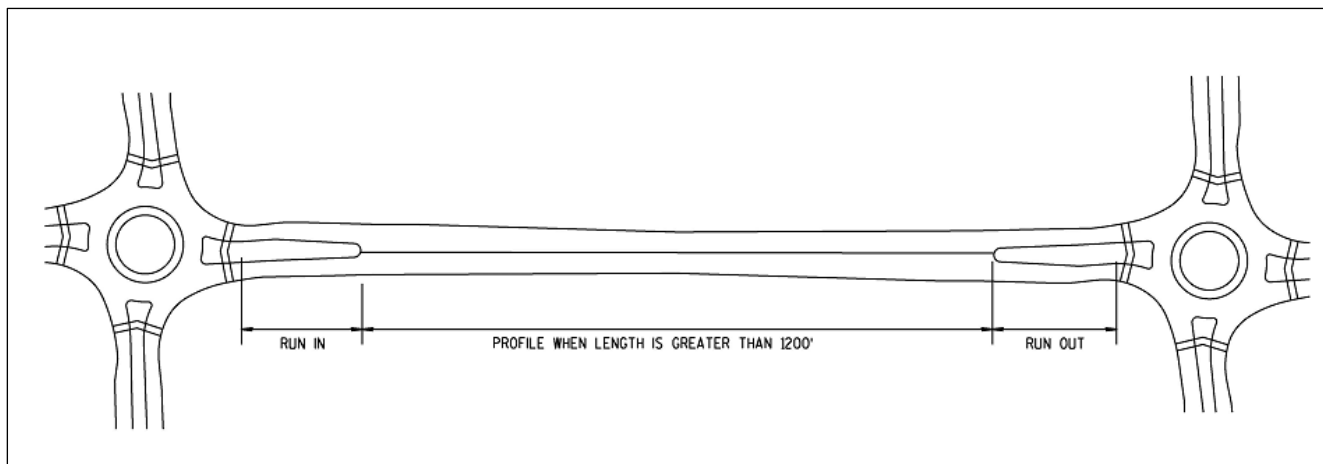
**FIGURE 838-1 Profiling Pavements To and From a Roundabout**



### 838.3.2 Profiling Pavements Between Roundabouts

Roadways between roundabouts should be profiled if the actual profile length, between the splitter islands, is greater than 1200 feet. Projects that meet this criterion will have pavement lengths, between pedestrian crossings, greater than 1500 feet since splitter islands are typically longer than the 150-foot minimum run-in/run-out length. Although the roundabout circulatory roadway and the pavement alongside the splitter islands are exempt from profiling, they are still subject to straightedging and engineer-directed corrective actions.

**FIGURE 838-2 Profiling Between Roundabouts**

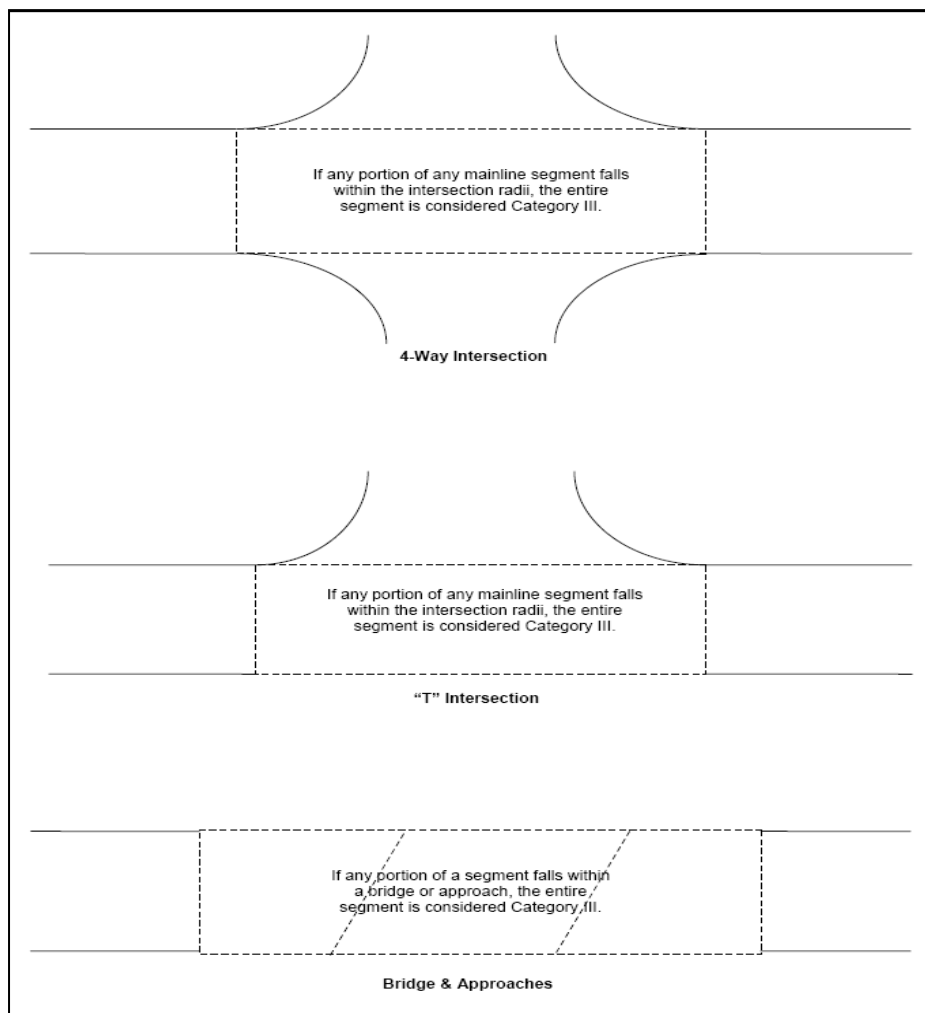


#### **838.4 Pavement Categories**

The Ride Quality specification subdivides mainline pavement into 500-foot long categorized segments. The categories are defined in [standard spec 740.3.2](#) and are based on the pavement type, posted speed limits, and various factors that can affect the contractor's ability to construct a smooth riding surface. Category III segments have a posted speed limit of at least 55 mph and include any portion of a paving obstacle such as a bridge, bridge approach, railroad crossing, intersection, or a gap (for concrete pavements). Examples of Category III segment locations are shown in figure 838-3. Categories IV segments are HMA & PCC segments with any portion having a posted speed limit less than 55 mph and also include any portion of a paving obstacle as defined in category III segments. RCDG V and UCDG V categories apply to pavements that are to be continuously diamond ground.

The pay equations and specification limits vary with each category.

**FIGURE 838-3 Category III Segment Locations**



## **838.5 Localized Roughness**

### **838.5.1 Localized Roughness Corrective Actions**

All areas of localized roughness, whether determined from profiler data or by straightedge, are subject to engineer-directed corrective actions to improve ride quality. Contractors are compensated extra for corrective actions in exclusionary zones.

The engineer and contractor should carefully consider the cause of profile irregularities when analyzing the profile data. It is not always in the best interest of the department to require repairs when roughness is shown on the profile. Grinding may not be warranted nor desired in some locations such as bridge decks or near utility obstructions.

Category IV and UCDG V segments are found in urban areas where there are many factors to consider when determining the cause of roughness and the appropriate action to take. Dips, for example, will cause profile irregularities, and consideration should be made in those instances to ensure that proposed corrective actions will improve the ride quality and not adversely affect roadway drainage.

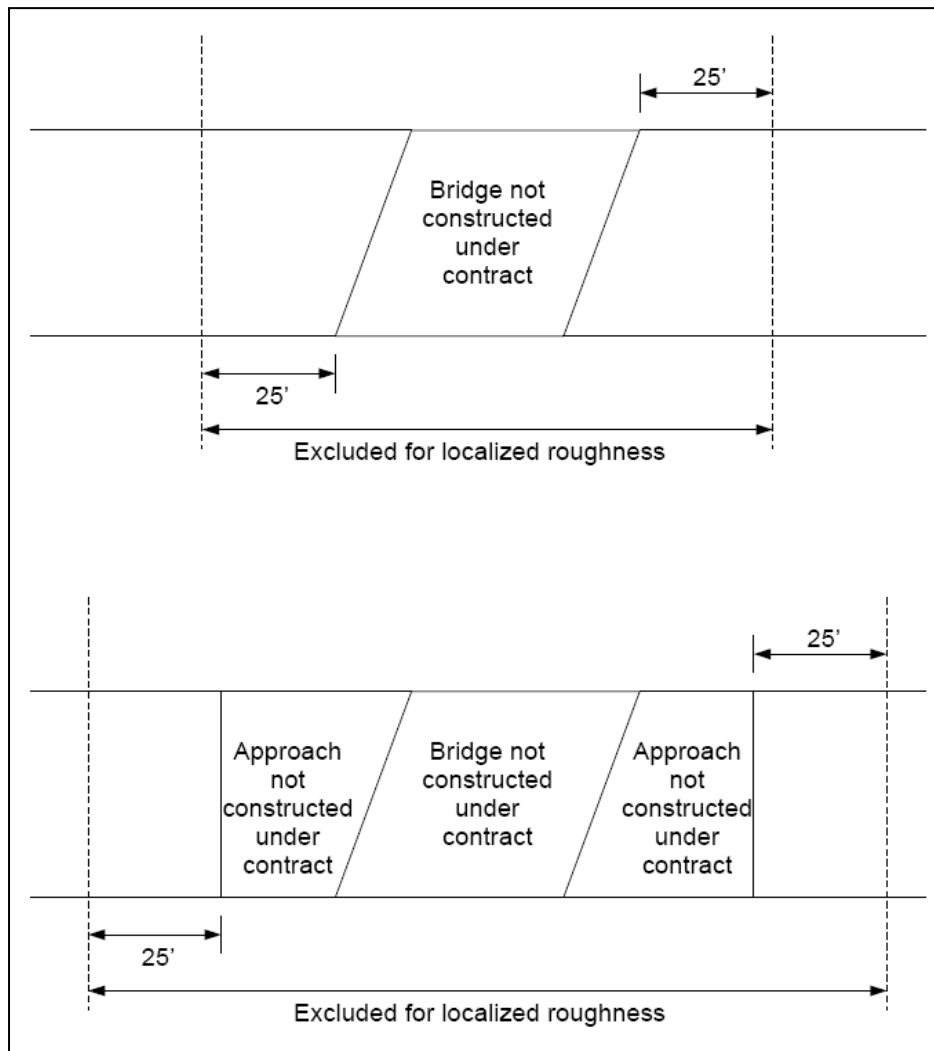
The engineer will not direct corrective action or assess a disincentive for area(s) of localized roughness without independent identification of that area as determined by physically riding the pavement.

### **838.5.2 Localized Roughness Pay Adjustments**

Category IV and Category V segments are excluded from localized roughness pay reductions.

Bridges, bridge approaches, railroad crossings, and 25 feet of pavement leading to and from these paving obstacles are considered exclusionary zones if they are not constructed under the contract (see figure 838-4). As such, they are excluded from localized roughness pay reductions. The department will compensate the contractor for engineer-directed corrective actions within these exclusionary zones.

**FIGURE 838-4 Localized Roughness Exclusionary Zones**



If bridges, bridge approaches, or railroad crossings are constructed under the contract, then the 25 feet of pavement leading to or from these paving obstacles is subject to localized roughness pay reductions and corrective actions without extra compensation. However, the contractor is compensated extra for any engineer-directed corrections made on any bridge decks or bridge approaches. The engineer will not direct corrective action on any bridges or bridge approaches without authorization from BOS.

The engineer evaluates each area of localized roughness that was not corrected and is not excluded from localized roughness pay reductions. The engineer needs to first determine if the roughness can be felt when driving on the pavement. If the roughness can be felt, the engineer needs to consider whether or not the roughness could have been prevented.

It is the responsibility of the contractor to construct all items including manholes, curb & gutter, and the final riding surface according to the plans and specifications. Some design features may cause poor ride quality, including varying pavement cross-slopes for drainage or matching into roadside features, and stamped pavement or other surface enhancements required in the contract. If a design feature is the cause of poor ride quality, and all items, including the riding surface, were constructed as specified, then localized roughness disincentives are not warranted.

Some rehabilitation and expansion projects can be a challenge to construct smoothly since the condition of the existing pavement may affect the constructability. If a contractor utilizes all means to construct a smooth riding pavement, and localized roughness is due to existing conditions outside of their control, then localized roughness disincentives are not warranted.

If it is determined that areas of roughness could have likely been prevented by any means, then the engineer should apply localized roughness pay reductions.

Re-profile corrected areas to verify that all segment IRIs are less than 140 in/mile.

### 838.6 Segment IRI Pay Adjustments

IRI Ride incentives for Category I, II, III, and IV segments are based on the initial IRI of each segment. Ride incentives for Category III segments are based on the category of the adjoining segments. Ride incentives for Category V segments are based on the final IRI—after localized roughness corrections. IRI ride disincentives only apply to Category I or II segments and are based on the final, after-correction, IRIs.

Ride disincentives are not applied to HMA pavements placed in cold weather because of a department-caused delay.

### 838.7 Documentation and Reporting

Figure 838-5 shows a recommended protocol for naming the data files of each profile run.

#### 838.7.1 ProVAL

Analyze the ride data utilizing the ProVAL software. Instructions for downloading and using the software can be found at:

<https://www.roadprofile.com/>

Use ProVAL to compute the IRI for each segment, determine areas of localized roughness, and simulate any corrective actions. Create two ride quality reports—one for segment IRI and one of the localized roughness. Prepare the reports using the following parameters in ProVAL:

	FIXED INTERVAL CONTINUOUS (LOCALIZED ROUGHNESS)
Base-length feet	25 feet
Threshold inches/mile inches/mile	

Create both ride quality reports in \*.pdf format and also in \*.xls format. The ride quality Excel (\*.xls) files are generated to allow for easier editing of the data/format to accommodate importing into Materials Reporting System (MRS). After making the necessary modifications, save the files as text (tab delimited) (\*.txt) files.

Submit the required ride quality information electronically using the MRS IRI software available at:

<http://www.atwoodsystems.com/>

#### 838.7.2 MRS IRI

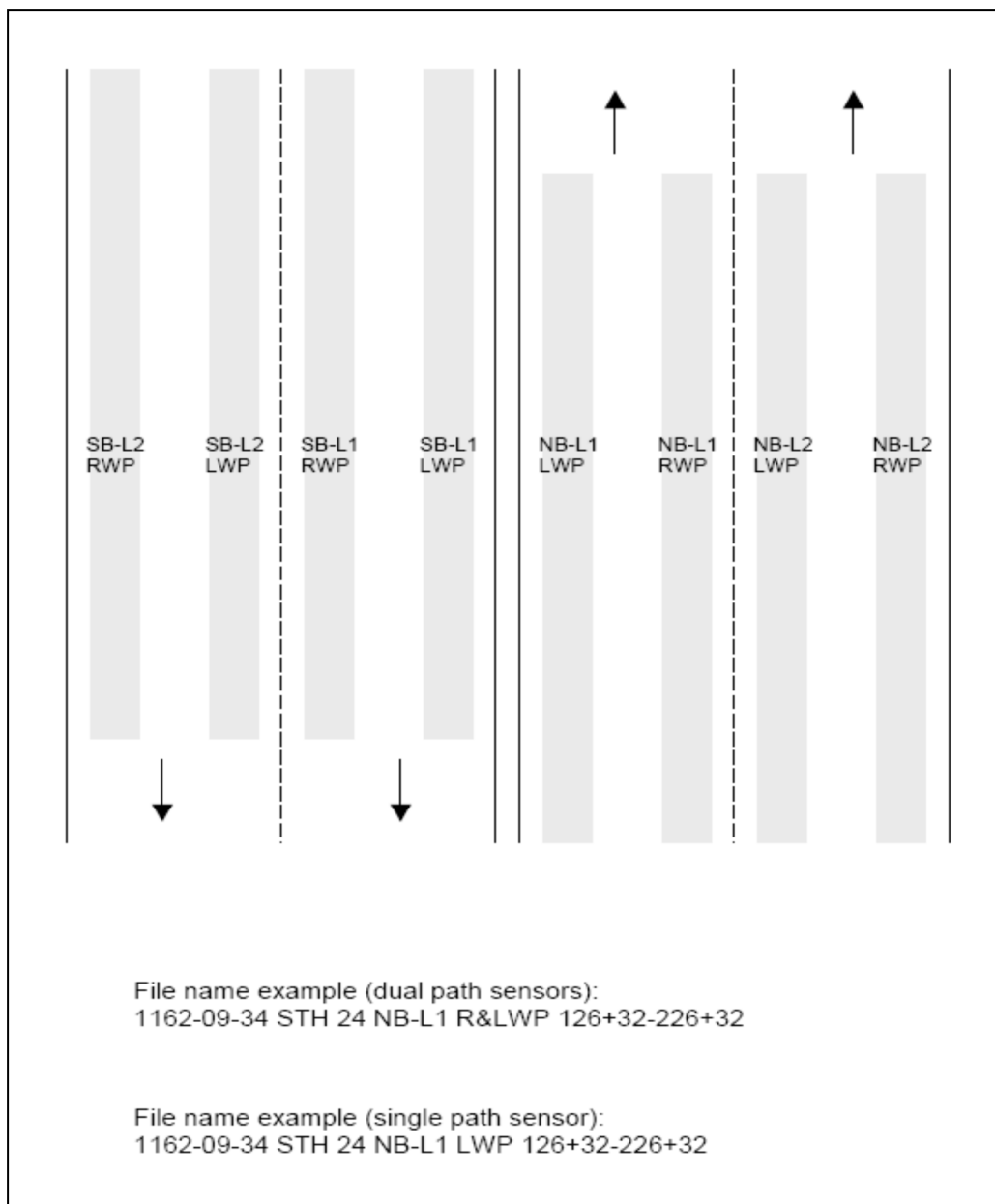
Use the 'Attach Source Files' tab to upload the profiler raw data files for each profile acceptance run and also to upload the two ride quality module reports in \*.pdf format. Complete the data fields in all screens of MRS. The segment IRI and the localized roughness \*.txt files can be imported into the 'Ride Details' and 'Roughness Data' screens, respectively. Submit the data and the reference files by selecting 'Send Verified Ride Data' and also 'Send \*.ppf & Other Reference Files'. Notify the engineer after the data has been submitted.

#### 838.7.3 Highway Quality Management System (HQMS)

The department reviews and verifies the contractor's data through the HQMS website. Verify the segment categories, exclusions noted, and carefully review the pay adjustments. Make any necessary adjustments. The HQMS website can be accessed at:

<http://www.atwoodsystems.com/>

**FIGURE 838-5 Recommended Protocol for Naming Profile Runs**



### 838.8 Diamond Grinding

Pavements may require diamond grinding to improve the ride. The equipment required depends upon whether the work is done under the Continuous Diamond Grinding Concrete Pavement bid item or if intermittent grinding is required to correct problems with new pavement.

The weight, grinding head width, and effective wheelbase for various applications are specified in [standard spec 420](#). The department requires heavier, wider equipment to be used for continuous grinding while lighter weight, narrower equipment will suffice for intermittent grinding for ride correction. The department requires equipment used for continuous grinding on high speed installations to have a longer wheelbase than equipment used on lower speed installations or in areas difficult to access.

Because manufacturer's specifications define effective wheelbase one way and the International Grooving and Grinding Association (IGGA) guide specifications define it another way, to avoid confusion the department defines it explicitly in [standard spec 420.3.2.1](#).

The contractor's equipment must conform the WisDOT definition illustrated below.

**IGGA** Distance from the front wheel assembly transverse pivot point to the transverse pivot point of the profile/depth control/ ground drive wheels.

**Manufacturer** Center of cutting head to center of front bogey.

**FIGURE 838-6 Effective Wheelbase of Diamond Grinding Equipment**

