



SECTION 610

PAVEMENT SMOOTHNESS

610.1 Description. This work shall consist of measuring the smoothness of the final pavement surface. Smoothness shall be measured using the International Roughness Index (IRI). The following pavement types shall comply with this specification:

- a) Multi-lift asphalt construction contained in [Secs 401](#) and [403](#).
- b) Concrete pavement construction contained in [Secs 502](#) and [506](#).
- c) Combination of surface planning, such as diamond grinding or milling, and single lift asphalt construction contained in [Secs 401](#) and [403](#).
- d) Single lift asphalt construction contained in [Secs 401](#) and [403](#).

610.2 Material Requirements.

610.2.1 Inertial Profiler. IRI shall be computed from profile data collected with an inertial profiler (IP) that meets the requirements of AASHTO M 328

610.2.2 ProVAL Software. The contractor shall use the ProVAL software program to compute IRI smoothness and locate areas of localized roughness (ALR) in accordance with MoDOT TM-59.

610.2.3 Straightedge. A rolling 10-foot straightedge shall be used for checking longitudinal elevation changes. A 4-foot straightedge shall be used for checking transverse elevation changes.

610.3 Certification. All inertial profilers used to collect data on MoDOT projects shall be annually certified at the MoDOT certification site in accordance with TM-59. The operator of the IP shall be certified through the MoDOT technician certification program.

610.4 Construction Requirements.

610.4.1 Smoothness Increments. Length of pavement shall be defined in the following increments for the purpose of smoothness acceptance:

- a) Section – A section is a day's paving and shall begin and terminate at the construction joints. Interruptions designated by the engineer which cause placement to cease and begin at a new location will be considered as a separate section for that day's operation if the separate section is greater than 250 feet.
- b) Segment – Sections shall be divided into segments of 0.1 mile lengths with the exception of the last segment. If the last segment is greater than 250 feet and less than 0.1 mile, then the segment shall be measured for smoothness as an independent segment. If the last segment is 250 feet or less, the profile for that segment shall be included in the evaluation for the previous segment. The combined segment IRI shall be weighted for the length.

610.4.2 Profiling Areas.

610.4.2.1 Profiling will be applicable to the surface of all the following:

- a) Mainline paving
- b) Auxiliary lanes, turning lanes and ramps for projects or combination of projects, consisting of more than 0.5 mile of total profilable pavement.

601.4.2.2 Profiling will not be required for the following exceptions:

- (a) Bridge decks, bridge approach slabs and concrete approach pavements.
- (b) Pavement on horizontal curves with centerline radius of curve less than 1000 feet and pavement within the superelevation transition of such curves.
- (c) Pavement on vertical curves having a "K" value less than 90 and a length less than 500 feet.
- (d) Pavement width transitions.
- (e) Fifty feet in direction of travel on each side of utility appurtenances such as manholes and valve boxes.
- (f) Fifty feet in direction of travel on each side of intersecting routes with special grade transition.
- (g) Shoulders.
- (h) Interruptions designated by the engineer which provide independently placed sections shorter than 50 feet.
- (i) The last 15 feet of any section where the prime contractor is not responsible for the adjoining surface.

610.4.2.3 In addition to the exceptions in [Sec 601.4.2.2](#), profiling may be waived by the engineer if staging of the overall project; such as multiple entrance lane gaps, lane staging, etc.; affects the normal paving operation, or if multiple profile exceptions continuously exist on a large portion of the same roadway. Upon waiver, exempted areas shall be checked with a 10-foot straightedge.

610.4.3 Longitudinal Straightedging. Any pavement surface not measured with an inertial profiler shall be measured with a 10-foot straightedge. The straightedge path in the longitudinal direction for driving lanes will be located three feet from the outside edge and for shoulders will be located in the center. Additional paths with suspect roughness may be selected at the engineer's discretion. Shoulders that are paved integrally with an adjacent driving lane will not require straightedging. Any variations in the longitudinal direction exceeding 1/8 inch in 10 feet shall be marked for correction in a manner approved by the engineer.

610.4.4 Transverse Straightedging. The engineer shall randomly check driving lanes, regardless of the smoothness measurement method used, for variations in the transverse direction with a 4-foot straightedge. Any variations in the transverse direction more than 1/4 inch shall be marked for correction in a manner approved by the engineer.

610.4.5 Full Depth Pavement and Multi-lift Overlays. These construction procedures apply to pavement treatments described in [Sec 610.1 \(a\)](#) and [\(b\)](#).

610.4.5.1 Quality Control Testing. The contractor shall perform quality control (QC) testing on all eligible profiling areas and provide daily section smoothness data and completed project ProVAL reports in accordance with the testing and reporting procedures in MoDOT TM-59. Reported IRI for each segment is the average of both wheel paths.

610.4.5.2 Quality Assurance Testing. The engineer will perform quality assurance (QA) testing with a MoDOT inertial profiler to verify the QC test results. The QA profile will comprise a whole number of segments and represent approximately 10 percent of the total lane miles subject to [Sec 610.4.5.1](#). The contractor's IRI value for the average of both wheel paths in each segment must be within 6 inches/mile of the MoDOT value. If these tests indicate the contractor-furnished IRIs are not within the desired accuracy, the engineer may test a greater length up to the entire project length. Furnishing inaccurate test results may result in decertification of the operator.

610.4.5.3 Minimum Daily Smoothness. If any section has an average IRI of 125.1 inches/mile or greater for a pavement having a final posted speed greater than 45 mph, or 175.1 inches per mile or greater for pavement having a final posted speed of 45 mph or less, the paving operation will be suspended and will not be permitted to resume until corrective action approved by the engineer is taken by the contractor.

610.4.5.4 Areas of Localized Roughness. All areas of localized roughness (ALR) in the right wheel path; defined as any length of pavement, having a final posted speed greater than 45 mph, with a continuous 25-foot average IRI of 125.0 inches or greater, or any length of pavement, having a final posted speed of 45 mph or less, with a continuous 25-foot average IRI of 175.0 inches/mile or greater; shall be corrected. After correcting ALRs, additional correction may be necessary to reduce any profile segment in a pavement with a final posted speed greater than 45 mph, to an average IRI of 80.0 inches or less; or reduce any profile segment in a pavement with a final posted speed of 45 mph or less to average IRI of 125.0 inches/mile or less. A new IRI and ALR ProVAL report shall be furnished to the engineer no later than two days after the contractor profiles the corrected areas to verify compliance with minimum smoothness requirements.

610.4.5.5 Method of Correction. Corrective action to eliminate ALRs and improve the average IRI shall be accomplished by a method approved by the engineer. Diamond grinding may be used for bumps, but the use of an impact device, such as a bush hammer, will not be permitted. Total grinding depth shall be limited to ¼ inch. The final surface texture of corrected pavement shall be comparable to adjacent sections that do not require correcting. Satisfactory longitudinal grinding is acceptable as the final surface of the corrected pavements. All corrective work shall be completed prior to determination of pavement thickness.

610.4.6 Multi-treatment Overlays. These construction procedures apply to pavement treatments described in [Sec 610.1 \(c\)](#).

610.4.6.1 Quality Control Testing. The requirements are the same as [Sec 610.4.5.1](#).

610.4.6.2 Quality Assurance Testing. The requirements are the same as [Sec 610.4.5.2](#).

610.4.6.3 Minimum Daily Smoothness. The requirements are the same as [Sec 610.4.5.3](#).

610.4.6.4 Areas of Localized Roughness. The requirements are the same as [Sec 610.4.5.4](#).

610.4.6.5 Method of Correction. Corrective action to eliminate ALRs and improve the average IRI shall be accomplished with a method approved by the engineer. Diamond grinding bumps shall only be permitted for a 1 ¾-inch or greater single lift overlay. Grinding depth shall be limited to ¼ inch. The final surface texture of corrected pavement shall be comparable to adjacent sections that do not require correcting. All corrective work shall be completed prior to determination of pavement thickness.

610.4.7 Single Lift Overlays. These construction procedures apply to pavement treatments described in [Sec 610.1 \(d\)](#).

610.4.7.1 Pre-Construction. Prior to performing any resurfacing work, the contractor shall profile the outside wheel path in accordance with TM-59. This control profile will serve as the baseline for calculating percent improvement for the project.

610.4.7.2 Post-Construction. As soon as practical after resurfacing, the contractor shall profile the outside wheel path again. The same stationing shall be used to ensure a direct comparison with the pre-construction profile.

610.4.8 Marred Surface Area. Any area of a segment that has corrective diamond grinding performed without grinding the entire segment shall be defined as a marred surface area.

610.5 Basis of Payment.

610.5.1 Fixed Value Improvement. The following basis of payment procedures shall apply to all pavement treatments described in [Sec 610.1 \(a\), \(b\) and \(c\)](#).

610.5.1.1 Smoothness Adjustment. Smoothness adjustments will be paid per segment based on the IRI before any corrections, except for the allowances in [Sec 610.5.1.5](#). Any segment with an IRI above the maximum limit in Tables 1 and 2 must be corrected through a method approved by the engineer to achieve the desired smoothness. When paving widths are greater than the travel lane widths, incentive payment will apply to the driving lane design width only.

610.5.1.2 Incentives. Incentive payment for smoothness shall be based on either Table 1 or Table 2. Table 1 shall be used for pavements having a final posted speed greater than 45 mph. Table 2 shall be used for pavements having a final posted speed of 45 mph or less and for pavements with no posted speed limits. Constant-width acceleration and deceleration lanes shall be considered as mainline pavements.

Table 1	
International Roughness Index, Inches Per Mile	Percent of Contract Price
40.0 or less	105
40.1 - 54.0	103
54.1 - 80.0	100
80.1 or greater	100 ^a

Table 2	
International Roughness Index, Inches Per Mile	Percent of Contract Price
70.0 or less	103
70.1- 125.0	100
125.1 or greater	100 ^b

^aAfter correction to 80.0 inches per mile or less.

^bAfter correction to 125.0 inches per mile or less.

610.5.1.3 Deductions. A minimum deduction of 20 percent of the contract unit price of the paving quantities will be made for marred surface areas as defined in [Sec 610.4.7](#). The deduction will be applied to an area of pavement extending from edge of the pavement to a longitudinal joint or between longitudinal joints in that section of pavement affected. If the length of the section affected is less than 10 feet, the deduction will be computed for 10 feet.

610.5.1.4 Segment Correction. If the contractor elects to diamond grind an entire segment and the corrected surface drops below the maximum IRI limits in the designated Table, then the contractor cannot receive any incentives, but the marred surface area deductions for that segment will be waived.

610.5.1.5 Section Correction. If the contractor elects to diamond grind an entire section then all segments within the section will be eligible for their respective incentives and the marred surface area deductions for that section will be waived.

610.5.1.6 Testing Cost. The contract unit price for pavement will be considered as full compensation for all items entering into the construction of the pavement including the cost of smoothness testing.

610.5.2 Percent Improvement. The following basis of payment procedures shall apply to all pavement treatments described in [Sec 610.1 \(d\)](#).

610.5.2.1 The contract price for resurfacing will be adjusted based on the improvement in profile index for each segment according to Table 3.

Table 3	
Percent Improvement (Change in IRI / Initial IRI) X 100	Percent of Contract Unit Price For Pavement
35.0 or greater	103
20.0 to 34.9	100
19.9 and lower	97

610.5.3 Dispute Resolution. Any dispute between the engineer and contractor regarding IRI QC/QA comparisons that cannot be settled at the project office level shall be arbitrated with the MoDOT reference profiler per the test procedure in TM-59. The results of the reference profiler shall be binding for the engineer and contractor.