

SECTION 401: PAVEMENT SMOOTHNESS MEASUREMENT

401.1 DESCRIPTION

This Work consists of providing and using profile-testing Equipment that incorporates the IRI measurement.

This specification applies to new and reconstruction projects. For overlay, rehabilitation, and pavement preservation projects, this specification applies only if the Department provides the Contractor with two or more opportunities to achieve smoothness. Examples of these types of opportunities are pavement surface milling followed by a HMA overlay and projects including two or more layers of HMA.

401.2 MATERIALS—Vacant

401.3 CONSTRUCTION REQUIREMENTS

401.3.1 Profile Measurements

Submit all unprocessed raw data profile measurements to the accompanying Department representative within 1 hour after all the data has been collected in the University of Michigan Transportation Research Institute's Engineering Research Division (ERD) format, on either a CD or Universal Serial Bus (USB) memory storage device. If the Contractor does not submit the profile measurements within this time period, the Department will not pay Incentives greater than 100% of the criteria presented in Table 401.5.1.1:1, "IRI Based Profile Pay Adjustment Schedule For HMA Pavements," Table 401.5.1.2:1, "IRI Based Profile Pay Adjustment Schedule for PCC Pavements, Ramps, Tapers, and Holding Lanes," or Table 401.5.1.3:1, "IRI Based Profile Pay Adjustment Schedule for HMA Ramps, Tapers, and Holding Lanes," for the section.

401.3.1.1 Profile Measurement Device

Provide, operate, and maintain a profile measurement device that is in accordance with AASHTO MP 11 and that uses computer programs in accordance with AASHTO PP 37, or an equal approved by the State Materials Bureau.

401.3.1.2 Profile Measurement Device Calibration and Certification

Certify the profile measurement device in accordance with the Department's *Standard Practice "Certification of Inertial Profilers"*. It must also have a current TTCP annual calibration sticker or manufacturer's calibration and certification certificate. The manufacturer's certificate is valid only until the date of the next TTCP-sponsored profile measuring device certification test.

Verify calibration of the profile measurement device. Verify both horizontal and vertical calibration before each use. Perform verifications in accordance with the manufacturer's approved procedures and maintain copies of the verification documentation and manufacturer's procedures with the machine. The Project Manager may require additional calibrations or verifications.

Remove the profile measurement device from the project if it does not meet manufacturer's calibration requirements. The Project Manager will report the TTCP profile measurement device certification number to the TTCP Administrator in order to provide notification that the Contractor cannot use the machine on other projects until the Contractor obtains re-certification. Once the manufacturer re-certifies the profile measurement device, provide a copy of the certificate to the Department's TTCP Administrator.

401.3.1.3 Technician Certification

The Department's TTCP will certify individuals performing profile measurement. The Department will base certification on demonstrated ability and a written test. The TTCP will establish the term and expiration date of certification and requirements for renewal. If concern arises as to the competence of a certified individual, submit concerns in writing to the Department State Materials Engineer and the District Construction Engineer. The Department State Materials Engineer, through the TTCP, will investigate the concern and implement corrective action if necessary in accordance with the TTCP Board of Directors established procedures.

401.3.1.4 Profile Measurement Operations

Sweep the Roadway surface and get the Project Manager's approval before beginning profile operations.

Measure the longitudinal smoothness of the final surface of HMA, OGFC, and PCCP using a profile measurement device. Operate the profile measurement device in accordance with AASHTO PP 50 and manufacturer's recommendations using a cutoff wavelength of 300 ft. Using dual-sensors, measure the profile traces for each wheel path. Locate outside trace 3 ft from and parallel to the approximate location of the pavement edge line. Ensure the centerline distance between sensors is 70.0 in + 1.0 in. At transverse joints, commence profile traces 15 ft into the previous placement. Operate the device on the driving surface of the Roadway and be sure it can maintain the manufacturer's recommended speed without interfering with traffic or its own operation.

On HMA projects, perform profile measurements and corrective actions on the final surface of HMA. On PCCP projects, perform profile measurements and corrective actions on the finished surface of PCCP before longitudinal diamond grooving operations.

The Department will use the latest version of the FHWA's "ProVal" software to determine the IRI for each lane, reported to the nearest 0.1 in per mile using the average of each wheel path IRI.

Maintain the profile data files. Take additional profiles to retest paved surfaces that have received corrective work. The Project Manager may require additional profiles to check previously submitted data or to identify the limits of surface irregularities. Include the following information for each data file:

1. Project number;
2. Date;
3. Lane profiled;
4. Beginning and ending stations;
5. Horizontal equation stations;
6. Location of Bridge abutments;
7. Net total linear feet of each lane; and
8. Operator's signature.

The Department will consider profile testing as part of the paving operation. Include the proposed frequency for profile testing with the paving plan submittal at the pre-paving conference.

401.3.2 Straightedge Measurements

Test the final surface of HMA, OGFC, or PCCP not subject to profile measurement with an approved 10-foot straightedge at both right angles and parallel to the centerline. Correct surface deviations greater than 1/8 in within 10 ft, as directed by the Project Manager. Exclude the following from profile measurement and evaluate using a straightedge:

1. Shoulders, turnouts, median lanes, and other areas less than 0.5 mi as designated by the Project Manager during the pre-paving conference;
2. Concrete pavement slab removal and replacement, and intersections not paved integrally with the main line;
3. A single lift of HMA over Cold In-Situ recycle; and
4. Other projects as determined by the Department.

401.3.3 Evaluation for Corrective Work

Evaluate the pavement in 0.1-mile sections for determining needed corrective work and price adjustments.

Develop an appropriate corrective action plan if the measured smoothness value falls within the "Corrective Work Required" value of Table 401.5.1.1:1, "IRI Based Profile Price Adjustment Schedule for HMA Pavements," Table 401.5.1.2:1, "IRI Based Profile Price Adjustment Schedule for PCC Pavements, Ramps, Tapers, and Holding Lanes," or Table 401.5.1.3:1, "IRI Based Profile Price Adjustment Schedule for HMA Ramps, Tapers, and Holding Lanes." Submit the plan to the Project Manager for review and approval. If approved, complete elected corrective action, including necessary traffic control, at no additional cost to the Department. After completion of the approved corrective action, re-profile the corrected area to verify compliance with specification requirements.

Identify areas of localized roughness with a 25 ft moving average filter. Determine the difference between the 25 ft moving average and the reported relative elevation for every profile point using the latest version of the FHWA's "ProVal" software. Evaluate reported

deviations greater than 0.15 in to develop an appropriate corrective action plan. The Department will refer to positive deviations as “bumps” and negative deviations as “dips.”

401.3.4 Corrective Work

Limit corrective work to diamond grinding, overlaying, or removing and replacing rejected 0.1-mile sections. Submit a written corrective action plan to the Project Manager including methods and procedures. Do not begin corrective work until the Project Manager approves the methods and procedures in writing. The Project Manager’s approval does not relieve the Contractor of the responsibility to comply with the specifications.

Perform corrective work in accordance with the following:

1. Diamond Grinding. Use a Roadway planning device to perform diamond grinding to bring the reported average measured smoothness value to an acceptable level in accordance with Table 401.5.1.1:1, “IRI Based Profile Price Adjustment Schedule for HMA Pavements,” Table 401.5.1.3:1, “IRI Based Profile Price Adjustment Schedule for PCC Pavements, Ramps, Tapers, and Holding Lanes,” or Table 401.5.1.4:1, “IRI Based Profile Price Adjustment Schedule for HMA Ramps, Tapers, and Holding Lanes.” Do not reduce planned pavement thickness by more than 0.3 in without approval of the Project Manager. Grind the edges of localized roughness areas to produce a smooth transition to the surrounding pavement. For HMA, if the Contract does not require an OGFC, apply a fog seal to the ground areas as approved by the Project Manager. For PCCP, perform additional diamond grinding as necessary in the following situations:
 - 1.1. The transverse direction, so the lateral grinding limits are at a constant offset from and parallel to the nearest lane line or pavement edge; and
 - 1.2. The longitudinal direction, so the grinding begins and ends at lines perpendicular to the pavement centerline. Maintain diamond ground locations as neat rectangular areas of uniform appearance. Ensure a skid resistance comparable to adjacent sections that do not require grinding. Immediately repair curing membrane damage resulting from diamond grinding if the concrete is less than 28 Days old;
2. Overlaying. If the Contractor uses an additional lift of HMA to correct rough pavement, it shall meet the requirements of the appropriate specification. Extend the overlay lift the full width of the underlying pavement surface to a finished compacted thickness sufficient to correct the existing pavement roughness. The Department will not allow a second overlay if the first overlay does not meet the longitudinal smoothness requirement. Correct a corrective overlay that does not meet the smoothness requirement by diamond grinding or removing and replacing;
3. Removing and Replacing. Remove pavement the full width of the lane and the full thickness of the course. The removal area shall begin and end with a transverse saw cut perpendicular to centerline. Use HMA or PCCP as replacement Material.

Re-profile the 0.1 mile section of travel lane after performing corrective work and use the re-profile’s reported measured smoothness data to represent the particular section for price adjustment purposes.

401.3.5 OGFC Placement and Profile Measurement

Ensure all HMA profile measurements and corrective actions have been completed before placing OGFC. If the measured average IRI of the OGFC is greater than the measured average IRI of the HMA on the same 0.1 mile section, the Department will base the pay factor for the HMA section on the OGFC’s measured average IRI and not the HMA’s measured average IRI.

401.4 METHOD OF MEASUREMENT—Vacant

401.5 BASIS OF PAYMENT

Surface smoothness testing and corrective work to bring the final surface within specification smoothness is included in the Bid Item Unit Price for HMA or PCCP; the Department will make no separate payment.

401.5.1 Price Adjustments

The Department will calculate a price adjustment for each 0.1 mile section of travel lane. The price adjustment will apply to the total accepted quantity of the total thickness or area of each section of HMA or PCCP constructed for the actual measured lane width and Roadway

length.

The Department will not include Shoulder and turnout areas for payment purposes. Determine the price adjustment by applying the appropriate percentage to the Bid Item Unit Price for HMA or PCCP.

If the pay factor for a 0.1 mile section is equal to or greater than 100%, the Project Manager will not allow additional Work to reduce the reported measured smoothness value.

If the pay factor for a 0.1 mile section is equal to or greater than 90% but less than 100%, the Contractor may accept the designated pay factor. Otherwise, get the Project Manager's approval to develop a corrective action plan to further reduce the measured smoothness value (to increase the designated pay factor).

401.5.1.1 Price Adjustment for HMA Projects

The Department will base price adjustments on the final average IRI in accordance with Table 401.5.1.1:1, "IRI Based Profile Price Adjustment Schedule for HMA Pavements," after the Contractor performs and measures corrective work.

Table 401.5.1.1:1
IRI Based Profile Price Adjustment Schedule for HMA Pavements^a

IRI ^b			
Interstate Routes	National Highway Routes	US (non-NH) and NM Routes	Pay Factor (%)
< 54.7	< 52.7	< 43.9	110
54.7 to 55.1	52.7 to 53.3	43.9 to 45.5	109
55.2 to 55.6	53.4 to 54.0	45.6 to 47.0	108
55.7 to 56.0	54.1 to 54.6	47.1 to 48.5	107
56.1 to 56.5	54.7 to 55.3	48.6 to 50.1	106
56.6 to 57.0	55.4 to 55.9	50.2 to 51.6	105
57.1 to 57.4	56.0 to 56.6	51.7 to 53.2	104
57.5 to 57.9	56.7 to 57.2	53.3 to 54.8	103
58.0 to 58.4	57.3 to 57.9	54.9 to 56.3	102
58.5 to 58.8	58.0 to 58.6	56.4 to 57.9	101
58.9 to 59.4	58.7 to 59.2	58.0 to 59.5	100
59.5 to 59.8	59.3 to 59.9	59.6 to 61.1	99
59.9 to 60.3	60.0 to 60.6	61.2 to 62.7	98
60.4 to 60.8	60.7 to 61.3	62.8 to 64.3	97
60.9 to 61.3	61.4 to 62.0	64.4 to 65.9	96
61.4 to 61.8	62.1 to 62.7	66.0 to 67.6	95
61.9 to 62.3	62.8 to 63.4	67.7 to 69.2	94
62.4 to 62.8	63.5 to 64.1	69.3 to 70.8	93
62.9 to 63.3	64.2 to 64.8	70.9 to 72.5	92
63.4 to 63.8	64.9 to 65.5	72.6 to 74.1	91
63.9 to 64.3	65.6 to 66.2	74.2 to 75.8	90
> 64.3	> 66.2	> 75.8	Corrective work required

^aBased on an Initial Serviceability Index of 4.3
^binch per 0.1 mi

401.5.1.2 Price Adjustment for PCCP Pavement, Ramps, Tapers, and Holding Lanes

The Department will base price adjustments on the final average IRI in accordance with Table 401.5.1.2:1, "IRI Based Profile Pay Adjustment Schedule for PCC Pavements, Ramps, Tapers, and Holding Lanes," after the Contractor performs and measures corrective work.

Table 401.5.1.2:1
IRI Based Profile Price Adjustment Schedule for PCC Pavements, Ramps,
Tapers, and Holding Lanes^a

IRI ^b		
Interstate and National Highway Routes	US (non-NH) and NM Routes	Pay factor (%)
< 52.2	< 49.6	110
52.2 to 53.2	49.6 to 50.9	109
53.3 to 54.2	51.0 to 52.1	108
54.3 to 55.2	52.2 to 53.4	107
55.3 to 56.2	53.5 to 54.7	106
56.3 to 57.2	54.8 to 55.9	105
57.3 to 58.2	56.0 to 57.2	104
58.3 to 59.2	57.3 to 58.5	103
59.3 to 60.2	58.6 to 59.8	102
60.3 to 61.3	59.9 to 61.1	101
61.4 to 62.3	61.2 to 62.4	100
62.4 to 63.3	62.5 to 63.8	99
63.4 to 64.4	63.9 to 65.1	98
64.5 to 65.4	65.2 to 66.4	97
65.5 to 66.4	66.5 to 67.8	96
66.5 to 67.5	67.9 to 69.1	95
67.6 to 68.5	69.2 to 70.5	94
68.6 to 69.6	70.6 to 71.8	93
69.7 to 70.7	71.9 to 73.2	92
70.8 to 71.7	73.3 to 74.6	91
71.8 to 72.8	74.7 to 76.0	90
>72.8	>76.0	Corrective work required

^aBased on an Initial Serviceability Index of 4.3

^binch per 0.1 mi

401.5.1.3 Price Adjustment for Miscellaneous HMA

The Department will base unit price adjustments for miscellaneous HMA pavement (including ramps, tapers, and holding lanes greater than 0.5 mi long) in accordance with Table 401.5.1.3:1, "IRI Based Profile Price Adjustment Schedule for HMA Ramps, Tapers, and Holding Lanes." Measure ramps, tapers, and holding lanes less than 0.5 mi long in accordance with Section 401.3.2, "Straightedge Measurements."

Table 401.5.1.3:1
IRI Based Profile Price Adjustment Schedule for HMA
Ramps, Tapers, and Holding Lanes^a

IRI ^b	Pay Factor (%)
< 50.8	110
50.8 to 51.7	109
51.8 to 52.5	108
52.6 to 53.3	107
53.4 to 54.1	106
54.2 to 55.0	105
55.1 to 55.8	104
55.9 to 56.7	103
56.8 to 57.5	102
57.6 to 58.3	101
58.4 to 59.2	100
59.3 to 60.0	99
60.1 to 60.9	98
61.0 to 61.7	97
61.8 to 62.5	96
62.6 to 63.4	95
63.5 to 64.2	94
64.3 to 65.1	93
65.2 to 65.9	92
66.0 to 66.8	91
66.9 to 67.6	90
> 67.6	Corrective work required

^aBased on an Initial Serviceability Index of 4.3

^binch per 0.1 mi