401-R-577 INERTIAL PROFILER WITH SMOOTHNESS PAY ADJUSTMENTS FOR HMA, FIXED INTERVAL

(Revised 11-18-22)

The Standard Specifications are revised as follows:

SECTION 401, DELETE LINES 593 THROUGH 705.

SECTION 401, AFTER LINE 705, INSERT AS FOLLOWS:

401.18 Pavement Smoothness

Pavement smoothness will be accepted by means of an inertial profiler, a 16 ft straightedge, or a 10 ft straightedge as described below.

(a) Inertial Profiler with Smoothness Pay Adjustments

When a pay item for Inertial Profiler, HMA is included in the contract, the Contractor shall furnish, calibrate, and operate an approved inertial profiler in accordance with ITM 917 for the acceptance of longitudinal smoothness on the mainline traveled way, including adjacent acceleration or deceleration lanes, where all of the following conditions are met:

1. *The posted speed is greater than 45 mph.*

2. *The traveled way width and slope are constant and is at least 0.5 mi in length.*

3. *The HMA is placed on a milled surface and the planned lay rate for a single lift is 165 lb/sq yd or greater, or the total combined planned lay rate of surface, intermediate, and base courses is 385 lb/sq yd or greater.*

The profiles and International Roughness Index, IRI, results including areas of localized roughness shall become the property of the Department. The inertial profiler shall remain the property of the Contractor.

The project area will be divided into individual smoothness sections measuring 0.1 mi in length for each lane. The paving exceptions and areas exempt from inertial profiler operation will be in accordance with ITM 917.

If the posted speed limit for an entire smoothness section is less than or equal to 45 mph, the section will be exempt from Inertial Profiler operation and the smoothness within the section will be accepted in accordance with 401.18(b).

If the posted speed limit is greater than 45 mph for a portion of a smoothness section and is less than or equal to 45 mph for the remainder, the section smoothness acceptance will be as follows:

1. *By inertial profiler for the portion of the section with a posted speed limit greater than 45 mph.*

2. *In accordance with 401.18(b) for the portion of the section with a posted speed limit less than or equal to 45 mph.*

At locations where the inertial profiler is required, it shall be used on the surface course and on any dense graded intermediate course immediately below the surface course.

(b) 16 ft Straightedge

The Contractor shall furnish and operate a 16 ft straightedge in accordance with 306.03(d) and as described below. The 16 ft straightedge shall be used to measure smoothness along the direction of mainline traffic.

Locations on the pavement surface scraped by the straightedge shall be marked. The pavement shall be corrected in accordance with 401.18(e) to meet the required tolerance. For existing utility and manhole castings that required no grade adjustment, the tolerance may be adjusted after being reviewed and approved by the Engineer.

For contracts which include the Inertial Profiler, HMA pay item, the 16 ft straightedge or the Inertial Profiler simulating the 16 ft straightedge shall be used to measure longitudinal smoothness on surface courses at the following locations:

1. *All mainline traveled way lanes shorter than 0.5 mi.*

2. *All mainline traveled way lanes at locations exempted from inertial profiler operation in accordance with ITM 917.*

3. *All mainline traveled way lanes within smoothness sections with posted speed limits less than or equal to 45 mph throughout the entire section length.*

4. *All tapers.*

5. *All ramps.*

6. *All turn lanes, including bi-directional left turn lanes shorter than 0.5 mi.*

7. *All acceleration and deceleration lanes associated with ramps with posted speeds of 45 mph or less.*

8. *All shoulders.*

9. *All intersections with significant change in cross slope.*

For contracts where the inertial profiler is not used for smoothness acceptance, the 16 ft straightedge shall be used to measure longitudinal smoothness on all surface courses, and on any dense graded intermediate course immediately below the surface course. Measurement with the 16 ft straightedge shall include the above locations, all mainline

traveled way lanes and ramps with posted speeds greater than 45 mph., and on ramp acceleration or deceleration lanes.

(c) 10 ft Straightedge

The 10 ft straightedge will be in accordance with 306.03(d). The 10 ft straightedge will be used to check transverse slopes, across travel lanes and shoulders, approaches, and crossovers. When the 10 ft straightedge is used, the pavement variations shall be corrected to 1/8 in. or less.

(d) Areas of Localized Roughness, ALR

At locations where the inertial profiler is being used on an intermediate course, all areas having a localized roughness in excess of 160 in./mi utilizing continuous IRI with a 25 ft window shall be corrected subject to approval by the Engineer.

At locations where the inertial profiler is being used on a surface course, all areas under category Type A, as defined in 401.19(c), having a localized roughness in excess of 160 in./mile or category Type B in excess of 170 in./mile utilizing continuous IRI with a 25 ft window shall be corrected subject to approval by the Engineer. After ALR's have been identified, a grinding simulation shall be performed to estimate whether the ALR can be corrected to an IRI value of less than 160 in./mi with no more than a 1/4 in. max grind depth at any spot. If such correction is not possible, then an ALR with an IRI value of less than 190 in./mi can remain uncorrected if approved by the Engineer, and an ALR with an IRI value greater than 190 in./mi shall require full depth removal and replacement of the surface course of sufficient area to meet specifications.

In addition, if there is only one ALR in any two lane mile section, then no smoothness correction will be required if the ALR does not exceed 190 in./mi and the overall smoothness in accordance with 401.18(d) of the two lane mile section does not require any corrective action. A two lane mile section will start one mile before the ALR and end one mile after the ALR in order that all two lane mile sections will have, at most, one ALR each.

(e) Smoothness Section Correction

The width of the corrected area may be partial or full lane width, depending on the respective wheel path profiles. Underlying courses that are exposed by corrective action shall be milled to a depth of 1 1/2 in. and replaced with surface course. After the corrective action is taken on a surface course, the inertial profiler shall be operated throughout the entire affected smoothness section to verify the adequacy of the corrective action.

At locations where the 16 ft straightedge is used, the pavement variations shall be corrected to 1/4 in. or less.

If grinding of an intermediate course is used for pavement smoothness corrections, the grinding shall not precede the surface placement by more than 30 calendar days if open to traffic.

SECTION 401, DELETE LINES 805 THROUGH 843.

SECTION 401, AFTER LINE 843, INSERT AS FOLLOWS:

(c) Smoothness

Smoothness pay adjustments will only be applied when the smoothness is measured by an inertial profiler in accordance with 401.18(a).

The Mean Roughness Index, MRI, will be determined utilizing a fixed interval for each lane for each 0.1 mile section of paving. The MRI for a 0.1 mile section will be the average of the IRI of the two wheel paths. Categorized segments shall be as follows:

1. *Type A. Pavement on a non-interstate with more than a single opportunity to achieve a smooth ride or asphalt pavement on an interstate with a single opportunity or more. The following operations, if performed on the contract, will be considered opportunities.*

   a. *A layer of HMA base, intermediate, and surface; each layer is an opportunity. Wedge and level will not be considered an opportunity.*

   b. *Profile milling to correct cross slope is considered an opportunity prior to placing base, intermediate, or surface HMA.*

2. *Type B. Pavement that is not included in the description above under Type A.*

At locations where an inertial profiler is used to accept smoothness, a quality assurance adjustment will be determined for each lane. This adjustment will be applied to all QC/QA HMA pay items within the pavement section. The adjustment will be calculated using the following formula:

$$q_s = (PF_s - 1.00) \sum_{i=1}^{n} \left(A \times \frac{S}{T} \times U \right)$$

where:

q_s = *quality assurance adjustment for smoothness for one section*
PF_s = *pay factor for smoothness*
n = *number of layers*
A = *area of the section, sq yd*
S = *planned spread rate for material, lb/sq yd*
T = *conversion factor: 2,000 lb/ton*
U = *unit price for the material, $/ton.*

The quality assurance adjustment for smoothness, Q_s, for the contract will be the total of the quality assurance adjustments for smoothness, q_s, on each section by the following formula:

$$Q_s = \sum q_s$$

When smoothness is measured by an inertial profiler, payment adjustments will be made for any 0.1 mile section based on initial MRI generated on the surface course only and in accordance with the following table. Smoothness correction, if required, shall be in accordance with 401.18(e). The MRI pay factors for smoothness will be determined prior to any required smoothness correction.

PAY FACTORS FOR SMOOTHNESS *Posted Speed greater than 45 mph*	
MRI, in./mi.	*Pay Factor, PFs*
over 0 to 35	*1.06*
over 35 to 40	*1.05*
over 40 to 45	*1.04*
over 45 to 50	*1.03*
over 50 to 55	*1.02*
over 55 to 60	*1.01*
over 60 to 70	*1.00*
over 70 to 75	*0.99*
over 75 to 80	*0.98*
over 80 to 85	*0.96*
over 85 to 90	*0.95*
over 90	*For Type A, PFs will be 0.95 and the section shall be corrected to 70 or less.*
over 90 to 110	*For Type B, PFs will be 0.95 and the section does not require correction.*
over 110	*For Type B, PFs will be 0.95 and the section shall be corrected to 90 or less.*

SECTION 401, BEGIN LINE 844, INSERT AS FOLLOWS:

401.20 Appeals

(a) Dense Graded Mixtures and Open Graded Mixtures

SECTION 401, BEGIN LINE 883, DELETE AND INSERT AS FOLLOWS:

~~(a)~~*1.* MSG

The backup MSG will be dried in accordance with ITM 572 and mass determined in water in accordance with AASHTO T 209.

~~(b)~~*2.* BSG of the Gyratory Specimen

New gyratory specimens will be prepared and tested in accordance with AASHTO T 312 from the backup sample.

~~(c)~~*3.* Binder Content

The backup binder content sample will be prepared and tested in accordance with ITM 571.

~~(d)~~*4.* BSG of the Density Core

Additional cores shall be taken within seven calendar days unless otherwise directed. Additional core locations will be determined by adding 1 ft longitudinally of the cores tested using the same transverse offset. The appeal density cores will be dried in accordance with ITM 572 and tested in accordance with AASHTO T 166, Method A or AASHTO T 331, if required.

The appeal results will replace all previous test result for acceptance of mixture in accordance with 401.09 and density in accordance with 401.16. The results will be furnished to the Contractor.

(b) Smoothness

The Department will perform annual Quality Assurance reviews of a portion of each Contractor's MRI results in accordance with ITM 917. The Contractor's results will be compared to the Department's. The Department will notify the Contractor of unacceptable results in a timely manner. The Department will allow an appeal period of 14 days during which time the Contractor must submit a written request and appeal results for Department review. If the Contractor's appeal results do not agree with the Department's results, the Contractor shall be required to perform a side-by-side evaluation. The Department's results will be utilized for smoothness payment in place of the Contractor's results unless the Contractor's appeal results are determined to be acceptable for payment. Sections where corrective action has taken place prior to the Department's data collection will utilize the Contractor's initial results prior to corrective action for payment.

SECTION 401, BEGIN LINE 916, DELETE AND INSERT AS FOLLOWS:

401.22 Basis of Payment

The accepted quantities for this work will be paid for at the contract unit price per ton for QC/QA-HMA, of the type specified, complete in place.

Payment for furnishing, calibrating, ~~and~~ operating the ~~profilograph~~*inertial profiler*, and furnishing *IRI* profile information will be made at the contract lump sum price for ~~profilograph~~*Inertial Profiler*, HMA.

Furnishing and operating the 16 ft straightedge shall be included in the cost of other pay items within this section.

Adjustments to the contract payment with respect to mixture, density, and smoothness for *the* mixture produced will be included in a quality adjustment pay item in accordance with 109.05.1.

SECTION 401, BEGIN LINE 940, DELETE AND INSERT AS FOLLOWS:

~~Profilograph~~*Inertial Profiler*, HMA.....LS

SECTION 401, BEGIN LINE 964, DELETE AND INSERT AS FOLLOWS:

The price for ~~Profilograph~~*Inertial Profiler,* HMA will be full compensation regardless of how often the ~~profilograph~~*inertial profiler* is used or how ~~many profilograms are produced~~*often the IRI is determined.*

SECTION 402, BEGIN LINE 344, DELETE AND INSERT AS FOLLOWS:

402.18 Pavement Smoothness

Pavement smoothness will be in accordance with 401.18 except ~~profilograph~~*inertial profiler* requirements will not apply.