

**SUPPLEMENTAL SPECIFICATION
REVISIONS TO STANDARD SPECIFICATION 410 -
HOT PLANT-MIX BITUMINOUS PAVEMENT SMOOTHNESS**

410-1 DESCRIPTION

410-1.01 Scope - This work shall consist in measuring the smoothness of bituminous pavement surface, determining a Profile Index (PI), and performing any corrective work necessary to produce a final paved surface having a Profile Index (PI) within the acceptance zone presented in Table 410-1. The work shall be performed in accordance with these specifications, and in conformance with the lines, grades and details shown on the plans or established by the Engineer. The terms “roughness” and “smoothness” represents the same surface characteristics and are used interchangeably throughout this specification.

410-2 EQUIPMENT

410-2.01 Paving Equipment - The Contractor shall provide paving equipment and employ methods capable to produce a riding surface having a Profile Index (PI) within the acceptance zone presented in Table 410-1.

410-2.02 Profilograph - A 25-foot computerized California-type profilograph or a compatible device meeting the requirements of ASTM E-1274 or the ASTM E-950 (Class I) as determined by the Engineer shall be used. The equipment shall be operated by qualified technical personnel in compliance with the equipment’s manufacturer recommendations and protocols as approved by the Engineer. The Contractor shall furnish profilograph equipment as described herein for performing and providing quality control measurements of intermediate layers. The profilograph shall be furnished by the Contractor at no extra cost to the Authority and shall remain the property of the Contractor. The measurements of the final paved surfaces, for determining approval and payment of bonuses or charging penalties, will be performed using the Authority’s profilograph equipment.

410-3 TEST REQUIREMENTS

410-3.01 Definitions of Terms

a. **Pavement Lot** – A pavement lot is defined as 528 linear feet (0.1-mile) or fraction thereof of bituminous pavement surface lane (intermediate and final) regardless of lane width. Pavement lots will begin or end at the 0.1 mile limit or fraction, at bridge approach slabs, at a bridge lot limit or at the project limits.

b. **Bridge Lot** - A bridge lot is defined as 528 linear feet (0.1-mile) or fraction thereof of bituminous overlay on existing bridge approach slabs and bridge deck beginning and ending 100-foot before and after existing bridge approach slabs.

c. **Test Section** – Portion of pavement constructed within project limits used to evaluate Contractor’s capability (workmanship and equipment) to produce a riding surface having a PI within the acceptance zone of Table 410-1.

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d. **Action Plan** – Contractor’s proposed strategies and related work to be performed on the intermediate layers as approved by the Engineer to produce a final paved surface having a Profile Index (PI) within the acceptance zone presented in Table 410-1.

e. **Defective Areas** - A defective area is any segment of paved surface (intermediate or final) having deviations, high or low points, in excess of 0.4 inches in a length of 25 feet. A defective area is also any pavement lot having a PI equal or greater than the rejection limit shown on Table 410-1 for the specified smoothness level.

f. **Corrective Measure** – Work proposed and performed by Contractor to remediate defective areas at no additional cost to the Agency and as approved by the Engineer.

g. **Profilogram** - The resulting surface plot presented on a full scale as follows: one inch on vertical axis represents a height of one inch; one inch on longitudinal axis represents a length of 25-feet. The profilogram shall be established using a 0.20-inch blanking band.

h. **Blanking Band** – A band of uniform height with its longitudinal center positioned optimally between the highs and lows of the surface plot depicting at least 100-feet of pavement.

410-3.02 The Contractor shall coordinate with the Engineer the testing of pavement smoothness at least 3 days in advance of performing the test.

410-3.03 Procedure – Calibrate the profilograph equipment previous to each operation and in the presence of the Engineer in accordance with the ASTM E-1274 or ASTM E-950 (Class I) and applicable manufacturer recommendations.

Measure the paved surface over the right wheel path of each lane parallel to the centerline of the pavement and approximately 3.0 feet (1.0 m) inside all lane edges, measured transversely. The equipment shall be operated in the direction of traffic. Remove any objects including dirt and debris prior to performing the surface smoothness measurements. Ramps, acceleration/deceleration lanes, and lots with a curvature radii of 50 feet or less, as determined by the Engineer, will be tested and evaluated under Smoothness Level # 5 requirements according to Table 410-1.

a. **Motive Power** - Motive power may be manual or by a propulsion unit attached to the assembly. The equipment will be moved at a speed no greater than 3 MPH or as determined by the Engineer.

Determine a Profile Index (PI) according to ASTM E-1274 or ASTM E-950 (Class I) as modified by this specification and as determined by the Engineer. The PI will be calculated using the original equipment’s software in inches per mile and will be carried out to one decimal point.

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b. Smoothness Level #4 – Before construction traffic, the Contractor shall coordinate with the Engineer the measurement by the Authority of the PI of existing surface. Existing surface is the surface before performing milling, overlaying, or any other contract work. The existing PI will be use to determine percent improvement of the final paved surface smoothness.

Determine the PI for each lane for each pavement lot. When the contract requires the overlay of bridge decks and approaches with hot plant mix bituminous pavement, determine the PI for each lane for each bridge lot. All measurements taken at the beginning or ending of the project, bridge approach slabs or bridge lot limits shall be performed with the equipment's measuring wheel 15 feet from such limit.

410-3.04 Test Section - Prior to the initial paving operations, or as required by the Engineer, the Contractor shall provide a test section equivalent to three (3) pavement lots. The measurements shall be performed with the Contractor's equipment as soon as the final rolling has been completed and the required density and temperatures have been attained. After the initial pavement smoothness evaluation, if paving methods and paving equipment are acceptable to the Engineer, the Contractor may proceed with the paving operations. If the resulting work is not acceptable to the Engineer the Contractor shall submit an action plan to the Engineer and a new test section shall be performed. This procedure shall be repeated until the resulting surface is approved by the Engineer.

410-3.05 Intermediate Layer (milled surfaces, leveling course surfaces, and base course surfaces) - The Contractor shall establish quality control procedures by measuring the surface smoothness of each intermediate layer. The Contractor shall submit in writing to the Engineer, at least 3 days before placing next layer, the resulting quality control profilogram and action plans when required.

410-3.06 Surface layer (final paved surface) - The Authority will perform the smoothness measurement of final paved surface for the acceptance or rejection of the bituminous pavement. The measurements will be performed after completion of the full length of the final surface for each traffic lane or as directed by the Engineer. During smoothness testing operations the Contractor shall provide traffic control and furnish survey services and reference points tied to the stationing system of the project.

Manhole covers, drainage grates, pavement markings, signal detection slabs, bridge joints, and any other appurtenances in the profiler's wheel path will be included in the measurement of the profile index.

410-3.07 Proposed Corrective Measures - The Contractor shall submit to the Engineer, for approval, a written proposal to correct defective areas. For final paved surfaces the proposal shall include cold milling and overlay, for removing and replacing bituminous concrete to the depth necessary to correct the deviations that does not impact the structural capacity or longevity of pavement structure as determined by the Engineer. The resulting overlay course

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shall comply with the minimum thickness requirements and all other contract requirements for hot plant mix bituminous pavements established in Specifications 401, 959, and others as applicable.

410-4 METHOD OF MEASUREMENT

410-4.01 All work, materials, labor, and equipment required to produce a riding surface having a Profile Index (PI) within the acceptance zone presented in Table 410-1 will not be measured directly for payment. This work shall include, but is not limited to: performing smoothness test, traffic control for performing tests and evaluations, equipment, operation, and reporting of test results, the Contractor's quality control procedures and reports, corrective measures and related labor and materials performed by Contractor, as well as all other related work, materials or labor required by this specification.

410-5 BASIS OF PAYMENT

410-5.01 The Contractor shall furnish all labor and equipment to complete the work as specified herein as a subsidiary obligation of the applicable hot plant mix bituminous asphalt mix pay item in the contract.

410-5.02 Acceptance Criteria - The acceptance criteria shall be in conformance with Table 410-1. For lots less than 528 feet in length, the pay adjustments shall be calculated proportionally with the actual length of the lot. Segments shorter than 15 feet will not be considered for payment.

For intermediate layers the Contractor shall submit all required quality control test results to the Engineer at the end of each month, as applicable, to process monthly certification. Failure to submit this information shall result in the withholding of payment certification for applicable hot plant mix bituminous pavement pay items. The smoothness measurements on intermediate layers will not be used for pay adjustments.

The pay adjustment for each lot of final paved surface shall be calculated using the final PI as measured by the Authority in conformance with the limits shown on Table 410-1. The pay adjustment shall be paid by mean of an extra work order for each lot regardless of lane width.

Pay adjustments for incentive will be based only on the measured PI of each lot prior to any corrective measure. No incentive will be paid for any lot with corrective measures regardless of the resulting PI. The Contractor may apply corrective measures to reduce or eliminate the disincentives pay adjustment.

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**Table 410-1
Pay Adjustment for Bituminous Pavement Smoothness of Final Paved Surface**

Smoothness Level	Column A Incentive ⁽¹⁾ \$400.00 (for every PI under limit)	Column B Incentive ⁽¹⁾ \$200.00 (for every PI within limits)	Column C Acceptance \$0.00 (for every PI within limits)	Column D Penalty ⁽²⁾ (\$200.00) (for every PI within limits)	Column E Rejection (Corrective Measure Required (PI))
Level 1	3.0 or less	over 3.0 to 5.0	over 5.0 to 10.0	over 10.0 to 20.0	over 20.0
Level 2	5.0 or less	over 5.0 to 7.0	over 7.0 to 15.0	over 15.0 to 40.0	over 40.0
Level 3	5.0 or less	Over 5.0 to 10.0	over 10.0 to 20.0	over 20.0 to 50.0	over 50.0
Level 4 ⁽³⁾	Pay adjustment and acceptance limits will be established for each specific project based on Final Percent Improvement (FPI). Refer to applicable instruction on contract documents for applicable limits.				
Level 5	Acceptance is established according to the surface requirements of Subsection 401-3.13				

(1) Pay Adjustment (Incentive) will be computed as follows:

- If Lot PI lies within the limits stated in column A above, the Pay Adjustment will be computed as follows:

$$PAI = LAF \times ((\$400) \times (CAPIUL - Lot PI) + (\$200) \times (CBPIUL - CBPILL))$$

- If Lot PI lies within the limits stated in column B above, the Pay Adjustment will be computed as follows:

$$PAI = LAF \times ((\$200) \times (CBPIUL - Lot PI))$$

- If Lot PI lies within the limits stated in column C above, no Pay Adjustment will be applied

$$PAI \text{ or } PAP = \$0.00$$

(2) Pay Adjustment (Penalties) will be computed as follows:

- If Lot PI lies within the limits stated in columns D or E above, the Pay Adjustment will be computed as follows:

$$PAP = LAF \times ((\$200) \times (Lot PI - CCPIUL))$$

Definitions:

- PAI: Pay Adjustment (Incentive)
- PAP: Pay Adjustment (Penalties)
- LAF: Length Adjustment Factor = (Total Length of Lot / 528 ft)
- CAPIUL: Column A PI Upper Limit
- CBPIUL: Column B PI Upper Limit
- CBPILL: Column B PI Lower Limit
- CCPIUL: Column C PI Upper Limit

(3) $Final\ Percent\ Improvement = \frac{(Initial\ PI - Final\ PI) \times 100}{Initial\ PI}$