Section 2317. Primary and Interstate Pavement Smoothness

2317.01 GENERAL.

~~A.~~ Evaluate pavement smoothness for all Interstate and Primary main line pavement surfaces, and all other road surfaces included on Primary projects, except when specifically excluded or modified by the contract documents. Main line pavement is defined as all permanent pavement for through lanes. ~~Exclusions from profilograph testing are detour pavement, shoulders, crossovers, and individual sections of pavement less than 50 feet (15 m) in length.~~

~~B. The Engineer may determine the pavement smoothness according to Materials I.M. 341 using a 10 foot (3 m) straightedge or rolling straightedge on surfaces excluded from profilograph testing. The variation of the surface from the testing edge of the straightedge is not to exceed 1/8 inch (3 mm) between any two contacts, longitudinal or transverse. Correct all irregularities exceeding the specified tolerance using equipment and methods approved by the Engineer. After the Contractor has corrected an irregularity, the Engineer may perform monitor testing of the area to verify compliance with the specified tolerance.~~

2317.02 EQUIPMENT.

A. Provide and operate an Ames type or California type profilograph or an inertial profiler to produce a profilogram (profile trace) of the surface tested according to Materials I.M. 341. ~~Other types of profilographs or profilers that produce compatible results and meet the requirements of Materials I.M. 341 may be used.~~ Ensure the operator is trained and certified to operate the profilograph as required by the Contracting Authority.

B. If the profilograph has a mechanical recorder, provide automated trace reduction equipment according to Materials I.M. 341. If it has a computerized recorder, the trace produced will be evaluated without further reduction.

C. For corrective work by diamond grinding, use grinding and texturing equipment meeting the requirements of Section 2532.

2317.03 SURFACE TOLERANCES, TESTING, AND EVALUATION.

A pavement segment is defined as a continuous area of finished pavement 0.1 mile (161 m) in length and one lane (10 to 12 foot (3.0 to 3.7 m) nominal) in width. A partial segment resulting from an interruption of the continuous pavement surface (in other words, bridge approaches, side road tie-ins, the cessation of the daily paving operations, and so forth) is subject to the same evaluation as a whole segment.

A. Tolerances.
Produce pavement with an average profile index per 0.1 mile (161 m) segment as shown in Table 2317.03-1.

Table 2317.03-1: Tolerance for Average Profile Index per 0.1 Mile (161 m)
(0 inch (0 mm) blanking band)

Surface Type	Profile Index For greater than 45 mph	Profile Index For 45 mph or less and ramps
	Inches per mile (mm / km)	Inches per mile (mm / km)
PCC Pavement	40.0 or less (630 or less)	65.0 or less (1025 or less)
HMA Pavement	35.0 or less (550 or less)	45.0 or less (710 or less)

B. Testing.

1. Determine the pavement profiles for each lane according to the procedures for one lane, as shown in Materials I.M. 341 except for main line traffic lanes which will be tested in the wheel paths. Round the trace scallops to the nearest 0.01 inch (0.1 mm). The wheel paths are defined as the 3 feet (0.9 m) and 9 feet (2.7 m) from the center line or lane line. Average the two wheel path profile indexes for each segment. Additional profiles may be taken only to define the limits of an out-of-tolerance surface variation.

2. The Engineer may use a 10 foot (3 m) straightedge (or other means) to detect irregularities outside the required trace paths. The Engineer may also use the straightedge to delineate the areas that require corrective action.

3. Test bridge approaches according to Section 2428.

4. Paved shoulders will be excluded from smoothness testing. When used as a temporary driving surface, evaluate paved shoulders for bumps and dips. Evaluate for high points and low points with deviations in excess of 0.5 inches (12.7 mm) in a length of 25 feet (7.6 m) or less. Take corrective action.

C. Evaluation.

1. Determine a profile index based on the 0 inch (0 mm) blanking band following the same procedures shown in Materials I.M. 341 for each segment of finished pavement surface except for:
   - **a.** Primary side road connections less than 600 feet (180 m) in length.
   - **b.** Non-primary side road connections, which are to be evaluated according to Section 2316.
   - **c.** Bridge approaches (evaluated according to Section 2428).
   - **d.** Storage lanes, turn lanes, and other auxiliary lanes less than 600 feet (180 m).
   - **e.** Pavement less than 8.5 feet (2.6 m) in width.
   - **f.** The 16 feet (5 m) before and the 16 feet (5 m) beyond the ends of the section when the Contractor is not responsible for the adjoining surface.
   - **g.** Single lift pavement overlays 2 inches (50 mm) thick or less, unless the existing surface has been corrected by milling or scarification.
   - **h.** Runout tapers on HMA overlays at existing pavement, bridges, or bridge approach sections where the thickness is less than the design thickness.
   - **i.** Detour pavement.
   - **j.** Crossovers.
   - **k.** Individual sections of pavement less than 50 feet (15 m) in length.

   Evaluate pavement segments excluded from profile index evaluation for high points and low points with deviations in excess of 0.5 inches (12.7 mm) in a length of 25 feet (7.6 m) or less. Take corrective action.

2. For the following situations, the profile index will be evaluated. If the average profile index exceeds the tolerances listed in Article 2317.03, A, the Contractor may elect to eliminate that area from the profile index for the day's paving operation. ~~and evaluate the area using a 10 foot (3 m) straightedge as outlined in Article 2317.01.~~

   Evaluate pavement segments eliminated from profile index evaluation for high points and low points with deviations in excess of 0.5 inches (12.7 mm) in a length of 25 feet (7.6 m) or less. Take corrective action.
   - **a.** Horizontal curves with a centerline radius of less than 1000 feet (300 m) and the pavement within the superelevation transition of such curves.
   - **b.** Crest and sag vertical curves with an L/A < 100 where L is the length of curve in feet and A is the grade change in percent (L/A < 30.5 where L is the length in meters and A is the grade change in percent).

3. Determine a daily average profile index for each day's paving operation. A day's paving operation is defined as a minimum of 0.1 mile (161 m) segment of pavement placed in a day. If less than 0.1 mile (161 m) segment is paved, the day's production will be grouped with the next day's production. If the production of the last day of project paving is less than 0.1 mile (161 m) segment, it will be grouped with the previous day's production.

4. Test each segment within 48 hours following placement. Furnish the profile index for each segment of paving to the Engineer by the end of the next day worked following the placement until there has been 3 consecutive days of paving where the index for all segments would result in 100% payment or better. Should any following day be evaluated to receive less than 100% payment, immediately notify the Engineer and take corrective action to modify paving methods and equipment to achieve 100% payment or better.

5. If the day's average profile index exceeds the values in Table 2317.03-1, notify the Engineer and suspend the paving operation until corrective action is taken. When the paving is resumed, the paving operations will be evaluated with the start-up testing procedures in the preceding paragraph.

6. Submit all final profilograph test reports and profile traces to the Engineer within 14 calendar days following completion of paving on the project. The Engineer may request selected reports and traces in advance of paving completion for purposes of validating the Contractor's test results. Incentive payments for qualifying segments will be made following receipt of appropriate documentation of certified smoothness results.

2317.04 CORRECTIVE ACTIONS.

A. General.

1. The pavement will be evaluated in 0.1 mile (161 m) segments using the profilograph, to determine pavement segments where corrective work or pay adjustments will be necessary. Each individual profilograph trace will be evaluated (not the average of multiple traces) to determine the areas where corrective action on 0.5 inch (12.7 mm) bumps and dips is needed.

2. Within each 0.1 mile (161 m) segment, correct all areas representing high points (bumps) or low points (dips) with deviations in excess of 0.5 inches (12.7 mm) in a length of 25 feet (7.6 m) or less regardless of the profile index value. Evaluate pavement segments excluded from profile index evaluation in Article 2317.03 for high points and low points with deviations in excess of 0.5 inches (12.7 mm) in a length of 25 feet (7.6 m) or less. Take corrective action.

3. Separately identify bumps and dips equal to or exceeding 0.5 inches (12.7 mm) in a length of 25 feet (7.6 m) or less.

4. On lanes over 8.5 feet (2.6 m) in width, for through traffic which requires matching the surface of the new pavement to the surface of an existing pavement, an Average Base Index (ABI) will be determined according to Section 2316.

B. Roadways with a posted speed greater than 45 mph.

Correct all 0.1 mile (161 m) segments, including bumps, having an initial average profile index of greater than those tolerances shown in Article 2317.05. Correct these segments to reduce the average profile index to those shown in Table 2317.04-1 below. The Contractor has the option to replace these segments. On segments where corrections are made, test the pavement to verify that corrections have met the average profile index as shown in Table 2317.04-1 below.

C. Roadways with a posted speed of 45 mph, or less, and ramps.

Correct all 0.1 mile (161 m) segments, including bumps, having an initial average profile index of greater than those tolerances shown in Article 2317.05. Correct these segments to reduce the average profile index to those shown in Table 2317.04-1 below. The Contractor has the option to replace these segments. On segments where corrections are made, test the pavement to verify that corrections have met the average profile index as shown in Table 2317.04-1 below.

Table 2317.04-1: Average Profile Index per 0.1 Mile (161 m) after Corrections (0 inch (0 mm) blanking band)

Surface Type	Profile Index For greater than 45 mph	Profile Index For 45 mph or less and ramps
	Inches per mile (mm / km)	Inches per mile (mm / km)
PCC Pavement	40.0 or less (630 or less)	65.0 or less (1025 or less)
HMA Pavement	40.0 or less (630 or less)	50.0 or less (790 or less)

D. Bridge Approach Sections.

Correct bridge approach sections according to Section 2428.

E. Corrective Work.

~~Corrective work is at the Contractor's expense except for the 16 feet (5 m) before and the 16 feet (5 m) beyond the end of the section when the Contractor is not responsible for the adjoining surface.~~

When the Contractor is not responsible for the adjoining surface, bumps and dips in the 16 feet (5 m) at the end of a section will be reviewed by the Engineer. Correct bumps and dips determined to be under the control of the Contractor and resulting from the Contractor's operations. Correction of bumps and dips determined to be beyond the control of the Contractor will be paid according to Article 1109.03, B. Complete the corrective work prior to determining pavement thickness. Do not use bush hammers or other impact devices.

1. PCC Pavement.
On PCC pavement, make corrections using an approved profiling device or by removing and replacing the pavement. Apply corrective methods to the full lane width. Ensure, when completed, the corrected area (full lane width) has uniform texture and appearance, with the beginning and ending of the corrected area squared normal to centerline of the paved surface. Where surface corrections are made, grooving will not be required.

2. HMA Pavement.

a. On HMA pavement, make corrections by diamond grinding, by overlaying the area, by replacing the area, or by inlaying the area. If the surface is corrected by diamond grinding, perform the same work and use the same equipment as specified for PCC pavement, except cover the ground surface with a seal coat according to Section 2307, with the following modifications:

1) The binder bitumen may be the emulsion or cutback asphalt used for tack coat, applied at a rate of 0.10 gallon per square yard (0.7 L/m^2). Hand methods may be used for spraying.

2) Apply a cover aggregate consisting of sand (slightly damp, but with no free moisture as determined by visual inspection) at a rate of 10 pounds per square yard (5 kg/m^2). Hand methods may be used for spreading. Embed cover aggregate with at least one complete pneumatic roller coverage.

3) This seal coat is intended to be placed immediately after the diamond grinding is completed in the travel lane. The Engineer may approve this construction when road surface temperatures are below 60ºF (16ºC).

4) Labor, equipment, and materials used for this seal coat are incidental to other items and will not be paid for separately.

b. If the surface is corrected by overlay, replacement, or inlay, begin and end the surface correction with a transverse saw cut normal to the pavement lane lines or edge lines within any one area. The profile of the surface must be smooth with no bumps or dips at the beginning or end of correction.

c. Overlay correction must be for the entire pavement width. Pavement cross slope must be maintained through the corrected areas.

F. Verification Testing.

1. The Engineer will perform verification testing to validate the Contractor's certified quality control testing. If the Engineer's verification test results validate the Contractor's test results, the Contractor's results will be used for acceptance. Disputes between the Contractor's and Engineer's test results will be resolved according to Materials I.M. 341.

2. The Engineer may test the entire project length if it is determined that the Contractor certified test results are inaccurate, The Contractor will be charged for this work at a rate of $400.00 per mile ($250.00 per kilometer), per profile track, with a minimum charge of $800.00.

3. Furnishing inaccurate tests may result in decertification of the Contractor's certified operator.

2317.05 PAY ADJUSTMENTS.

A. General.

1. Pay adjustments will be based on the initial average profile index determined for the segments prior to performing any corrective work. Areas excluded from the profilograph testing and bridges approaches will not be subject to price adjustments.

2. If the Contractor elects to remove and replace the segments, the Contractor will be paid the price adjustment that corresponds to the initial average profile index obtained on the pavement segments after replacement.
3. When the plans dictate that an area of pavement is to be hand finished, the area will not be subject to reduced payment. However, the area is to be profiled and corrected as necessary to meet these specifications.

~~1~~B. PCC Pavement.

The payment will be adjusted as shown in Table 2317.05-1 according to the posted or proposed speed.

Table 2317.05-1: Schedule for Adjustment Payment for PCC Pavements (0 inch (0 mm) blanking band)

Profile Index For greater than 45 mph	Profile Index For 45 mph or less and ramps	Dollars per 0.1 mile (161 m) segment per lane	
Inches per mile (mm / km)	Inches per mile (mm / km)	Interstate & Multi-Lane Divided Segments	Other Primary Segments
22.0 or less (345 or less)	25.0 or less (395 or less)	+950.00	+850.00
22.1 to 23.5 (346 to 370)		+800.00	+650.00
23.6 to 26.0 (371 to 410)	25.1 to 30.0 (396 to 475)	+600.00	+450.00
26.1 to 40.0 (411 to 630)	30.1 to 65.0 (476 to 1025)	0.00	0.00
40.1 to 45.0 (631 to 710)	65.1 to 70.0 (1025 to 1105)	-600.00 or grind*	-450.00 or grind*
45.1 or more (711 or more)	70.1 or more (1105 or more)	0.00*	0.00*
* These segments ~~must~~ shall be corrected to the levels shown in Table 2317.04-1.			

~~2~~C. HMA Pavement.

The payment will be adjusted as shown in Table 2317.05-2 according to the posted or proposed speed.

Table 2317.05-2: Schedule for Adjustment Payment for HMA Pavements (0 inch (0 mm) blanking band)

Profile Index For greater than 45 mph	Profile Index For 45 mph or less and ramps	Dollars per 0.1 mile (161 m) segment per lane	
Inches per mile (mm / km)	Inches per mile (mm / km)	Interstate & Multi-Lane Divided Segments	Other Primary Segments
10.0 or less (160 or less)		+850.00	+750.00
10.1 to 11.5 (161 to 180)	15.0 or less (235 or less)	+650.00	+500.00
11.6 to 13.5 (181 to 215)		+500.00	+350.00
13.6 to 15.5 (216 to 245)	15.1 to 20.0 (236 to 315)	+350.00	+200.00
15.6 to 35.0 (246 to 550)	20.1 to 45.0 (316 to 710)	0.00	0.00
35.1 to 40.0 (551 to 630)	45.1 to 50.0 (711 to 790)	-350.00 or grind*	-200.00 or grind*
40.1 or more (631 or more)	50.1 or more (791 or more)	0.00*	0.00*
* These segments ~~must~~ shall be corrected to the levels shown in Table 2317.04-1.			