~~Draft~~ DS-01095
(Replaces DS-01056 and DS-01093)

Iowa Department of Transportation

DEVELOPMENTAL SPECIFICATIONS
FOR
PAVEMENT SMOOTHNESS

Effective Date
June 19, 2007

THE STANDARD SPECIFICATIONS, SERIES 2001, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE DEVELOPMENTAL SPECIFICATIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

Replace all of Section 2316 with the following:

Section 2316. Pavement Smoothness

2316.01 GENERAL.
Pavement smoothness shall be evaluated for all Interstate and Primary main line pavement surfaces, and all other road surfaces included on Primary projects, except when specifically excluded by the contract documents. Pavement smoothness shall not be evaluated for all other roads unless specified in the contract documents. Main line pavement is defined as all permanent pavement for traffic lanes, including tapers to parallel lanes or through lanes at intersections, tapers to climbing lanes, and tapers to ramps and loops. Pavement smoothness shall also be evaluated for all interchange ramps and loops, side roads, auxiliary lanes, and bridge approaches. Exclusions from profilograph testing are detour pavement, shoulders, crossovers, and individual sections of pavement less than 50 feet (15 m) in length.

If this specification is required by contract documents on non-Primary projects let by the Department, it will be added in its entirety without modification.

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 shall not exceed 1/8 inch (3 mm) between any two contacts, longitudinal or transverse. The Contractor shall 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.

2316.02 EQUIPMENT.
The Contractor shall provide and operate a California type profilograph to determine the pavement profile in accordance with 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. The Contractor's operator shall be trained and certified to operate the profilograph as required by the Contracting Authority.

If the Contractor's profilograph has a mechanical recorder, the Contractor shall provide automated trace reduction equipment in accordance with Materials I.M. 341. If the Contractor's profilograph has a computerized recorder, the trace produced will be evaluated without further reduction.

2316.03 SURFACE TOLERANCES, TESTING, AND EVALUATION.
A pavement section 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 section resulting from an interruption of the continuous pavement surface (i.e. bridge approaches, side road tie-ins, the cessation of the daily paving operations, etc.) is subject to the same evaluation as a whole section.

A. Tolerances.
The Contractor shall produce pavement with an average profile index per 0.1 mile (161 m) section as shown in the table below.

TOLERANCE FOR AVERAGE PROFILE INDEX PER 0.1 MILE (161 m)
(0 inch 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 HMA Pavement	45.0 or less (710 or less) 40.0 or less (630 or less)	65.0 or less (1025 or less) 45.0 or less (710 or less)

B. Testing.
The Contractor shall 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 and through 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 section. Additional profiles may be taken only to define the limits of an out-of-tolerance surface variation. 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.

C. Evaluation.
The Contractor shall 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 section of finished pavement surface except for:

1. Side roads connections less than 600 feet (180 m) in length.
2. Bridge approaches less than 50 feet (15 m).
3. Storage lanes, turn lanes, and other auxiliary lanes less than 600 feet (180 m).
4. Pavement less than 8.5 feet (2.6 m) in width.
5. The 16 feet (5 m) beyond the ends of the section when the Contractor is not responsible for the adjoining surface.
6. On HMA pavements, single lift pavement overlays.
7. Runout tapers on HMA overlays at existing pavement, bridges, or bridge approach sections where the thickness is less than the design thickness.

The Contractor shall determine, for information only, a profile index based on the 0.2 inch (5.1 mm) blanking band.

For the following situations, the profile index will be evaluated. If the average profile index exceeds the tolerances listed in Article 2316.03, 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 2316.01.

1. Horizontal curves with a centerline radius of less than 1000 feet (300 m) and the pavement within the superelevation transition of such curves.
2. 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).

The Contractor shall 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) section of pavement placed in a day. If less than 0.1 mile (161 m) section 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) section, it will be grouped with the previous day's production.

During the first 3 days of the paving operation, and after long shut-down periods, the pavement shall be tested and the test report furnished to the Engineer and District Materials Engineer by the end of the next day worked following the placement. On HMA pavement, the testing shall be performed as soon as the pavement has cooled sufficiently to permit testing. The Engineer and the Contractor will use the results of the initial testing to evaluate the paving methods and equipment. If the initial paving operation produces acceptable results, the Contractor may continue paving.

If the day's average profile index exceeds 45.0 inches per mile (710 mm/km) (65.0 inches per mile (1025 mm/km) on roadways with posted speeds of 45 mph or less), the paving operation will be suspended until corrective action is taken by the Contractor. When the paving is resumed, the paving operations will be evaluated with the start-up testing procedures in the preceding paragraph.

The Contractor shall make the profilogram and evaluation available to the Engineer and District Materials Engineer during the project and furnish both at the end of the project. The evaluation of the trace shall be performed according to Materials I.M. 341. The test report shall be furnished to the Engineer within 2 working days after placement of the pavement and again within 2 working days after any corrections are made.

2316.04 CORRECTIVE ACTIONS.
The pavement will be evaluated in 0.1 mile (161 m) sections using the profilograph, to determine pavement sections 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 inches (12.7 mm) bumps and dips is needed.

Within each 0.1 mile (161 m) section, 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 shall be corrected by the Contractor regardless of the profile index value. Pavement sections excluded from profile index evaluation in Article 2316.03 shall be evaluated 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 and shall be corrected by the Contractor.

Bumps and dips equal to or exceeding 0.5 inches (12.7 mm) in a length of 25 feet (7.6 m) or less shall be identified separately.

A. ~~For r~~Roadways with a posted speed greater than 45 mph.

Any 0.1 mile (161 m) section, including bumps, having an initial average profile index of greater than those tolerances shown in Article 2316.03, A, shall be corrected to reduce the average profile index to those shown in the table below, or replaced at the Contractor's option. On sections where corrections are made, the Contractor shall test the pavement to verify that corrections have met the average profile index as shown in the table below.

B. ~~For r~~Roadways with a posted speed of 45 mph, or less, and ramps. ~~from the nose to the intersection of the adjoining roadway, acceleration and deceleration lanes including the taper, and/or acceleration lanes that become a through lane are limited to 500 feet (150 m) from the nose:~~

Any 0.1 mile (161 m) section, including bumps, having an initial average profile index of greater than those tolerances shown in Article 2316.03, A, shall be corrected to reduce the average

profile index to those shown in the table below, or replaced at the Contractor's option. On sections where corrections are made, the Contractor shall test the pavement to verify that corrections have met the average profile index as shown in the table below.

AVERAGE PROFILE INDEX PER 0.1 MILE (161 m) AFTER CORRECTIONS
(0 inch 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~~ 40.0 or less (~~550~~ 630 or less)	45.0 or less (710 or less)

C. Bridge approach sections having an initial average profile index of 65.1 inches per mile (1026 mm/km) or greater shall be corrected to reduce the profile index to 65.0 inches per mile (1025 mm/km) or less on each trace, or replaced at the Contractor's option. On sections where corrections are made, the pavement will be tested by the Contractor to verify that corrections have produced a profile index of 65.0 inches per mile (1025 mm/km) or less for each trace.

D. Corrective work shall be at the Contractor's expense except for the 16 feet (5 m) beyond the end of the section when the Contractor is not responsible for the adjoining surface. Corrective work shall be completed prior to determining pavement thickness.

Bush hammers or other impact devices will not be permitted.

1. PCC Pavement.
On PCC pavement, corrections shall be made using an approved profiling device or by removing and replacing the pavement. The corrective methods used by the Contractor shall be applied to the full lane width. When completed, the corrected area (full lane width) shall have 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, transverse grooving will not be required.

2. HMA Pavement.
On HMA pavement, corrections shall be made by diamond grinding, by overlaying the area, by replacing the area, or by inlaying the area. If the surface is corrected by diamond grinding, the work and equipment shall be the same as specified for PCC pavement except that the ground surface shall be covered with a seal coat ~~as described in Article 2303.03, A, 2, for a runout.~~ in accordance with Section 2307 with the following modifications:

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.

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

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).

Labor, equipment, and materials used for this seal coat will not be paid for, but shall be considered incidental to other items.

If the surface is corrected by overlay, replacement, or inlay, the surface correction shall begin and end 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 beginning or end or correction.

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

E. The Engineer may perform profilograph testing on the surface for monitoring and comparison purposes. The procedure for monitoring and comparing results is in Materials I.M. 216. The Engineer may test the entire project length if it is determined that the Contractor certified test results are inaccurate, and 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. Furnishing inaccurate tests may result in decertification of the Contractor's certified operator.

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 calculated as shown in Materials I.M. 341; this will be the smoothness base in inches per mile (millimeters per kilometer) for payment for the new pavement unless otherwise specified. The schedule for adjusted payment for the ABI is in Article 2316.05. Should the surface of the existing pavement be specified for correction, smoothness testing for ABI calculation shall be done after correction. Surface correction is required for smoothness exceeding ABI +50 for any section for posted speeds greater than 45 mph or exceeding ABI +85 for any section for posted speeds of 45 mph or less and ramps.

2316.05 PAY ADJUSTMENTS.
Pay adjustments will be based on the initial average profile index determined for the sections prior to performing any corrective work. Areas excluded from the profilograph testing and bridges approaches will not be subject to price adjustments.

If the Contractor elects to remove and replace the sections, the Contractor will be paid the price adjustment that corresponds to the initial average profile index obtained on the pavement sections after replacement.

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.

A. PCC Pavement.
The payment will be adjusted as shown in the table below according to the posted or proposed speed.

SCHEDULE FOR ADJUSTMENT PAYMENT
FOR PCC PAVEMENTS (0 inch blanking band)

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)	Dollars per 0.1 mi. section per lane
22.0 or less (345 or less)	25.0 or less (395 or less)	+850.00
22.1 to 23.5 (346 to 370)		+650.00
23.6 to 26.0 (371 to 410)	25.1 to 30.0 (396 to 475)	+450.00
26.1 to 45.0 (411 to 710)	30.1 to 65.0 (476 to 1025)	0.00
45.1 or more (711 or more)	65.1 or more (1026 or more)	0.00*

* These sections must be corrected to the levels shown in the table in Article 2316.04.

B. HMA Pavement.
The payment will be adjusted as shown in the table below according to the posted or proposed speed.

SCHEDULE FOR ADJUSTMENT PAYMENT
FOR HMA PAVEMENTS (0 inch blanking band)

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)	Dollars per 0.1 mi. section per lane
10.0 or less (160 or less)		+750.00
10.1 to 11.5 (161 to 180)	15.0 or less (235 or less)	+500.00
11.6 to 13.5 (181 to 215)		+350.00
13.6 to 15.5 (216 to 245)	15.1 to 20.0 (236 to 315)	+200.00
15.6 to 40.0 (246 to 630)	20.1 to 45.0 (316 to 710)	0.00
40.1 or more (631 or more)	45.1 or more (711 or more)	0.00*

* These sections must be corrected to the levels shown in the table in Article 2316.04.

C. Pavements using ABI.

SCHEDULE FOR ADJUSTMENT PAYMENT
FOR PAVEMENTS USING ABI (0 inch blanking band)

Profile Index For greater than 45 mph	Profile Index 45 mph or less and ramps	Contract Price Adjustment
Inches per mile (mm/km)	inches per mile (mm/km)	Dollars per section*
0 to ABI	0 to ABI	0.00
ABI +.1 (1) to ABI +30.0 (470)	ABI +0.1 (1) to ABI +45.0 (710)	-300.00
ABI +30.1 (471) to ABI +40.0 (630)	ABI +45.1 (711) to ABI +65.0 (1025)	-500.00
ABI +40.1 (631) to ABI+50.0 (790)	ABI +65.1 (1026) to ABI +85.0 (1340)	-800.00

* Payment will be based on results after correction.