

**OKLAHOMA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION
FOR
PAVEMENT AND BRIDGE DECK SMOOTHNESS**

These Special Provisions amend and where in conflict, supersede applicable sections of the 2009 Standard Specifications for Highway Construction, English and Metric.

430.01 DESCRIPTION

This section establishes procedures for determining acceptability and pay adjustments as they relate to smoothness requirements of pavements and bridge decks. The equipment and testing applicable to this section shall be provided and/or operated by the party or parties specified in Appendix A of this provision.

Except as noted herein, these special provisions apply to all types of Portland cement and asphalt concrete pavements, as well as bridge decks constructed as part of this contract, or as specified on the plans.

430.03 EQUIPMENT AND PERSONNEL

Provide an approved profiler as described below. Ensure the equipment is certified by the Oklahoma Highway Construction Materials Technician Certification Board, and is capable of running on Portland cement pavements having a compressive strength of 2,500 psi without causing any damage to the pavement.

A. Profilograph

(1) California Profilograph

Use a California profilograph supported on multiple wheels arranged in a staggered pattern so that no two wheels cross the same bump simultaneously and without a common axle. Mount the strip chart recorder on a lightweight frame 25 ft long. Measure the relative smoothness of the pavement or bridge deck by recording the vertical movement of a sensing wheel at least 6" in diameter attached to the midpoint of the frame. Record the graphical traces of the profilogram on a 1" to 1" scale for the vertical motion of the sensing wheel. Ensure the profilogram is driven by the chart drive on a scale of 1" of chart paper equal to 25 ft of longitudinal movement of the profilograph.

(2) Light Weight Profilometer

Provide lightweight profilometer equipment meeting the following requirements:

- (a)** Mounted on a lightweight, motorized vehicle such as an all-terrain vehicle, golf car, or other Engineer-approved vehicle,
- (b)** Capable of running on concrete that has not achieved its design strength without causing damage,
- (c)** Contains an onboard, precision accelerometer that measures movement of the light weight profilometer,

- (d) Contains an infrared or laser type non-contact vertical distance sensor mounted on the vehicle,
- (e) Measures and provides the information as specified in subsection 430.04.B, "Evaluation," and
- (f) Measures the road profile in accordance with ASTM E950-98, Class I.

(3) High Speed Profilometer

Provide high speed profilometer equipment meeting the requirements of AASHTO M 328-14 *Standard Equipment Specification for Inertial Profiler*.

B. Calibration

Calibrate the profilograph or profilometer within the following limits:

- Horizontal measurements shall be within ± 5 feet per 1,000 feet of distance tested.
- Vertical measurements shall be the same as those of the calibration blocks measured.

Submit a profilograph or profilometer calibration report to the Engineer after every calibration using the appropriate form provided by the Engineer. Calibrate the profilograph or profilometer the day of the testing prior to collecting the smoothness data. Repeat the calibration as directed by the Engineer.

C. Provision and Operation of the Profilograph/Profilometer

If specified, provide a profilograph or profilometer operator, certified by the Oklahoma Highway Construction Materials Technician Certification Board, to perform profilograph or profilometer measurements, and to interpret and analyze the produced profilograms.

430.04 CONSTRUCTION

A. Surface Testing

Notify the Engineer by phone 24 hours before performing any surface testing. If the Engineer is unable to be reached by phone, notify the Engineer in writing by email. Surface testing performed without proper notification or coordination with the Engineer will not be accepted.

Provide traffic control for smoothness measurements regardless of the provider or operator of the equipment. If specified, use an acceptable and approved profilograph or profilometer to measure pavement smoothness. Collect profilometer readings or profilograph traces beginning at a location 25 ft prior to the beginning point of a project, including any exception areas, and through all bridges and changes in the pavement types to a location 25 ft beyond the ending point of a project, including any exception areas. The surface will be tested as soon as possible after the completion of the work.

If milling is not required for overlay projects, the surface will be tested immediately before construction and as soon as possible after completion of the work to determine the percent reduction in the profile index in accordance with Table 430:2. However, the Contractor may request in writing the elimination of the before construction testing requirement. Elimination of such testing will also eliminate the Contractor's option of using Table 430:2 for pay purposes.

For full depth asphalt pavement, test the next to last lift and perform any corrective action on bumps and dips in accordance with subsection 425.04.A(1) prior to placing the final lift. Test the final lift to determine the pay adjustment.

For concrete pavement where a longitudinal construction joint is within 6 inches of the wheel path, provide an additional test along the joint for the purpose of determining corrective action. The pay adjustment will be based on the test within the wheel path.

The Engineer will include smoothness deviations at construction and expansion joints when calculating the profile index and when identifying bumps.

Remove objects and foreign material on the surface before testing. Remove any protective covers before testing. Properly replace protective covers after testing. While testing for smoothness, produce a final trace. Produce a second trace for segments on which allowable surface corrections have been made. The second trace must contain a minimum of 50 feet on either end of the corrected area and it must have the correct stationing.

Propel the profilograph at a speed no greater than 3 mph. Gather data at lower speeds if the pavement or bridge deck is rough or profilograms are not being produced clearly.

Operate the profilometer at a constant speed as recommended by the manufacturer, but no greater than 20 mph for a light-weight profilometer.

The testing sequence of the pavement or bridge deck to be tested will be one pass per driving lane in the wheel path farthest from the edge of a pavement or bridge deck. The profilograph/profilometer must be within the planned driving lane when making a pass.

Provide the profilogram evaluations to the Department, including at a minimum:

- Company name,
- Operator name,
- Federal/state project number,
- Job piece number,
- Route number/name,
- Lane description (NB, SB, EB, WB)
- Lane location (left, center, right)
- Pass description (1st, 2nd, etc.)
- Correct time and date,
- The electronic files from which the profilograms were derived, and
- An evaluation summary extended to include pay adjustments per segment and totaled, in spread sheet format, within 14 days after the final trace is run.

A continuous graphical trace may consist of a single trace or multiple traces including the minimum overlap, and may be submitted as an electronic file to the Engineer.

Take additional profiles only to define the limits of an out-of-tolerance surface variation. The Department reserves the right to verify the testing, the evaluation, or both. The Department's test results will be considered final. If the Contractor's test results contain significant errors, the Department may assess the cost of the verification efforts.

B. Evaluation

For pay adjustment purposes, evaluation of the surface testing results will be limited to the following specifications:

(1) Profile Index

The Department defines an "extent" as a segment of driving lane of pavement or bridge deck 528 ft long or the entire length of bridge, including approach slabs, whichever is less. Use ProVAL or other ODOT approved computerized profilogram reduction system to calculate a profile index for an extent. Other computerized profilogram reduction systems must be submitted in writing to the Resident Engineer for approval. Calculate the index by summing the vertical deviations using a zero blanking band (0.2 for bridge decks) as indicated on the profile trace. The Engineer may require additional field surveys to establish bump locations. Convert the measurements from inches into inch per mile. When the quantity represented is less than a full extent in length, the Contractor may combine the quantity with an adjacent full extent or treat it as a separate extent.

(2) Bumps

Bumps will appear as high points on the profile trace and correspond to high points on the pavement or bridge deck surfaces. The Department defines unacceptable bumps as bumps with vertical deviations greater than 0.60 in, without using a blanking band, in a 25 ft span.

(3) Exceptions

The following areas will be considered as exceptions:

- Shoulders,
- Ramps,
- Two-way, left turn lanes,
- Acceleration, deceleration, climbing, and turn lanes less than 528 ft,
- Tapered transitions associated with shoulders, ramps, acceleration, deceleration, climbing and turn lanes,
- Pavement with horizontal centerline curves with radii less than 1,000 ft and the super elevation transitions of these curves,
- In overlays only, areas in roadway within a 10 ft radius of existing inlets, street returns, and utility covers (this exception does not apply to full depth pavements), and
- Pavement areas requiring handwork (this exception does not apply to areas placed by hand for the Contractor's convenience).

These exception areas will not require testing for smoothness, however the requirements for tolerances defined in subsection 401.04 of the Standard Specifications will remain in effect. For the

above exceptions, the profile index, calculations and associated adjustments specified in this special provision will not apply.

(4) Special Evaluation Requirements

The Engineer will evaluate bridge approach slabs in accordance with bridge deck smoothness requirements. There will be no exceptions made for any portion of bridge decks or approach slabs. The profile measurements for the entire length of the bridge deck and approach slabs will be used for the determination of the pay adjustments.

The Engineer will exclude the following from the profile index calculation used for determining pay adjustments for new pavements and overlays:

- For a secondary street, the 25 ft that ties into an existing primary street as determined by the Engineer,
- The 25 ft that ties into existing bridges or approach slabs (this does not apply to new bridge construction), and
- The 25 ft at the beginning and ending stations of the project (this does not apply to multiple adjoining projects in a single contract)

These excluded areas will be tested for smoothness, and the requirements for mandatory correction of bumps as defined in this special provision and tolerances defined in subsection 401.04 of the Standard Specifications will remain in effect. Such corrections (including grinding) will not affect pay adjustments of individual extents or a possible incentive for overall smoothness.

C. Surface Correction

Ensure all ground surfaces exhibit good workmanship and are neat in appearance. Ensure all ground final surfaces are in accordance with subsection 425.04.A.(1) of the Standard Specifications. Fog seal the surfaces of ground asphalt pavements. Cores for thickness determination, as applicable, will be taken subsequent to all corrective work. Perform all corrective actions, including identifying locations needing correction, and all work associated with the correction, at no additional cost to the Department.

Grind the concrete in the vicinity of the joint as part of the corrective process when correcting bridge decks and approach slabs. Do not grind metal expansion joints. Do not reduce the concrete cover over reinforcing steel to less than 2 inches. Retexture the surfaces of corrected areas in accordance with subsection 504.04.G of the Standard Specifications.

(1) Pavements

Unless otherwise permitted in writing by the Engineer, correct all new pavement surfaces to acceptable limits as specified below:

- Reduce pavement extents having indices in excess of acceptable limits in Table 430:1 (greater than 46.9 in/mi), not including areas defined in subsection 430.04.B.(3) “*Exception*” or 430.04.B.(4) “*Special Evaluation Requirements*,” to a Profile Index of 35.0 in/mi or less.

- Reduce surfaces having individual bumps in excess of 0.60 inch in a 25 foot span, including any areas defined as “*Exception*” (subsection 430.04.B.(3)) or “*Special Evaluation Requirements*” (subsection 430.04.B.(4)), to a Profile Index below 0.60 inch in 25 foot span.
- When an unacceptable pavement extent or bump is permitted to be excluded from correction in writing by the Engineer, the location will be considered a “ground area” for the purposes of incentive determination in accordance with 430.06 “BASIS OF PAYMENT” of this provision.

(2) Bridge Decks and Approach Slabs

Unless otherwise permitted in writing by the Engineer, correct all new bridge decks and approach slabs to acceptable limits as specified below:

- Reduce extent of bridge decks and approach slabs having indices in excess of acceptable limits in Table 430:3 Class I to a Profile Index of 36.0 in/mi or less, or Table 430:3 Class II to a Profile Index of 40.0 in/mi or less as applicable.
- Reduce surfaces having individual bumps in excess of 0.60 inch in a 25 foot span to a Profile Index below 0.60 inch in 25 foot span.

430.06 BASIS OF PAYMENT

There will be no separate payment for providing and/or operating a profilograph or profilometer. Include such costs, and any other costs related to smoothness measurements or evaluations, in the price for *Contractor's Quality Control* when the proposal contains a pay item for quality control and acceptance. Otherwise include such costs in the prices of other items.

Failure to provide the information listed in subsection 430.04.A for profilogram evaluations will result in a \$500 pay deduction per instance to be applied on the pay adjustment.

The pay adjustments shown in the following tables are for extents of 528 feet in length. Pay adjustments for extents of different lengths will be reduced or increased proportionally. (i.e. adjustment for a 792 feet extent is equal to the pay adjustment from the Table multiplied by 1.5).

The pay adjustments shown in the following tables are for extents of 12 feet in width. Pay adjustments will not be made for extents of different widths.

A. Pay Adjustment for Pavements

The Department will base pay adjustments for smoothness of pavements on the initial profile indices determined before corrective actions.

The Department will base smoothness pay adjustments for pavement sections removed and replaced or overlaid as approved by the Engineer on the profile indices determined after the corrective actions, but before grinding. The Department will not increase pay for pavements with grinding.

The smoothness pay adjustment will be determined for each extent in accordance with Table 430:1 or, when applicable, Table 430:2. In the event that the pay adjustment from Table 430:2 results in less pay than that established by using Table 430:1, the adjustment will be derived from Table 430:1.

Table 430:1 SMOOTHNESS PAY ADJUSTMENTS Pavements			
Profile Index (in/mi) ² (greater than 45 mph)	Adjustment ¹ (\$ / Extent)	Profile Index (in/mi) ² (45 mph or less and ramps)	Adjustment ¹ (\$ / Extent)
15.0 or less	1,250	19.0 or less	1,250
15.1 to 25.0	3,125 - 125x	19.1 to 29.0	3,625 - 125x
25.1 to 35.0	0	29.1 to 39.0	0
35.1 to 41.0	14,000 - 400x	39.1 to 45.0	15,600 - 400x
41.1 to 46.9	32,450 - 850x	45.1 to 50.9	35,850 - 850x
47.0 or more	-7,500 ³	51.0 or more	-7,500 ⁴

Where “x” is the profile index (in/mi.)

- ¹ These pay adjustments are for 10" thick asphalt and 8" thick P.C. concrete pavements. Pay adjustments for pavements or overlays of different thicknesses will be reduced or increased proportionally, based on the typical section for the extent. (i.e. pay adjustment for a 12" P.C. concrete pavement is equal to the adjustment from the Table multiplied by 1.5).
- ² Except as noted in subsection 430.04.B.(4) pay adjustments for roadways (including ramps and service roads) will be based on posted speed limits.
- ³ Correct pavement extents with profile indices greater than 46.9 in/mi to 35.0 in/mi or less at no additional expense to the Department. The required correction will not increase payment unless deficient sections are removed or overlaid. Failure to correct to 35.0 in/mi will result in zero payment for the affected extents.
- ⁴ Correct pavement extents with profile indices greater than 50.9 in/mi to 39.0 in/mi or less at no additional expense to the Department. The required correction will not increase payment unless deficient sections are removed or overlaid. Failure to correct to 39.0 in/mi will result in zero payment for the affected extents.

TABLE 430:2 SMOOTHNESS PAY ADJUSTMENTS Overlays - No Milling Required	
Total Nominal Thickness > 1.5 inches	
Reduction in Profile Index (%)	Adjustment (\$ / Extent) ¹
90.0 or more	140
90.0 through 60.0	10x - 760
60.0 through 50.0	40x - 2,560
Less than 50.0	Unacceptable
Total Nominal Thickness ≤ 1.5 inches	
Reduction in Profile Index (%)	Adjustment (\$ / Extent) ¹
85.0 or more	140
85.0 through 55.0	10x - 710
55.0 through 45.0	40x - 2,360
Less than 45.0	Unacceptable

Where “x” is the reduction in the Profile Index (%)

- ¹ The above adjustments are for 1" thick asphalt or concrete overlays. Adjustments for overlays of different thicknesses will be reduced or increased proportionally, based on the typical section for the extent (i.e. adjustment for a 2" overlay is equal to the adjustment from the Table multiplied by 2).

B. Pay Adjustments for Bridge Decks and Approach Slabs

For those sections corrected or ground in a manner approved by the Engineer pay adjustments for smoothness of bridge decks will be based on the profile indices determined after corrective actions. Pay for a bridge deck or approach slab extent that is corrected or ground for any reason will be limited to a maximum of full pay, including extents whose profile indices would otherwise justify incentive pay.

For projects with multiple bridges, the bridges will be evaluated independently. Corrective action on any bridge will not affect the pay adjustment on any other bridge.

The smoothness pay adjustments will be determined for each extent in accordance with Table 430:3.

TABLE 430:3 SMOOTHNESS PAY ADJUSTMENTS Bridge Decks and Approach Slabs	
CLASS I	
Profile Index (in/mi)	Adjustment (\$ / Extent) ^{1,3}
6 or less	7,500
6.1 through 24	10,500 - 500 <i>x</i>
24.1 through 36	55,500 - 2,375 <i>x</i>
More than 36	Unacceptable ²
CLASS II	
10 or less	7,500
10.1 through 24	12,850 - 535 <i>x</i>
24.1 through 40	45,010 - 1,875 <i>x</i>
More than 40	Unacceptable ²

Where “*x*” is the profile index (in/mi.)

- ¹ These adjustments for the bridge decks and approach slabs are independent of thickness of the bridge deck.
- ² Failure to correct to maximum acceptable profile index will result in zero payment for the affected extents.

