

October 20, 2016

REVISION OF SECTION 105 PORTLAND CEMENT CONCRETE PAVEMENT SMOOTHNESS

NOTICE

This is a standard special provision that revises or modifies CDOT's *Standard Specifications for Road and Bridge Construction*. It has gone through a formal review and approval process and has been issued by CDOT's Project Development Branch with formal instructions for its use on CDOT construction projects. It is to be used as written without change. Do not use modified versions of this special provision on CDOT construction projects, and do not use this special provision on CDOT projects in a manner other than that specified in the instructions unless such use is first approved by CDOT's Standards and Specifications Unit. The instructions for use on CDOT construction projects appear below.

Other agencies which use the *Standard Specifications for Road and Bridge Construction* to administer construction projects may use this special provision as appropriate and at their own risk.

Instructions for use on CDOT construction projects:

Use on all projects having concrete pavement. The designer will specify the roadway pavement smoothness category in the General Notes if it is not MRI Category II. The instructions for determining the pavement smoothness category and traffic control for the Department's Quality Assurance portion of this specification are in Design Bulletin 2011-3, Revised May 8, 2014.

Note: This specification requires a Force Account item for incentive payment.

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Section 105 of the Standard Specifications is hereby revised for this project as follows:

Delete subsection 105.08 and replace with the following:

105.08 Conformity to Roadway Smoothness Criteria of Portland Cement Concrete Pavement. Roadway smoothness testing and corrective work shall be performed as described below. The pavement smoothness category shall be MRI Category II unless shown on the plans. At least 2 weeks prior to the pre-paving conference the Contractor may request a change to the pavement smoothness category based on the CDOT's Design Bulletin guidelines for assigning pavement smoothness categories https://www.codot.gov/business/designsupport/bulletins_manuals/design-bulletins/. The Contractor shall not assume a change will be granted and be prepared to build the pavement according to the assigned smoothness category.

(a) *Smoothness Quality Control Testing.*

1. The Contractor shall perform Smoothness Quality Control (SQC) testing. A profile shall be taken for each day's paving within 24 hours after the concrete has achieved sufficient strength. The Contractor shall not perform the SQC testing until after the concrete has attained a compressive strength of 1,000 psi if a light weight profiler is used or 2,000 psi if a high speed profiler is used. The test results shall be submitted to the Engineer within 48 hours of completion. SQC test results shall show the Mean Roughness Index (MRI) for each 0.10 mile.

All traffic control costs associated with SQC testing will be paid for in accordance with Section 630.

SQC testing shall be performed using the Contractor's inertial profiler, pursuant to the methods described in subsection 105.08(b) and in accordance with the manufacturer's recommendations. The Contractor's Profiler shall be certified according to CP 78. A list of certified profilers is located at <https://www.codot.gov/business/designsupport/materials-and-geotechnical/pave-smooth-testing/2016-certified-profilers/view>.

Production shall be suspended if SQC testing indicates that corrective work is required in accordance with subsection 105.08 (c). If the SQC data becomes available after production has started for the day, suspension will begin at the end of that production day. Production will remain suspended until the problem is identified and corrected. Each time production is suspended, corrective actions shall be proposed in writing by the Contractor. Production will not be allowed to resume until the proposed corrective actions have been accepted by the Project Engineer in writing.

When production resumes, the Contractor shall profile the day's paving. The conditions above for suspension of work will apply.

2. The finished transverse and longitudinal surface elevation of the pavement shall be measured using a 10 foot straightedge. Areas to be measured will be directed by the Engineer. The Contractor shall furnish an approved 10 foot straightedge, depth gauge and operator to aid the Engineer in testing the pavement surface. Areas showing high spots of more than 3/16 inch in 10 feet shall be marked and diamond ground until the high spot does not exceed 3/16 inch in 10 feet.
3. No more than 5 working days prior to the Department's Initial Acceptance (SA) Testing, the Contractor shall profile each lane 3 times following the procedures in Subsection 105.08 (b). One profile will be collected in the morning (~6:00 am to 10:00 am), one profile will be collected mid-day (~12:00 pm to 4:00 pm) and one profile will be collected in the evening (~6:00 pm to 10:00 pm). The Contractor shall submit the data electronically to the Department at DOT_Profiles@state.co.us and to the Project Engineer. The Contractor will use this data to determine the best time of day for the Department perform SA Testing.

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- (b) *Initial Smoothness Acceptance Testing.* The Department will perform Smoothness Acceptance Testing (SA) which will be used for acceptance and calculation of incentive adjustments.

All traffic control costs associated with SA testing will be paid for in accordance with Section 630.

1. Longitudinal Pavement Surface Smoothness Acceptance. Pavement surfaces shall be tested and accepted for longitudinal smoothness as described herein.
 - A. Testing Procedure (General). The longitudinal surface smoothness of the final pavement surface shall be tested by the Department in accordance with CP 74 and using the Department's high-speed profiler (HSP).

The Contractor shall lay out a distance calibration site. The distance calibration site shall be located no more than ten miles from the Project limits. The distance calibration site shall be 1056 feet long and shall be on a relatively flat, straight section of pavement as approved by the Engineer. The site shall have a speed limit equal to the Project's highest speed limit that allows for the HSP to operate uninterrupted. The limits of the site shall be clearly marked and the distance shall be measured to an accuracy of +/- 3 inches. The Contractor shall provide in writing the site location to the Engineer. The cost of the distance calibration site will not be measured and paid for separately, but shall be included in the work.

The entire length of each through lane, climbing lane and passing lane including bridge approaches, bridge decks and intersections from the beginning to the end of the project shall be profiled in their planned final configuration. Shoulders less than 12 foot in width and medians will not be profiled and will not be subject to incentive adjustments. Shoulders with a width of 12 feet or greater, ramps, tapers, turn slots, acceleration lanes and deceleration lanes will be profiled, but will not be subject to incentive adjustments. Shoulders with a width of 12 feet or more, ramps, tapers, turn slots, acceleration lanes and deceleration lanes will be evaluated for MRI and shall require corrective work if a 0.10 mile or fraction thereof section exceeds an MRI greater than 100.0 in/mile. The profile of the entire length of a lane shall be taken at one time. However, the Engineer should break a project into sections to accommodate Project phasing.

A sufficient distance shall be deleted from the profile to allow the profiler to obtain the testing speed plus a 300 foot distance to stop and start when required. Incentive adjustments will not be made for this area. The final surface of these areas shall be tested in accordance with subsection 105.08(a) 2.

Shoulders less than 12 foot in width and medians constructed as part of this project shall be measured in accordance with subsection 105.08(a) 2.

The profile shall include transverse joints when pavement is placed by the project on both sides of the joint. When pavement is placed on only one side of the joint, the profile shall start and stop at project paving limits.

The profile of the section of pavement 25 feet outside the paving limits to 5 feet inside paving limits will be evaluated in accordance with subsection 105.08(a) 2.

The profile of the area 25 feet each side of every railroad crossing, cattle guard, bus pad, manhole, gutter pan and intersection (where there is a planned breakpoint in the profile grade line in the direction of traffic) shall be deleted from the profile before the MRI is determined. Incentive adjustments will not be made for these areas. Areas deleted from the profile shall be tested in accordance with subsection 105.08(a) 2.

When both new pavement and a new bridge or new bridge pavement are being constructed in a project, the profile of the area 25 feet each side of the bridge deck shall be deleted from the profile

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before the MRI is determined. Incentive adjustments will not be made for this area. Areas deleted from the profile shall be tested in accordance with subsection 105.08(a) 2. Corrective work required in these areas will not be measured and paid for separately, but shall be included in the work. For all other projects, the profile of the area 25 feet each side of the bridge deck shall be deleted from the profile before the MRI is determined. Incentive adjustments will not be made for this area. If the Engineer determines that corrective work is required in this area, payment will be made in accordance with subsection 109.04.

- B. Smoothness Testing Procedures. The Contractor shall submit a Method for Handling Traffic (MHT) to the Engineer for approval at least ten days in advance of SA testing. The MHT shall detail the methods for traffic control that will allow for continuous non-stop profiling of each lane to be profiled at a minimum speed of 15 mph and for the placement of triggers. The Contractor shall provide the traffic control in accordance with the approved MHT. SA testing will not be performed without an approved MHT

The Contractor shall mark the profiling limits and excluded areas. The Engineer will verify that the Contractor's marks are located properly. The Department will use traffic cones with reflective tape or reflective tape on the pavement at the beginning and end of each lane for triggering the start and stop locations on the profiler and at any other location, where portions of the profile are being excluded. The Contractor shall provide sufficient traffic control for the Department to safely place the traffic cones or reflective tape.

The ambient temperature shall be at least 34 °F for the profiler to operate.

The Contractor shall clear the lanes to be tested of all debris before profiling.

Each lane will be profiled at least once. Profiling will be at a constant speed (+/- 5 mph of the distance calibration speed) with a minimum speed of 15 mph and a maximum speed of 70 mph. Shoulders with a width of 12 feet or more, ramps, tapers, turn slots, acceleration lanes and deceleration lanes shall be profiled. The profile will be taken in the planned direction of travel. The left and right wheel paths will be profiled simultaneously. The collected profiles will be analyzed using CP 74.

The Department will determine a MRI for each 0.1 mile section or fraction thereof of completed pavement. The MRI consists of the left and right wheel path's profile passed through the International Roughness Index (IRI) filter. The IRI for the left and right wheel paths will be averaged to determine MRI.

The SA test results will be available within ten working days of the completion of SA testing. The Engineer will give the Contractor a report that will include the lane profiled, the MRI in 0.10 mile increments and a summary of areas requiring corrective work. The Engineer may determine that it is necessary to re-profile a lane.

Areas requiring corrective work will be determined according to subsection 105.08(c)

Sections less than 0.005 miles in length shall not be subject to corrective work as specified by Table 105-10. Sections less than 0.005 miles in length shall be evaluated in accordance with subsection 105.08(a) 2.

- C. Acceptance and incentive adjustments for pavement smoothness will be made on a square yard basis in accordance with the following:

Incentive adjustments will be based on the MRI for each 0.1 mile section or fraction thereof. Incentive adjustments for Pavement Smoothness will be made in accordance with Table 105-10.

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Incentive payments will not be made until all sections requiring corrective work have been corrected.

**Table 105-10
 PCCP SMOOTHNESS (INCHES/MILE)
 MEAN ROUGHNESS INDEX**

Pavement Smoothness Category	Maximum Incentive Payment (\$/sqyd)	Incentive Payment (\$/sqyd)	No Incentive	Corrective Work Required (0.10 mile sections)
I	MRI ≤ 46.0 I = \$2.80	MRI > 46.0 and < 73.0 I = 7.57 – 0.1037 MRI	MRI ≥ 73.0 and ≤ 88.0	MRI > 88.0
II	MRI ≤ 40.0 I = \$2.80	MRI > 40.0 and < 67.0 I = 6.948 – 0.1037 MRI	MRI ≥ 67.0 and ≤ 82.0	MRI > 82.0
III	MRI ≤ 52.0 I = \$2.80	MRI > 52.0 and < 80.0 I = 8.00 – 0.100 MRI	MRI ≥ 80.0 and ≤ 97.0	MRI > 97.0

**Table 105-11
 CORRECTIVE WORK CRITERIA (INCHES/MILE)
 0.005 TO 0.10 MILE SECTIONS
 MEAN ROUGHNESS INDEX**

Pavement Smoothness Category	Corrective Work Required D = Section Length (miles)
I	MRI > 134.32 – 463.16 D
II	MRI > 125.16 – 431.58 D
III	MRI > 148.05 – 510.53 D

(c) *Corrective Work.*

The Department will analyze the SA testing for acceptance and indicate areas requiring corrective work in accordance with subsection 105.08(b). Corrective work shall be proposed in writing by the Contractor. Corrective work shall not be performed until approved in writing by the Engineer. The Contractor shall perform corrective work in the areas indicated by the SA testing.

The Contractor shall profile the roadway to demonstrate the required corrective work has been completed.

If the Contractor elects to perform corrective work prior to the completion of initial SA testing, the entire 0.10 mile section, or fraction thereof, will not be eligible for incentive payment. The Engineer will not modify the limits of the 0.10 mile sections to group corrective work areas in an effort to reduce the number of sections impacted by this decision.

The criteria for determining if a 0.1 mile section requires corrective work is specified in Table 105-10. The criteria for determining if a section less than 0.10 miles in length and greater than 0.005 miles in length requires corrective work is specified in Table 105-11.

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Corrective work shall consist of diamond grinding. Diamond Grinding. Grinding shall not reduce planned pavement thickness by more than 0.3 inches. Diamond grinding shall be the full width of a wheel path, the wheel path is from the stripe to the center of the lane. When any grinding on concrete pavement occurs where a core for determining pavement thickness has been previously taken, another core shall be taken after the grinding has been completed and shall replace the original core in the calculation of pavement thickness incentive and disincentive. Joint sealant that has been damaged by grinding on concrete pavement shall be repaired or replaced at the Contractor's expense in accordance with Standard Plan M-412-1 and subsection 412.18. Cores shall be taken to verify that minimum pavement thicknesses have been maintained. A minimum of one core shall be taken every 100 cumulative feet or fraction thereof per lane of diamond grinding, as directed by the Engineer. Coring shall be at the Contractor's expense.

The grinding process shall produce a pavement surface that is true to grade and uniform in appearance. The grooves shall be evenly spaced. Any ridges on the outside edge next to the shoulder, auxiliary, ramps or adjacent lanes greater than 3/16 inch high shall be feathered out to the satisfaction of the Engineer in a separate, feather pass operation.

The pavement surface after grinding shall have no depressions or misalignment of slope in the longitudinal direction exceeding 1/8 inch in 12 feet when measured with a 12 foot straightedge placed parallel to the centerline. All areas of deviation shall be reground at no additional cost.

Diamond ground surface texture will be considered acceptable when the average texture depth (ATD) of the panel is greater than 0.05 inch. The Contractor will perform surface texture testing in accordance with CP 77 Method B. Each area in a lane that required diamond grinding will be tested at least once. Areas in a lane with more than 500 continuous feet of grinding will be tested at a frequency of 1 test per 500 linear feet. Areas with deficient surface texture shall be diamond ground and retested.

The slurry and residue resulting from the grinding operation shall not be allowed to flow across lanes occupied by the traffic and shall be continuously removed during the grinding operation, leaving the pavement in a clean condition. The Contractor shall haul the grinding residue to a suitable location at an approved location at no additional cost.

- (d) *Final Smoothness Acceptance Testing.* After the Contractor has completed the required corrective work the Department will retest the pavement in accordance with subsection 105.08(b). Final SA testing will only be required on lanes with sections requiring corrective work. Final SA testing will start and stop at the same locations as the Initial SA testing. If additional corrective work is required, the Contractor shall perform the corrective and additional Final SA Testing will be performed by the Department. Time count will be charged pursuant to contract requirements during the time period required for all Final SA Testing. Delays associated with additional Final SA Testing will be considered non-excusable and non-compensable.

The Contractor shall notify the Engineer pursuant to 105.08(b) to schedule the final SA testing.

Final acceptance and incentive adjustments for pavement smoothness will be made on a square yard basis in accordance with the following:

Incentive payments will be based on the MRI for each 0.1 mile section or fraction thereof from the Department's initial SA testing.

Those sections requiring corrective work indicated by the initial SA testing, will be re-evaluated; however, no incentives may be earned in these areas, regardless of the final smoothness.