

**REVISION OF SECTIONS 105, 412 and 601
PCCP ROADWAY SMOOTHNESS
(HIGH SPEED PROFILER)**

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 portland cement concrete pavement.

HRI Category I is for construction that will be affected by curb & gutter, intersections and utility boxes. Not to be used for Interstates or express ways.

HRI Category II is for rural construction and interstate construction.

The designer will list the smoothness category in the General Notes of the plans. Multiple smoothness categories may be assigned for sections of the pavement.

The Designer will set up a planned force account for pavement smoothness based on the maximum incentive possible for the project.

Projects may be broken into different sections with different pavement smoothness categories instead of using the easier pavement smoothness category for the whole project.

If the designer intends for shoulders to be future driving lanes, a note needs to be added in the General Notes stating whether or not these future driving lanes are subject to incentive/disincentive payments.

The Designer will estimate the required number of Flagging Hours, Traffic Control Supervision, Traffic Control Devices and Uniformed Traffic Control necessary to implement the Department's Quality Assurance portion of this specification. The designer will include these quantities in the quantities table to be bid.

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Sections 105, 412 and 601 of the Standard Specifications are hereby revised for this project as follows:

Delete subsection 105.07 and replace with the following:

105.07 Conformity to Roadway Smoothness Criteria. Roadway smoothness testing and corrective work shall be performed as described below. The pavement smoothness category shall be HRI Category II unless shown on the plans.

(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 Half Car Roughness Index (HRI) for each 0.10 mile section and the results for localized roughness

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 105.07(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 <http://www.dot.state.co.us/DesignSupport/>

Production shall be suspended when SQC testing indicates that corrective work is required in accordance with subsection 105.07 (c). **If the SQC data becomes available after production has started for the day, work will be allowed to continue until 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 and approved by the Engineer.

When production resumes, the Contractor shall profile the first half mile of 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 shall be as directed by the Engineer. The Contractor shall furnish an approved 10 foot straightedge and depth gauge and provide an operator to aid the Engineer in testing the finished 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. When longitudinal tining is required on concrete pavement, the pavement shall be grooved to restore the longitudinal texture (tining) as shown in the plans and specifications.

(b) *Initial Smoothness Acceptance (SA) Testing.* The Department's smoothness testing results will be used for acceptance and calculation of incentive and disincentive payments.

All traffic control costs associated with SA testing will be paid for by the Department 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 and evaluated by the Department in accordance with CP 74 using the Department's high-speed profiler (HSP).

The HSP instrumentation will be verified in accordance with CP 74 prior to measurements. 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

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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 Contractor shall notify the Engineer in writing at least 10 working days in advance to schedule SA testing. The Engineer will not schedule pavement smoothness testing if the Contractor has not submitted SQC results.

The Contractor shall notify the Department at least 48 hours prior to the scheduled SA testing date when the smoothness testing needs to be cancelled for any reason. The Contractor shall be charged \$500 for failure to meet this requirement and rescheduling is required. The Engineer may waive the \$500 charge if re-scheduling is a result of weather or at the convenience of the Department.

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. Shoulders less than 12 foot in width and medians will not be profiled and will not be subject to incentive/disincentive adjustments. Shoulders with a width of 12 foot or more, ramps, tapers, turn slots, acceleration lanes and deceleration lanes will be profiled, but will not be subject to incentive/disincentive adjustments. Shoulders with a width of 12 foot or more, ramps, tapers, turn slots, acceleration lanes and deceleration lanes will be evaluated for localized roughness corrective work. The profile of the entire length of a lane shall be taken at one time. However, the Engineer may 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/disincentive payments will not be made for this area. The final surface of these areas shall be tested in accordance with subsection 105.07(a) 2.

Shoulders less than 12 foot in width and medians constructed as part of this project shall be measured in accordance with subsection 105.07(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 5 feet outside the project paving limits.

The profile of the area 25 feet each side of every manhole, railroad crossing, cattle guard, gutter pan and intersection (where there is a planned breakpoint in the profile grade line in the direction of testing) shall be deleted from the profile before the HRI is determined. Incentive/disincentive payments will not be made for these areas. Areas deleted from the profile shall be tested in accordance with subsection 105.07(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 every bridge expansion device shall be deleted from the profile before the HRI is determined. Incentive/disincentive payments will not be made for this area. Areas deleted from the profile shall be tested in accordance with subsection 105.07(a) 2. **The bridge deck will not be subject to incentive/disincentive payments, but will be evaluated for localized roughness.** 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 every bridge expansion device shall be deleted from the profile before the HRI is determined. Incentive/disincentive payments 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.

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- B. Smoothness Testing Procedures. The Contractor shall submit a Method for Handling Traffic (MHT) to the Engineer for approval at least 10 working days prior to the smoothness test or longer as determined by the Engineer. The MHT shall detail the methods for traffic control that shall allow for continuous non-stop profiling of each lane to be profiled at a minimum speed of 15 mph. The Contractor shall provide the traffic control in accordance with the 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 deleted. The Contractor shall provide sufficient traffic control for the Department to safely place the traffic cones or reflective tape.

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

Each lane will be profiled three times at a constant speed (+/- 5 mph) with a minimum speed of 15 mph and a maximum speed of 70 mph. Shoulders with a width of 12 foot or more, ramps, tapers, turn slots, acceleration lanes and deceleration lanes will be profiled once. The profile will be taken in the intended 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 HRI for each 0.1 mile section or fraction thereof of completed pavement. The HRI consists of the average of the left and right wheel path's profile passed through the International Roughness Index (IRI) filter.

The Department's SA test results will be available within five working days of the completion of testing. The Engineer will give the Contractor a report that will include the HRI 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 105.07(c) The third run of each lane will be used for the determination of Localized Roughness.

Sections less than 0.01 miles in length shall not be subject to corrective work as specified by Table 105-6. Sections less than 0.01 miles in length shall be included in the Localized Roughness determination.

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

Incentive and Disincentive payments will be based on the HRI for each 0.1 mile section or fraction thereof.

Incentive/Disincentive payments for Pavement Smoothness will be made in accordance with Table 105-6. Sections less than 0.01 miles in length will not be subject to disincentive payments. The profile of the section of pavement 5 feet outside the paving limits to 25 feet inside paving limits will not be subjected to incentive or disincentive payments, but will be evaluated for localized roughness.

Disincentive payments for Pavement Smoothness for each 0.1 miles section or fraction thereof will be one half of the values listed in Table 105-06 for projects awarded prior to January 1, 2014.

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**Table 105-6
PCCP PAVEMENT SMOOTHNESS (INCHES/MILE)
HALF-CAR ROUGHNESS INDEX**

Pavement Smoothness Category	Incentive Payment (\$/sqyd)	No Incentive or Disincentive	Disincentive Payment (\$/sqyd)	Corrective Work Required
I	When HRI ≤ 40.0 I = \$1.40	When HRI ≥ 63.0 and ≤ 72.0 I = \$0.00	When HRI > 72.0 and < 90.0 I = 5.59 – 0.0776 HRI	When HRI > 90.0
	When HRI > 40.0 and < 63.0 I = 3.84 – 0.061 HRI		When HRI ≥ 90.0 I = – \$ 1.40	
II	When HRI ≤ 35.0 I = \$ 1.40	When HRI ≥ 58.0 and ≤ 67.0 I = \$0.00	When HRI > 67.0 and < 85.0 I = 5.20 – 0.0776 HRI	When HRI > 85.0
	When HRI > 35.0 and < 58.0 I = 3.53 – 0.061 HRI		When HRI ≥ 85.0 I = – \$ 1.40	

- (c) *Corrective Work.* The Department will analyze the initial SA testing for acceptance and indicate areas requiring corrective work in accordance with subsection 105.07(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 not perform any corrective work on the pavement until after the Engineer returns the results of the initial SA testing.** The Contractor shall perform corrective work in the areas indicated by the SA testing.

The Contractor shall profile the roadway to verify that 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 but will be eligible for disincentive. 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 Contractor may elect to perform additional corrective work to reduce or eliminate the disincentive payment for each 0.1 mile section or fraction thereof after the Departments initial SA testing.

The criteria for determining if a 0.1 mile section or fraction thereof requires corrective work is specified in Table 105-6. In addition to determining if a 0.1 mile section or fraction thereof requires corrective work, the profiles shall be analyzed for areas of Localized Roughness.

Localized Roughness. The profiles shall be analyzed to determine where areas of Localized Roughness occur. The profile shall be summarized using the continuous HRI reporting system using an averaging length of 25 feet. The FHWA's ProVal (Version 2.7 or later) software shall be used to generate the continuous HRI report. ProVal can be downloaded at <http://www.roadprofile.com>.

Areas shall be considered deficient, and require corrective work where the continuous HRI report exceed the values in Table 105-9. Areas of localized roughness less than 25 feet in distance that contain a valve box shall be tested in accordance with subsection 105.07 (a) 2. for corrective work.

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Table 105-9
CONTINUOUS HRI USING 25 FOOT AVERAGING FOR LOCALIZED
ROUGHNESS CORRECTIVE WORK ON PCCP PAVEMENTS

HRI SMOOTHNESS CATEGORY	HRI In/mile
I	135.0
II	125.0

Corrective work on concrete pavements shall consist of diamond grinding.

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. When longitudinal tining is required on concrete pavement, the pavement shall be grooved to restore the longitudinal texture (tining) as shown in the plans and specifications.

- (d) *Final Smoothness Acceptance Testing.* After the Contractor has completed the required corrective work and any additional corrective work, the Department will retest the pavement in accordance with subsection 105.07(b). **If the Contractor requests to do additional corrective work to reduce disincentive after Final SA Testing, the Department will perform an additional Final SA Testing for the project. A charge of \$500 will be assessed to the Contractor for each additional trip to the project required to perform additional Final SA Testing. 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 105.07(b) to schedule the final SA testing.

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

Incentive payments will be based on the HRI for each 0.1 mile section or fraction thereof from the Department's initial SA testing. Those sections which earned incentives or full payment based on the initial SA testing will not be re-evaluated for incentive after final SA testing.

The disincentive payment will be based on the HRI for each 0.1 mile section or fraction thereof from the Department's Initial SA testing or the Department's Final SA testing, whichever is less. Those sections which had disincentive levels indicated by the initial SA, will be re-evaluated for disincentive. The Contractor may eliminate disincentives on those 0.1 mile sections; however, no incentives may be earned in these areas, regardless of the final smoothness.

Delete the second sentence of subsection 412.17

Delete subsection 601.15 (f) 2. and Table 601-2.

Subsection 3.2.1 of CP 78 has been changed to state the following:

3.2.1 The High Speed Profiler (HSP) shall meet the specifications of AASHTO MP 11-03 except that profilers used to measure the smoothness on concrete pavement shall have approved line lasers with at least a three inch wide foot print.