



# Construction Policy Bulletin

## CPB 13-2 Inertial Profiler Construction Inspection Guidance

References:	2010 <i>Standard Specifications</i>	Section 51, "Concrete Structures"
	<i>Construction Manual</i>	Section 4-39, "Hot Mix Asphalt" Section 4-40, "Concrete Pavement"
	2010 Standard Special Provisions	Section 39-1.12, "Smoothness" Section 40-1, "General"

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Approved:   
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### Background

The Department of Transportation (Caltrans) is transitioning from measuring smoothness of pavements with the California Profilograph to inertial profilers. Improvements in technology combined with benefits in terms of safety and cost have made inertial profilers a preferable method of measuring pavement smoothness.

Pavement projects advertised after February 22, 2013 will contain inertial profiler specifications for determining international roughness index (IRI), mean roughness index (MRI), and areas of localized roughness to ensure pavements meet smoothness requirements. Similar to previous smoothness specifications, certain specified areas will be exempt from the inertial profiler requirements, but will be subject to straightedge requirements.

Surface smoothness of concrete structures will continue to be determined using the bridge profilograph in accordance with Section 51, "Concrete Structures," of the *Standard Specifications*.

### Existing Procedure

Sections 4-39, "Hot Mix Asphalt," and 4-40, "Concrete Pavement," of the *Construction Manual* provide existing policy and procedures for determining pavement smoothness. Existing guidance relies on information contained in California Test Method 526, "Method of Test for Operation of California Highway Profilograph and Evaluation of Profiles."

## **New Procedure**

### Before Work Begins

Before work begins, take the following steps:

- Review contract provisions and determine whether grinding and profiling of existing pavements is required prior to placing hot mix asphalt (HMA) overlays or paving adjacent lanes. Separate bid items will be included for this work on existing pavements.
- Review the contract and determine which portions of new pavement will be subject to the inertial profiler requirements and which portions will be subject to straightedge requirements.
- Ensure project staff are knowledgeable in advance on the use of ProVAL software for analyzing contractor's submitted raw profile data. Inertial profiler training, including use of ProVAL software, has been developed and delivered to Caltrans staff in districts and regions across the state. Continuing training classes and on-line training modules are anticipated.
- Discuss pavement smoothness requirements, including submittals, at the preconstruction conference with the contractor.
- Verify that the inertial profiler certification for the equipment and operator has been submitted and complies with specification requirements. Verify that the operator has been certified for the type of inertial profiler being used. Note that the inertial profiler equipment must display a current certification decal with expiration date.
- Ensure the contractor has provided a list of the manufacturer's recommended test procedures for inertial profiler calibration and verification.

### During the Course of Work

During the work, take the following steps:

- Immediately prior to the contractor performing quality control testing for pavement smoothness, the inertial profiler calibration and verification testing must be performed. The calibration and verification testing is to be performed each day in the engineer's presence before inertial profiling begins. Included in this testing are the following:
  - Block test—to verify the height sensor accuracy in accordance with the American Association of State Highway and Transportation Officials (AASHTO) R57-10, Section 5.3.2.3.
  - Bounce test—to verify the combined height sensor and accelerometer accuracy in accordance with AASHTO R57-10, Section 5.3.2.3.2.
  - Distance measurement instrument test—to verify the distance measurement accuracy in accordance with AASHTO R56-10, Section 8.4.
  - Any other manufacturer's recommended daily tests.
- Prior to the contractor performing quality control testing for pavement smoothness, a cross correlation inertial profiler verification test must be performed successfully in the presence of the engineer. This test must be performed at least once per project in advance of the initial profiling, and annually thereafter. The test is meant to demonstrate the repeatability of the data acquisition system by conducting 5 repeat runs on

an authorized test section of 0.1 miles in length. The cross correlation is performed under AASHTO R56-10, Section 8.3.1.2, and the minimum acceptable correlation is 0.92.

- Ensure the inertial profiler uses a minimum 4-inch line laser to obtain profile measurements for concrete pavements.
- Ensure the contractor has removed foreign objects from the pavement surface prior to performing profiling.
- Once inertial profiling begins, ensure the contractor is accurately locating the beginning and ending stationing on the pavement shoulder. This information is needed to properly identify the profile data in conformance with the specified naming convention and to ensure Caltrans' acceptance testing can be compared to the contractor's quality control testing. Reject any profile data that does not conform to the specified naming convention. Also take special note of begin and end stationing of all approach slabs, bridges, and visible surface culverts as these areas will be excluded from analysis when using the ProVAL software.
- The contractor is required to submit profiling data within two business days of each day of inertial profiling. This information is submitted to the engineer and to the [smoothness@dot.ca.gov](mailto:smoothness@dot.ca.gov) electronic mailbox address. The profiling data will include the raw profile data for each lane and the following:
  - ProVAL ride quality analysis report for the IRI of left and right wheel paths of each lane in portable document file (PDF) format.
  - ProVAL ride quality analysis report for the MRI of each lane in PDF format. Note that the MRI is simply the average of the IRI values of the left and right wheel paths.
  - ProVAL smoothness assurance analyses reports for the IRIs of each wheel path in PDF format. Note that this information will identify areas of localized roughness that must be corrected.
  - Global positioning system data file for each lane in global positioning system eXchange file format.
  - AASHTO inertial profiler calibration and verification test results including bounce, block, distance measurement instrument, and manufacturer's recommended tests.
- Using the ProVAL software, contractor's raw profile data, and exclusion limits (for example, bridge stationing), determine IRIs of each wheel path and MRIs of each lane in 0.1-mile pavement sections as well as areas of localized roughness. When determining IRIs, ensure the ProVAL ride quality analysis utilizes a 250-milimeter filter. The ProVAL ride quality analysis will also be used to determine the MRIs by averaging the IRI values from the left and right wheel paths. Note that ProVAL will proportionally adjust the IRI and MRI values for pavement sections less than 0.1 mile in length. When determining areas of localized roughness, ensure the ProVAL smoothness assurance is run with a continuous IRI for each wheel path, a 25-foot interval, and 250-milimeter filter. Compare these reports to those provided by the contractor and identify pavement sections that do not meet specification requirements for MRI or areas of localized roughness.
- Areas exempt from inertial profiler requirements must be straightedged by the contractor and meet specified requirements. The contractor is required to submit areas requiring smoothness correction in conformance with the specifications.
- Prior to authorizing the contractor's corrective plan, ensure that any specified pavement curing and strength requirements have been met prior to grinding.

- Ensure that the entire lane width is ground at lines perpendicular to the roadway centerline to produce a uniform texture and appearance within the corrected area. Ensure residue from the grinding operations is handled and disposed of properly.
- Where corrections are made within areas where testing with a 12-foot straightedge is required, the contractor is required to retest the corrected areas with a straightedge. These retests will often be performed immediately after the grinder has performed the corrective work. Verify straightedge requirements are met by visual observation of the contractor's retesting.
- Where corrections have been made on areas where testing with an inertial profiler is required, ensure the contractor retests the entire lane length with an inertial profiler conforming to these requirements. Verify that the corrective lane has met MRI and areas of localized roughness requirements by analyses with ProVAL software. Verify that the contractor has submitted the corrected profiling data to the [smoothness@dot.ca.gov](mailto:smoothness@dot.ca.gov) electronic mailbox address.
- Once the contractor has provided profile data that shows MRI and areas of localized roughness requirements have been met, contact the district materials engineer to arrange for Caltrans' smoothness acceptance testing. Efforts should be made to avoid piecemeal smoothness acceptance testing due to limited availability of Caltrans inertial profiler vehicles and operators. Ensure smoothness acceptance testing is performed on pavements as early as practical, but definitely prior to any relief of maintenance or contract acceptance. Attempt to provide at least three weeks advance notice to the district materials engineer to allow for proper scheduling of inertial profiler equipment and personnel. Obtain copies of Caltrans inertial profiler equipment and operator certifications to file within the project records.
- Ensure project staff are available to assist Caltrans inertial profiler smoothness testing personnel with stationing limits of inertial profiling and excluded areas.
- Obtain the Caltrans inertial profiler smoothness testing reports and compare IRI values with the contractor's testing reports. When the contractor's results differ by more than 10 percent from Caltrans' IRI values, investigate why this has occurred. Determine if the contractor's inertial profiler equipment should be recalibrated and the section reprofiled. If the contractor's results are inaccurate due to operator error, disqualify the inertial profiler operator until recertification is obtained.
- In the absence of complete Caltrans inertial profiler testing of pavement areas, the contractor's inertial profiler testing may be used to accept pavement smoothness if there is an acceptable correlation on areas that received both Caltrans and contractor inertial profiler testing.

#### Payment

- Performance of straightedge and inertial profiler testing, smoothness corrections, and retesting are included in the price paid for the new pavement.

#### Special Considerations

- Certain HMA pavement projects may contain thin lifts or open graded friction course (OGFC) placed on different prepared surfaces that impact acceptable MRI values and could result in the need for inertial profiling of different surface layers. For example, if OGFC is placed on a newly constructed HMA overlay, there will be an MRI value requirement on the HMA surface and an MRI value requirement on the OGFC. Inertial profiler testing must be performed on the HMA surface to verify smoothness requirements have been met prior to placing the OGFC and checking final surface smoothness requirements. Likewise, areas of localized roughness on the HMA surface would require testing, correction, and retesting prior to placement of OGFC and checking the final surface for areas of localized

roughness. Begin and end stationing for profiling must be the same when profiling more than one surface. These requirements are identified in the specifications.

- Where OGFC surfaces receive corrective grinding, assess the ground surface and determine if raveling is an issue. OGFC that is raveling must be removed and replaced.
- Smoothness correction of the final pavement surface must leave at least 75 percent of the specified HMA thickness. Where concerns on thickness are noted, order cores to verify at least 75 percent of the specified thickness remains. Costs for coring, including traffic control are change order work. If cores show less than 75 percent of the specified thickness, order removal and replacement of the deficient pavement areas.
- On ground areas not to be overlaid with OGFC, apply a fog seal coat in accordance with Section 37-2 of the *Standard Specifications*.
- For jointed plain concrete pavements subject to inertial profiler smoothness requirements, consider the ambient temperature conditions and their potential impacts when comparing the contractor's and Caltrans' IRI values from inertial profiler smoothness testing. Significant variability in temperatures between when the tests occurred may impact the IRI values due to slab curl. These affects will be more recognizable on slabs without dowel bars.
- Where concrete pavements specify construction of test strips, smoothness is initially assessed by means of straightedge measurements. In instances where the test strip will be part of the project's pavement, the test strip portion must conform to the project's pavement smoothness requirements and be included in the final inertial profilogram as specified.

If you have any questions or comments regarding this bulletin, please contact Ken Darby, Division of Construction, at [ken\\_darby@dot.ca.gov](mailto:ken_darby@dot.ca.gov) or (916) 227-5705.