

Operating Inertial Profilers and Evaluating Pavement Profiles

AASHTO Designation: PP 50-07 (2008)¹



1. SCOPE

- 1.1. This practice describes the procedure for operating and verifying the calibration of an inertial profiler. This practice is meant to be performed as a Quality Assurance (QA) test for use with the appropriate smoothness specification for paving operations. It is not meant to be required as a Quality Control (QC) procedure to monitor daily paving operations; however, this method is recommended when inertial profilers are used for QC testing and for network level data collection. It also provides:
- evaluation procedures for the profiles that are generated, and
 - a methodology for resolution of disputes arising from suspect profiler output.

2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- MP 11, Inertial Profiler
 - MP 17, Pavement Ride Quality When Measured Using Inertial Profiling Systems
 - PP 49, Certification of Inertial Profiling Systems
 - R 43M/R 43, Quantifying Roughness of Pavements
- 2.2. *ASTM Standards:*
- E 867, Standard Terminology Relating to Vehicle-Pavement Systems
 - E 950, Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference

3. TERMINOLOGY

- 3.1. *Definitions:*
- 3.1.1. *roughness*—according to ASTM E 867, the deviation of a surface from a true planar surface with characteristic dimensions that affects vehicle dynamics and ride quality.
- 3.1.2. *longitudinal profile*—the set of perpendicular deviations of the pavement surface from established horizontal reference planes to the lane direction.
- 3.1.3. *International Roughness Index (IRI)*—a statistic used to determine the amount of roughness in a measured longitudinal profile. The IRI is computed from a single longitudinal profile using a quarter-car simulation as described in the paper, “On the Calculation of International Roughness

Index from Longitudinal Road Profile” (Sayers 1995). Computer programs to calculate the IRI statistic from a longitudinal profile are referenced in R 43M/R 43.

- 3.1.4. *report interval*—the travel distance between the outputs of a profile index value.

4. SIGNIFICANCE AND USE

- 4.1. This practice outlines standard procedures for operating inertial profilers and evaluating pavement profiles for project level QA determinations. These procedures can also be used for network-level data collection and analyses and are recommended for project-level QC determinations.

5. EQUIPMENT

- 5.1. *Minimum Requirements*—The inertial profiling system must meet all requirements and specification found in MP 11 and must be currently certified in accordance with PP 49.

Note 1—For consistent pavement profile determination, maintain air pressure on the wheels of the housing vehicle according to the manufacturer’s specification. The housing vehicle and all system components will be in good repair and proven to be within the manufacturer’s specifications. The operator of the inertial profiler shall have all tools and components necessary to adjust and operate the inertial profiler according to the manufacturer’s instructions.

- 5.2. *Repair, Adjustment, and Upgrade of Inertial Profilers:*

- 5.2.1. Major component repairs or replacement to an inertial profiler that would require the re-certification of the equipment include, but are not limited to, the following:

- the accelerometer and its associated hardware;
- the non-contact height sensor and its associated hardware;
- any printed circuit board necessary for the collection of raw sensor data or the processing of the inertial profiles and IRI;
- change of housing vehicle; or
- major repairs to housing vehicle.

The operator of the inertial profiler will be allowed to make minor adjustments to the equipment without having to complete the re-certification process as long as the adjustments allow the equipment to fulfill the verification of calibration process in Section 5.3.

- 5.2.2. Minor adjustments to the system include, but are not limited to, the following:

- inspecting, re-soldering, or replacing connectors;
- cleaning components, normal adjustments to voltage levels as required by the manufacturer; or
- setting software parameters and/or scale factors as required by the manufacturer in a routine calibration procedure.

- 5.3. *Verifying Calibration*—The following verification procedure is required for QA testing and is recommended when an inertial profiler is to be used as a QC instrument on a daily basis.

- 5.3.1. *Standards:*

- 5.3.1.1. *Horizontal:*

- 5.3.1.1.1. The horizontal or longitudinal verification standard shall be a straight and level roadway test section of at least 528 ft in length.
- 5.3.1.1.2. Measure this length accurately to within 0.05 percent using a steel survey measurement tape since the distance to be measured is the travel length the wheels encounter.
- 5.3.1.2. *Vertical:*
 - 5.3.1.2.1. The vertical measurement standard shall be flat plates or blocks of known thickness and low thermal expansion.
 - 5.3.1.2.2. Mark the blocks with the known thickness.
 - 5.3.1.2.3. As a minimum, test a smooth base plate and both a 1-in. and a 2-in. gauge block.
 - 5.3.1.2.4. Certify the block thickness accurate to within 0.001 in.
- 5.3.2. *Procedure:*
 - 5.3.2.1. *Frequency of Verifying Calibration:*
 - 5.3.2.1.1. Perform the horizontal and vertical verification of calibration of the inertial profiler prior to use on each paving project in accordance with the manufacturer's recommendation and at such times as the Owner-Agency determines that verification is necessary.
 - 5.3.2.1.2. Check the tire air pressure on the wheels of the housing vehicle at least daily and maintain according to the manufacturer's recommendations.
 - 5.3.2.1.3. Maintain a log with the inertial profiler to provide a verification of calibration history.
 - 5.3.2.2. *Horizontal Verification of Calibration:*
 - 5.3.2.2.1. Perform the horizontal (longitudinal) verification of calibration by navigating the inertial profiler over a measured test section of at least 528 ft in length.
 - 5.3.2.2.2. The inertial profiler's distance measuring subsystem, after tire and electronic warm-up in accordance with the manufacturer's recommendations, must measure the length of the test section to within 0.15 percent of its actual length.
 - 5.3.2.2.3. Adjust the inertial profiler's distance measurement subsystem according to the manufacturer's guidelines as needed.
 - 5.3.2.2.4. Failure to meet the specified tolerance, after attempts to adjust have been performed, will require re-calibration by the contractor and re-verification as described under Verifying Calibration.
 - 5.3.2.3. *Vertical Verification of Calibration:*

Block Test—Vertical height sensor check tests shall be performed in accordance with the manufacturer's recommended procedures. In the absence of manufacturer's procedures, perform the block test as described in Section 5.3.2.3.1.