
Standard Practice for

Certification of Inertial Profiling Systems

AASHTO Designation: PP 49-08 (2008)¹



1. SCOPE

- 1.1. This practice describes minimum performance requirements for inertial profilers to be used for quality control/quality assurance (QC/QA) of surface smoothness on Owner-Agency paving projects where the profile-based smoothness construction specification is applicable.
- 1.2. The practice describes a certification procedure for test equipment used to measure a longitudinal surface profile based on an inertial reference system that is mounted on a transport vehicle. The minimum requirements stipulated herein are intended to address the need for accurate and repeatable profile measurements during construction.
- 1.3. If any part of this practice is in conflict with references made, such as ASTM Standards, this practice takes precedence for its purposes.
- 1.4. *This practice does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this practice to establish appropriate safety and health practices and determine the applicability of regulatory limitations related to and prior to use.*

2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- MP 11, Inertial Profiler
 - PP 50, Operating Inertial Profilers and Evaluating Pavement Profiles
 - R 40, Measuring Pavement Profile Using a Rod and Level
 - 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
 - E 1926, Standard Practice for Computing International Roughness Index of Roads from Longitudinal Profile Measurements

3. TERMINOLOGY

3.1. *Definitions:*

- 3.1.1. *high-pass filtering*—reduces the effect of long wavelengths that are associated with gradual elevation changes such as hills.
- 3.1.2. *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.
- 3.1.3. *longitudinal profile*—the set of perpendicular deviations of the pavement surface from an established horizontal reference plane to the lane direction.
- 3.1.4. *report interval*—the travel distance between the outputs of a profile index value.
- 3.1.5. *sample interval*—the longitudinal distance between data capture points. These points may, in turn, be averaged to create a final value on the reported profile.

4. SIGNIFICANCE AND USE

- 4.1. This practice outlines standard procedures for certifying and verifying the operational accuracy and repeatability of inertial profiling equipment. It also provides guidance for qualifying equipment system operators.

5. EQUIPMENT

- 5.1. *Minimum Requirements*—The inertial profiling system must meet all requirements and specifications found in MP 11.
- 5.2. *Operating Parameters*—The inertial profiler must be capable of providing relative elevation measurements that meet the following requirements:
 - 5.2.1. *Reporting Interval*—the interval at which relative profile elevations are reported must be less than or equal to 2 in.
 - 5.2.2. *High-Pass Filter*—the algorithm for high-pass filtering the profile data shall have an undistorted response (profile amplitude and location error of less than 5 percent) for all wavelengths shorter than 150 ft when operated between 15 and 70 mph for high-speed profilers and 10 and 20 mph for low-speed profilers. It shall also have a minimum of a 30 percent reduction in profile amplitude for wavelengths longer than 300 ft. The filter will have a minimum of a 90 percent reduction for wavelengths longer than 450 ft.
- 5.3. The profiler software must also be able to calculate and report the IRI (in inches per mile and meters per kilometer) from the corresponding measured true profile and permit the operator to:

- automatically trigger the start of data collection at the designated location;
- in addition to any binary data file storage, provisions shall be made to provide the measured true profiles in electronic text files following the format prescribed by PP 50 for evaluation of profiler accuracy and repeatability; and
- verify the height and distance measurements as described herein.

6. EQUIPMENT CALIBRATION VERIFICATION

- 6.1. *General*—This section refers to two important calibration and verification procedures: the block test and the bounce test. It is highly recommended that operators perform these procedures and calibrate their distance measurement instrument (DMI) immediately prior to certification and on a regular basis during normal operation as recommended by the manufacturer. Operators are further encouraged to adhere to the procedures recommended in PP 50. The certifying agency shall provide adequate opportunity and facilities to perform these procedures, but it is the responsibility of the profiler operator to provide the needed equipment (e.g., calibration blocks, etc.).
- 6.1.1. *Block Test*—The purpose of the “block test” is to check the height measurements (in inches or millimeters) from the height sensors(s) of the test vehicle using blocks of known heights. Vertical height sensor check tests are run after the profiler has reached operational stability as specified by the manufacturer. Perform the test as described in PP 50.
- 6.1.2. *Bounce Test*—Perform a “bounce test” as a final check on the system stability. The test is performed after the equipment has reached operational stability as specified by the manufacturer. Perform the test as described in PP 50.
- 6.1.3. *Calibration Verification Log*—Maintain a log to be kept with the inertial profiler to provide a verification of calibration history. Record any repairs, replacement of components, and changes in native software version.

7. OPERATOR QUALIFICATION

- 7.1. Operators of inertial profilers used for QA testing of pavement ride quality must pass a proficiency test and be certified to operate an inertial profiler. Applicants for certification will be tested on the following:
- Owner-Agency ride smoothness specification,
 - Operating inertial profilers,
 - Collection of profile data, and
 - Evaluating quality of data collected and IRI value calculated.
- Applicants for certification shall undergo both written and practical examinations. They must pass both portions of the test to be certified. Prior to taking the proficiency test, applicants should have completed a profile training course such as NHI Course 131100 and must have undergone training on the use of the specific inertial profiler they will be operating in the field. Applicants must know how to perform vertical and horizontal calibrations and collect profile data with the inertial profiler. Applicants must bring the inertial profiler with them at the time of testing.
- Upon passing the proficiency test, successful applicants will be given an identification card, which will verify that they are certified to operate the inertial profiler for QA testing on paving projects. The card shall identify the specific type or brand of inertial profiler that the operator is certified to operate. This card will be valid for a minimum initial period of 12 months from the date of issue unless revoked because of misuse.