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# **Standard Practice for Certification of Inertial Profiling Systems**

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**AASHTO Designation: R 56-14 (2022)<sup>1</sup>**

**Technically Revised: 2014**

**Reviewed but Not Updated: 2022**

**Technical Subcommittee: 5a, Pavement Measurement**



**American Association of State Highway and Transportation Officials  
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# Certification of Inertial Profiling Systems

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## 1. SCOPE

- 1.1. This practice describes a certification procedure for test equipment used to measure a longitudinal surface elevation profile of highways based on an inertial reference system that is mounted on a host vehicle. The minimum requirements stipulated herein are intended to focus on the need for accurate and repeatable profile measurements for construction quality control/quality assurance, acceptance and network-level data collection.
- 1.2. This practice describes minimum performance requirements for inertial profiling systems to be used on Owner-Agency paving projects where a profile-based smoothness specification is applicable and for network data collection programs.
- 1.3. The filtering methods and threshold values recommended in this document were established to ensure adequate determination of the International Roughness Index (IRI) and the profile features that affect it. An Owner-Agency planning to use an index other than the IRI should filter the profile and set thresholds accordingly. In particular, replace the preprocessor filter in Step 3, Appendix X.1 with a filter that corresponds to the relevant waveband for the alternative index.
- 1.4. If any part of this practice is in conflict with referenced documents, such as ASTM Standards, this practice takes precedence for its purposes.
- 1.5. *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 its use.*

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## 2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
  - [M 328](#), Inertial Profiler
  - [R 57](#), Operating Inertial Profiling Systems
- 2.2. *ASTM Standard:*
  - [E1926](#), Standard Practice for Computing International Roughness Index of Roads from Longitudinal Profile Measurements
- 2.3. *Other Documents:*
  - Karamihas, S. M. Development of Cross Correlation for Objective Comparison of Profiles. *International Journal of Vehicle Design*, Vol. 36, Nos. 2/3 (2004), pp. 173–193.

- Karamihas, S. M. Benchmark Test Evaluation Report. Federal Highway Administration Project. “Improving the Quality of Pavement Profile Measurement,” University of Michigan Transportation Research Institute, September 2011. [www.pooledfund.org/Details/Study/280](http://www.pooledfund.org/Details/Study/280)
- Sayers, M. W. “On the Calculation of International Roughness Index from Longitudinal Road Profile.” In *Transportation Research Record 1501*. Transportation Research Board, National Research Council, Washington, DC, 1995, pp. 1–12.

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### 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 at 50 mph (Sayers 1995). Computer programs to calculate the IRI from a longitudinal profile are referenced in [ASTM E1926](#).
- 3.1.3. *line laser*—a line laser obtains a series of data points along a line, which is typically perpendicular to the travel direction, with the line typically being 4 in. long. A single, bridged elevation value is computed from this data.
- 3.1.4. *longitudinal profile*—the vertical deviations of the pavement surface taken along a line in the direction of travel referenced to a horizontal datum.
- 3.1.5. *report interval*—the longitudinal distance between the outputs of a profile index value.
- 3.1.6. *sample interval*—the longitudinal distance between data capture points. The data include location, height, and accelerometer values. These data points are combined to create one profile data point. These points, in turn, may be combined to create a final value in the reported profile.

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### 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 the equipment operators.

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### 5. EQUIPMENT

- 5.1. *Minimum Requirements*—The inertial profiling system must meet all requirements and specifications found in [M 328](#).
- 5.2. The profiler software must be able to calculate and report the IRI (in in./mile or appropriate SI units) from the corresponding measured true profile and permit the operator to:
  - 5.2.1. Automatically trigger the start of data collection at the designated location;
  - 5.2.2. Provide the measured true profiles in electronic text files following the formats prescribed by [R 57](#), in addition to any binary data file storage provided. These profile data are necessary to evaluate profiler accuracy and repeatability and to verify the height and distance measurements as described herein.