
Standard Practice for

Quantifying Roughness of Pavements

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1. SCOPE

- 1.1. This practice describes a method for estimating roughness for a pavement section. An international roughness index (IRI) statistic is calculated from a single longitudinal profile measured with a road profiler in both the inside and outside wheelpaths of the pavement. The average of these two IRI statistics is reported as the roughness of the pavement section.
- 1.2. The practice recognizes the need for a quality assurance (QA) plan and proposes guidelines for the development of a QA plan.
- 1.3. Measurements of profile are made in accordance with ASTM E 950. If any part of this practice is in conflict with its references made, such as ASTM standards, this practice takes precedence for its purpose.
- 1.4. *This practice does not purport to address all of the safety issues, 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.*

2. REFERENCED DOCUMENTS

- 2.1. *ASTM Standards:*
 - E 867, 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 1166, Standard Guide for Network Level Pavement Management
- 2.2. *Other Documents:*
 - Sayers, Michael W. On the Calculation of IRI from Longitudinal Road Profile. University of Michigan, Transportation Research Institute, Preprint TRB, 74th Annual Meeting, Washington, DC, January 1995.
 - Sayers, Michael W., T. D. Gillespie, and W. D. O. Paterson. Guidelines for Conducting and Calibrating Road Roughness Measurements. *The World Bank Technical Paper*, Number 46. The World Bank, 1986.

3. SIGNIFICANCE AND USE

- 3.1. This practice outlines standard procedures for measuring longitudinal profile and calculating the International Roughness Index (IRI) for highway pavement surfaces to help produce consistent estimations of IRI for network-level pavement management.

4. TERMINOLOGY

4.1. *Definitions:*

- 4.1.1. *roughness*—according to ASTM E 867, the deviation of a surface from a true planar surface with characteristic dimensions that affect vehicle dynamics and ride quality. In this practice, the term *roughness* is the average of two IRI statistics calculated from longitudinal profile measurements, one in each pavement wheelpath.
- 4.1.2. *longitudinal profile*—the set of perpendicular deviations of the pavement surface from an established horizontal reference plane to the lane direction.
- 4.1.3. *international roughness index (IRI)*—a statistic used to estimate 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 report “On the Calculation of IRI from Longitudinal Road Profile” (Sayers 1995). Computer programs are referenced in Appendix X1 of this procedure to calculate the IRI statistic from a longitudinal profile.

5. QUALITY ASSURANCE

- 5.1. Agencies using this practice are required to develop a satisfactory quality assurance plan. At a minimum, the QA plan shall include the requirements listed in the following sections:

- 5.1.1. Qualification and training records of individuals conducting the survey;

- 5.1.2. Accuracy and calibration records of equipment used in the survey; and

- 5.1.3. Periodic and ongoing quality control program and the content of the program.

Note 1—The estimate of roughness of pavements can be used both at network- and project-level pavement management. Guidelines for network level are included in ASTM E 1166, which can be used as a source for the development of a QA plan.

Note 2—The guidelines that can be used for the development of a quality assurance plan are given in Appendix X2.

6. DATA COLLECTION

- 6.1. Agencies using this practice are expected to designate the lane(s) and direction(s) of travel to be surveyed based on sound engineering principles and management needs within the agency.

- 6.2. Locate (place) the two sensors, separated approximately 1.6 to 1.8 m in the wheelpaths. The longitudinal profile points used for calculating the IRI shall have a longitudinal spacing not greater than 150 mm. Long wavelength filters are used to remove all wavelengths exceeding 60 m.

Note 3—The use of anti-aliasing filters and averaging to remove small wavelength content from the profile is left to the discretion of the agency and equipment manufacturers.

7. CALCULATIONS

- 7.1. Calculate IRI values for each 0.1 km for both wheelpaths. Compute an average of the two IRI values to determine roughness.