

Pavement Ride Quality When Measured Using Inertial Profiling Systems

AASHTO Designation: PP 51-03 (2005)¹



1. SCOPE

- 1.1. This procedure is intended to be used as an example specification for Owner-Agencies to use in development of specific language when requiring the measurement and evaluation of ride quality and compliance using inertial profiling systems.
- 1.2. *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. *AASHTO Standards:*
- MP 11, Inertial Profiler
 - PP 37, Determination of International Roughness Index (IRI) to Quantify Roughness of Pavements
 - PP 37M, Quantifying Roughness of Pavements
 - PP 49, Certification of Inertial Profiling Systems
 - PP 50, Operating Inertial Profilers and Evaluating Pavement Profiles
- 2.2. *ASTM Standards:*
- E 867, Terminology Relating to Vehicle-Pavement Systems
 - E 950, 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. *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 PP 37 and PP 37M.
- 3.1.2. *localized roughness*—areas of localized roughness shall be identified through a 25-ft moving average filter. The difference between the 25-ft moving average and the reported relative elevation

for every profile point is determined. Deviations greater than 0.15 in. are considered a detected area of localized roughness.

- 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. *reporting interval*—the travel distance between the outputs of a profile index value.
- 3.1.5. *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.
- 3.1.6. *surface Test Type A*—a test procedure to measure surface profile deviations using a straightedge.
- 3.1.7. *surface Test Type B*—a test procedure to measure the surface profile index known as the International Roughness Index (IRI) using an inertial profiling system.

4. SIGNIFICANCE AND USE

- 4.1. This practice provides example specification language for measuring ride quality on newly constructed paving projects using inertial profiling systems.

Note 1—Coarse surface textures, such as those found on chip-sealed, tined (transverse or longitudinal), and grooved pavement, for example, are very challenging to existing inertial profilers. Coarse texture is likely to adversely affect the repeatability and accuracy of any profile-based index, such as the IRI. The consequence may be an upward bias in the index value. Please note that application of these protocols does not guarantee acceptable performance of inertial profilers on coarse-textured surfaces.

5. EQUIPMENT

- 5.1. Provide an approved straightedge with minimum length of 10 ft.
- 5.2. Provide an inertial profiling system meeting all requirements and specifications found in MP 11, and currently certified in accordance with PP 49. The equipment must be operated in accordance with PP 50.

Note 2—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.
- 5.3. Provide the Owner-Agency copies of Equipment Certification. Display a current decal on the equipment indicating the expiration date of certification.
- 5.4. Provide a certified profiler operator. Provide the Owner-Agency copies of Operator Certification.

6. WORK METHODS

- 6.1. *General*—Measure and evaluate profiles using Surface Test Types A and B on surfaces as described below or specified on the plans.

- 6.1.1. *Transverse Profile*—Measure the transverse profile of the finished riding surface in accordance with Surface Test Type A.
- 6.1.2. *Longitudinal Profile*—Measure the longitudinal profile of the finished riding surface including horizontal curves.
- Use Surface Test Type B on the finished riding surface of all travel lanes except as follows:
 - Use Surface Test Type A on service roads and ramps unless Surface Test Type B is shown on the plans.
 - Use Surface Test Type A when project pavement limits are less than 2,500 ft unless otherwise shown on the plans.
 - Use Surface Test Type A on all other areas.
 - Use Surface Test Type A for shoulders and all other areas including intermediate pavement layers.
- 6.2. *Profile Measurements*—Measure the finished surface in accordance with Surface Test Type A or B as required.
- 6.2.1. *Surface Test Type A*—Test the surface or intermediate layer longitudinally, transversely, or both, as specified with an approved straightedge at locations selected by the Owner-Agency.
- 6.2.2. *Surface Test Type B*—Surface Test Type B consists of quality control, quality assurance, and possible referee testing with an inertial profiling system.
- 6.3. *Quality Control (QC) Testing (non-directed)*—Perform QC tests on a daily basis throughout the duration of the project. Use an approved straightedge, inertial profiler, profilograph, or any other appropriate means to perform QC tests.
- 6.4. *Quality Control (QC) Testing (directed)*—Perform QC tests using either a high-speed or lightweight inertial profiler. Perform QC tests on the finished surface of the completed project or at the completion of a major stage of construction as approved by the Owner-Agency. Coordinate with and receive authorization from the Owner-Agency before starting QC testing. Perform QC tests within seven days after receiving authorization and submit results to the Owner-Agency within 24 hours of data collection.
- 6.4.1. Operate the profiler in accordance with PP 50. The Owner-Agency may require QC testing be performed at off-peak times for traffic flow. Operate the inertial profiler in a manner that does not unduly disrupt traffic flow as determined by the Owner-Agency. When using a lightweight inertial profiler to measure a surface that is open to traffic, use a moving traffic control plan in accordance with the *Manual on Uniform Traffic Control Devices*. Traffic control for both QC and QA testing is at the expense of the Contractor. Provide all profile measurements to the Owner-Agency in electronic data files of the format specified in PP 50.
- 6.4.2. Within 24 hours immediately before and after taking QC measurements, verify the compliance of the inertial profiler by running the profiler over a designated section with a known IRI value. The Owner-Agency will maintain a list of designated verification sections.
- 6.5. *Acceptance/Referee Testing*—Within 10 working days after the Contractor's QC testing under Section 6.4 is completed, the Owner-Agency may perform acceptance testing using a certified inertial profiler meeting the requirements of PP 49. If the acceptance testing results produce an IRI of the profile trace averaged over a 0.1-mile section that differs from that obtained using the Contractor's profiler by more than 6.0 in. per mile, then the Owner-Agency and Contractor should attempt to resolve the differences to their mutual satisfaction.