Standard Specification for

Inertial Profiler

AASHTO Designation: M 328-14 (2018)[1]

Technical Subcommittee: 5a, Pavement Measurement

Release: Group 1 (April)

AASHTO

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1. SCOPE

1.1. The objective of this specification is to define the required attributes of an inertial profiler, which, when combined with an operator, becomes a complete inertial profiling system (IPS). The system may be used to measure a longitudinal pavement profile for construction quality control and acceptance or for network data collection. The equipment may be added to a host vehicle as a single-function device or a component of a multifunctional data collection device. The equipment shall be able to calculate summary roughness indices, particularly the International Roughness Index (IRI). This specification is designed to apply to both low-speed and high-speed profilers.

1.2. The equipment shall be capable of outputting the pavement elevation profile as a temporary display, a printed record, and a data file.

1.3. It is not the intent of this specification to relieve the supplier from the final responsibility to provide an appropriate product for the intended function, nor is it intended to specify all the design details. The objective is to provide a sufficiently detailed specification that the function is clearly defined. It is intended to be sufficiently detailed that the data collected from multiple profilers will be identical.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standard*:

- R 56, Certification of Inertial Profiling Systems

2.2. *ASTM Standards*:

- E867, Standard Terminology Relating to Vehicle-Pavement Systems
- E1926, Standard Practice for Computing International Roughness Index of Roads from Longitudinal Profile Measurements
- E2560, Standard Specification for Data Format for Pavement Profile

2.3. *Other Document*:

- Sayers, M. W. On the Calculation of International Roughness Index from Longitudinal Road Profile. *Transportation Research Record 1501*. Transportation Research Board, National Research Council, Washington, DC, 1995, pp. 1–12.

3. TERMINOLOGY

3.1. *Definitions*:

3.1.1. *accelerometer*—transducer that provides an output proportional to acceleration.

3.1.2. *aliasing*—the error that can result when a signal is sampled at a rate less than twice the frequency of the various sinusoidal components that compose the signal. To avoid aliasing, the signal is band limited so that the sampling frequency used will be greater than twice as high as the highest frequency component in the signal. It is also described as the error that results from sampling a long wavelength signal that is mixed with a short wavelength noise signal.

3.1.3. *anti-aliasing filter*—a low-pass analog filter that suppresses short-wavelength contamination of longer-wavelength measurements to improve the accuracy of the sampling process.

3.1.4. *continuous IRI*—a series of IRI values calculated over a running interval, one for each profile data point throughout the test section. Each IRI value is provided at the midpoint of the running interval.

3.1.5. *filtering*—procedure to extract desired information from a signal that also contains unwanted information (commonly called noise). Digital filtering is a calculation procedure that takes one set of numbers and transforms them into another set in which the noise is reduced. Moving average is one type of such transformation or filter.

3.1.6. *index*—measure or standard. Within the context of this test method, a suitably chosen index quantifies the ride quality of a pavement.

3.1.7. *inertial profiler*—the combination of the profiling equipment and the host vehicle.

3.1.8. *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.

3.1.9. *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.

3.1.10. *longitudinal profile*—the vertical deviations of the pavement surface taken along a line in the direction of travel referenced to a horizontal datum.

3.1.11. *low-pass filter*—smoothing type filter that reduces the effect of short wavelengths that are associated with rapid elevation changes such as expansion joint ribs.

3.1.12. *measurement range*—the detectable range of heights, accurately measurable by the sensor.

3.1.13. *moving average*—filtering process whereby each data point is replaced with the average value of several adjacent points or elevations. It is a smoothing process because the changes from one elevation point to the next will not be as significant due to the fact that the difference in elevation has been divided by the total number of data points in the averaging scheme. It is a type of low-pass filter.

3.1.14. *repeatability*—consistency in successive measurements of the same quantity. It is a quantifier of the variability in measurement error using the same equipment and operator.

3.1.15. *report interval*—the longitudinal distance between the outputs of a profile *index* value.

3.1.16. *roughness*—according to ASTM E867, the deviation of a surface from a true planar surface with characteristic dimensions that affect vehicle dynamics, ride quality, dynamic loads, and drainage.