Designation: E1170 – 97 (Reapproved 2012)

Standard Practices for Simulating Vehicular Response to Longitudinal Profiles of Traveled Surfaces[1]

This standard is issued under the fixed designation E1170; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 These practices cover the calculation of vehicular response to longitudinal profiles of traveled surface roughness.

1.2 These practices utilize computer simulations to obtain two vehicle responses: (*1*) axle-body (sprung mass) motion or (*2*) body (sprung mass) acceleration, as a function of time or distance.

1.3 These practices present standard vehicle simulations (quarter, half, and full car) for use in the calculations.

1.4 The values stated in SI units are to be regarded as the standard.

1.5 *This standard 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 standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E950 Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference

2.2 *ISO Standard:*

2631 Guide for the Evaluation of Human Exposure to Whole-Body Vibration[3]

3. Summary of Practices

3.1 These practices use a measured profile (see Test Method E950) or a synthesized profile as part of a vehicle simulation to obtain vehicle response.

3.2 The first practice for obtaining vehicle response uses simulation of a quarter-car or half-car model. The output is the accumulated relative motion between the sprung and unsprung vehicle masses, of the simulated vehicle, for a predetermined distance. The units are accumulated relative motion per unit of distance traveled (m/km or in./mile). For example, the quarter-car simulation is used when a Bureau of Public Roads BPR/roadmeter is to be simulated, and the half-car model (or the quarter car with the average of the left and right elevation profile input) is used when a road meter is to be simulated.

3.3 The second practice uses either a quarter-car, half-car, or full-car simulation to obtain vehicle body acceleration. The acceleration history can be computed as a function of time or distance, or both. One application of this practice is to use the acceleration history in a ride quality evaluation, such as the ISO Guide 2631.

3.4 For all calculations, a vehicle test speed is selected and maintained throughout the calculation. Pertinent information affecting the results must be noted.

4. Significance and Use

4.1 These practices provide a means for evaluating traveled surface-roughness characteristics directly from a measured profile. The calculated values represent vehicular response to traveled surface roughness.

4.2 These practices provide a means of calibrating response-type road-roughness measuring equipment.[4]

5. Apparatus

5.1 *Computer*—The computer is used to calculate acceleration and displacement of vehicle response to a traveled surface profile, using a synthesized profile or a profile obtained in accordance with Test Method E950 as the input. Filtering shall be provided to permit calculation, without attenuation, at frequencies as small as 0.1 Hz at speeds of 15 to 90 Km/h (10 to 55 mph). Computation may be analog or digital. Noise within the computer shall be no more than one quarter of the

[1] These practices are under the jurisdiction of ASTM Committee E17 on Vehicle - Pavement Systems and are the direct responsibility of Subcommittee E17.33 on Methodology for Analyzing Pavement Roughness.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Gillespie, T. D., Sayers, M. W., and Segel, L., "Calibration and Correlation of Response-Type Road Roughness Measuring Systems," *NCHRP* Report 228, 1980.

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