Designation: E1215 – 93 (Reapproved 2017)

Standard Specification for Trailers Used for Measuring Vehicular Response to Road Roughness[1]

This standard is issued under the fixed designation E1215; 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 This specification covers the design, performance, and operating features of a trailer used for measuring response to road roughness.

1.2 The specified trailer is a two-wheeled, single-axle vehicle that is towed on highways at typical traffic speeds while the relative movement between the axle and body is transduced and recorded as an indication of road roughness.

1.3 The instrumentation for sensing the movements of the trailer is not covered in this specification. One example of instrumentation is described in Test Method E1082.

1.4 The values stated in inch-pound units are to be regarded as the standard.

1.5 The following caveat pertains only to Section 5 of this specification: *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.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E1082 Test Method for Measurement of Vehicular Response to Traveled Surface Roughness

E1136 Specification for P195/75R14 Radial Standard Reference Test Tire

2.2 *Other Document:*

A4082 TPC Tire Performance Criteria, Procedures and Specifications[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *sprung mass*—the total mass minus the unsprung mass.

3.1.2 *suspension deflection*—the change in the vertical distance between the axle at its centerline and a hypothetical reference line directly above the axle centerline on the rigid frame structure.

4. Other Requirements

4.1 *Damping Ratio of Suspension System*—The damping ratio of the suspension system on the assembled trailer shall be evaluated by measuring the accumulated suspension movement on the trailer as it is towed over a known or standard calibration test surface. It must be verified that it meets one of the acceptance criteria.[3] The design requirements for the shock absorbers (5.1.1.3) may be used as an alternative to this requirement.

4.2 *Spring Rate*—The spring force constant (spring rate) of the assembled suspension shall be measured as follows:

4.2.1 *Apparatus:*

4.2.1.1 *Dial Indicators,* with a nominal accuracy of 0.001 in. (0.025 mm). Two are required.

4.2.1.2 *Loading Weights,* permitting load increments of approximately 20 lbf (89 N) are required.

4.2.2 *Procedure*—Measure the vertical deflections of the suspension by placing the dial indicators at points proximate to the coil springs. With the trailer parked on a level surface, gently apply the weights, in approximately 20-lbf (89-N) increments, on the longitudinal centerline of the trailer directly above the centerline of the axle while recording the suspension deflection values observed on each dial indicator. Take care not to jar the trailer when applying the weights. Once all the

[1] This specification is under the jurisdiction of ASTM Committee E17 on Vehicle - Pavement Systems and is the direct responsibility of Subcommittee E17.31 on Methods for Measuring Profile and Roughness.

Current edition approved June 1, 2017. Published June 2017. Originally approved in 1987. Last previous edition approved in 2012 as E1215 – 93 (2012). DOI: 10.1520/E1215-93R17.

[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 General Motors Engineering Staff, GM Proving Ground, Milford, MI 48042.

weights have been applied up to the total mass, remove them in the same manner while recording the deflection measurements at each increment.

4.2.3 *Data Reduction*—Separately plot the load-deflection values for each suspension system (left and right) on rectilinear graph paper. Draw a straight line that best reflects the slope of the upward (loading) and downward (unloading) data points, ignoring the initial data point if necessary. The slope of that line is the spring rate and must fall within the range of 180 to 220 lbf/in. (32 to 39 N/mm).

4.3 *Legal Requirements:*

4.3.1 The vehicle and trailer shall comply with all applicable state and federal laws, including those related to hitch connections and lighting of towed vehicles.

4.3.2 Reasonable precautions shall be taken beyond those imposed by laws and regulations to ensure maximum safety of operating personnel and other traffic.

5. Design Requirements

5.1 *Chassis*—The chassis shall consist of a rigid frame suspension, two wheels mounted on a rigid axle, and a tow hitch.

5.1.1 *Suspension System*—The trailer frame shall be suspended on the axle by a system that includes the following components:

5.1.1.1 *Horizontal Linkages*— shall separately constrain the axle in the longitudinal and lateral directions while allowing free vertical excursion.

5.1.1.2 *Springs*—Two coil springs connecting the axle and frame shall be mounted vertically over the centerline of the axle. The force constant of each spring shall be 200 ± 20 lbf⁄in. (350± 35 N/mm or m). The springs shall be equidistant from the longitudinal centerline of the trailer at a distance not less than 15 in. (0.38 m).

5.1.1.3 *Shock Absorbers*—Two shock absorbers, mounted vertically from the axle to the trailer frame, shall be equidistant from the longitudinal centerline of the trailer. The ratios of the shock absorbers damping value over ½ the sprung mass ($2C/M_S$) shall be in the range of 5.5 to 13 s^{-1} with a mean value of 8 s^{-1}.[4] The performance requirement for the damping rate of the suspension system in 4.1 may be used as an alternative to this requirement.

5.1.2 *Axle and Wheels*—The trailer shall have a two-wheel rigid axle in accordance with the following requirements:

5.1.2.1 *Wheels*—The wheels shall be 15 by 6 in. rims. Radial runout at the bead seats of the wheels when installed on the axle shall be less than 0.01 in. (0.25 mm) peak-to-peak. The rim shall be marked to indicate the "low-point" for matching with the tire. The low-point is established by determining the points of minimum radius on each bead seat and locating the low-point intermediately between those points in proportion to their relative magnitudes.

5.1.2.2 *Tires*—The tires shall be size P215/75R15, or equivalent, or Specification E1136, and shall meet the GM TPC Specification.[3] Before operation, set the tire inflation pressure at the tire manufacturer's maximum recommended pressure for size and type of tire used at ambient temperature.

5.1.2.3 *Optional Alternative*—If the equipment given in 4.2.1 is used, the dial indicators are placed close to the tires to measure axle-to-road displacement. The tire pressure is adjusted to give a 1⁄16-in. (1.6-mm) vertical displacement when 200 lbf (890 N) is used rather than the manufacturer's maximum recommended pressure.

5.1.2.4 *Tire-Wheel Assembly*—The tires shall be mounted on the wheels so that the painted dot indicating peak tire runout reaches the low-point mark on the wheel. The tire-wheel assemblies shall be balanced within 8.0 in./oz (0.58 cm/kg).

5.1.2.5 *Wheel Track*—The lateral distance between the center planes of the two tires shall be 68 ± 5 in. (1.73 ± 0.13 m).

5.1.3 *Tow Hitch*—A ball-type hitch receptacle shall be mounted at the forward end of the frame on the longitudinal centerline of the trailer.

NOTE 1—The towing vehicle must have power enough to pull the trailer at whatever uniform velocity is specified, even up 6 % grades, and must be in good operating condition, particularly its shock absorbers.

5.1.3.1 *Wheelbase*—The trailer shall be designed so that the longitudinal distance between the center of the ball-hitch and the centerline of the axle shall be 120 ± 1 in. (3.05 ± 0.03 m).

5.1.4 *Total Mass*—The mass of the fully assembled trailer shall be 1660 ± 50 lbm (753 ± 23 kg), and it shall be distributed so that the ground load at each of the wheels will be 780 ± 20 lbf (3470 ± 89 N), and the hitch load shall be 100 ± 10 lbf (445 ± 44 N). The center of percussion in the vertical plane shall be located as near to the axle as possible.

5.1.5 *Unsprung Mass*—The total mass of the axle, wheels, and tires, together with that of the suspension system, shall be 320 ± 30 lbm (145 ± 14 kg).

5.1.6 *Sprung Mass*—shall normally be 1340 lbm (608 kg).

NOTE 2—The ratio of the unsprung mass to the sprung mass (M_u/M_s) is higher than many automobiles.

[4] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:E17-1002. Contact ASTM Customer Service at service@astm.org.