Designation: F457 – 04 (Reapproved 2010)

Standard Test Method for Speed and Distance Calibration of Fifth Wheel Equipped With Either Analog or Digital Instrumentation[1]

This standard is issued under the fixed designation F457; 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 test method covers the determination of vehicle speed and cumulative distance traveled using a device termed a fifth wheel and using appropriate associated instrumentation.

1.2 This test method also describes the calibration technique applicable to digital or analog speed and distance measurement systems employing a fifth wheel.

1.3 The values stated in SI (millimetre-kilogram) units are to be regarded as the standard.

1.4 *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.* For specific precautionary statements, see Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F538 Terminology Relating to the Characteristics and Performance of Tires

F1082 Practice for Tires—Determining Precision for Test Method Standards (Withdrawn 2005)[3]

3. Terminology

3.1 Refer to Terminology F538.

4. Summary of Test Method

4.1 Vehicle speed and distance determinations are made by use of a fifth wheel, signal transducer(s), and compatible display devices.

4.2 The fifth wheel assembly and signal transducer(s) are attached to the vehicle or the test trailer so that the fifth wheel remains in contact with the normal roadway surface while the equipment is in motion. The rotation of this wheel is detected in a suitable manner and is translated into measurements of vehicle speed and distance with auxiliary equipment.

4.3 The speed is to be communicated to the vehicle operator at all times, and should be visible without undue distraction or a requirement for physical movement on the part of the operator.

4.4 Fifth wheel calibration is performed by operating the device at a fixed speed over a known distance and comparing the speed and distance readout to a known speed and distance.

5. Significance and Use

5.1 This test method may be used for calibration of speed and distance measurement systems used on tire test vehicles and tire test trailers, or any land-based vehicle that contacts the road and that uses a trailing-wheel system for measurement of speed and distance. This test method applies only to hard, dry, smooth surfaces and is not accurate for highly curved vehicle paths. This test method does not encompass optical types of devices.

6. Apparatus

6.1 *Fifth Wheel*—The fifth-wheel assembly shall be of sufficient mechanical integrity to withstand long periods of sustained operation with minimal maintenance. The wheel vertical pivot assembly shall be sufficient to permit directional changes without inducing lateral skidding of the fifth-wheel tire. The fifth-wheel assembly shall be equipped with a suspension capable of minimizing bounce and wheel hop, due to roadway irregularities, to the extent necessary to ensure measurement accuracy. The wheel shall be equipped with a suitable tire, preferably of a straight-ribbed design. The tires shall have a minimum (new) size of 349–37 (16 × 1⅜). Tire and wheel shall be balanced statically each time the tire is replaced.

6.2 *Instrumentation*—Fifth-wheel systems shall be equipped with either analog or digital instrumentation for determining wheel rotation. Suitable readouts shall be provided.

6.2.1 *Analog Instrumentation:*

[1] This test method is under the jurisdiction of ASTM Committee F09 on Tires and is the direct responsibility of Subcommittee F09.10 on Equipment, Facilities and Calibration.

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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] The last approved version of this historical standard is referenced on www.astm.org.

6.2.1.1 *Generator (tachometer)*—The generator shall be coupled to the fifth wheel to produce an electrical output proportional to the angular velocity (converted into linear velocity expressed in km/h (mph)) of the fifth wheel. The generator output shall be continuously proportional to the rotational velocity within the required tolerance. The generator output shall be biased after engineering unit conversion by an amount less than or equal to 0.5 % of the converted speed, or 0.3 km/h (0.2 mph), whichever is greater. The generator response to changes in speed shall not exceed 0.5 s throughput. Generator operation shall not be degraded by direct or condensed moisture, road film, petroleum residue, dust, salt, or other environmental contaminates and ambient temperature extremes.

6.2.1.2 *Speed Readout*—The display shall measure the generator output and display the output as kilometres per hour (miles per hour). The generator output readout shall be equipped with a low pass active filter that will reduce the ripple output of the generator to less than or equal to 1 % of the measured signal or 0.8 km/h (0.5 mph) peak to peak, whichever is greater. The maximum propagation delay of the filter/readout combination shall not exceed 0.5 s. The readout shall be biased to an amount less than or equal to 1.0 % of the true speed, 0.5 km/h (0.3 mph), whichever is greater.

6.2.1.3 *Distance Readout*—The distance measuring device shall consist of a counter actuated by the fifth wheel with an output of at least 31 counts per metre (10 counts per foot). Distance traveled is calculated by multiplying the distance per pulse by the number of pulses indicated. The count shall be restorable to zero and possess sufficient digit capacity to minimize the need for recycling the count during testing. The analog integration of an electrical generator signal to yield a distance measurement is not recommended. The distance measuring device shall have a capability of a resolution of 8 cm (3 in.).

6.2.2 *Digital Instrumentation:*

6.2.2.1 *Transducer*—The digital transducer shall produce a periodic electrical signal whose period is some integer fraction of the revolution rate of the fifth wheel, and there shall be a minimum of ten signal counts per 0.3 m (1 ft) of travel of the fifth wheel along the vehicle path. The transducer shall be capable of providing the periodic electrical signals at speeds from zero to the maximum speed necessary for the test being conducted. Transducer operation shall not be degraded by direct or condensed moisture, road film, petroleum residue, dust, salt, or other environmental contaminates and ambient temperature extremes.

6.2.2.2 *Distance Readout*—The distance display presented to the operator shall consist of a digital number representing the distance traveled. The use of analog integration is not recommended unless equipment adjustments can be maintained within the tolerances stated below, over the expected ambient temperature range. The distance measuring device shall have a capability of a resolution of 0.076 ± 0.038 m (0.25 ± 0.125 ft).

6.2.2.3 *Speed Readout*—The speed display device shall consist of a digital number. The use of analog integration or successive approximation techniques of speed determination, or both, are not recommended unless equipment adjustments can be maintained within tolerances stated below, over the expected temperature range of the instrumentation environment. The speed readout displays shall be communicated to the vehicle operator at all times without causing undue distractions or requiring physical movement on the part of the operator. The minimum increment of the digital speed readout shall be 1 km/h, if the readout displays in km/h, or 1 mph, if the readout displays in mph.

6.3 *Tire Pressure,* to be accurate to 3 kPa (0.5 psi).

6.4 *Stopwatch* (required only for analog instrumented fifth wheel).

7. Safety Precautions

7.1 Fifth-wheel assemblies shall be inspected periodically to assure security of attachment. A safety chain is recommended to prevent loss under extreme operating conditions. Wheel assemblies should not be subjected to undue side forces, or other conditions that may either impair accuracy or present a hazard to adjacent vehicles.

8. Calibration Procedure

8.1 Since analog instrumentation measures fifth-wheel angular velocity and digital instrumentation measures angular displacement, follow different calibration procedures for each system. In either case, accomplish calibration by adjustments of electronics rather than tire pressure or other mechanical means. Adjustment of tire pressure may affect the dynamics of the fifth-wheel suspension and may disrupt optimum tire-road contact. However, small tire inflation pressure changes less than 5 psi may be used for small recalibration adjustments.

8.2 *Fifth-Wheel Preparation:*

8.2.1 Install the fifth wheel according to the manufacturer's instructions and as near as possible to the mid-track position of the vehicle.

8.2.2 Adjust the fifth-wheel tire pressure to the manufacturer's specification.

8.2.3 It is common practice that the fifth wheel be prepared for testing by running at least 8 km (5 miles) at approximately 64 km/h (40 mph) immediately before use. Normal travel in preparation for calibration fulfills this requirement.

8.3 *Analog Calibration*—The ultimate accuracy of speed measurements is determined principally by the accuracy to which the speed per volt or current calibration can be established and how constant this calibration remains over the range of speed and over time. The accuracy of the distance measurement is dependent primarily upon the accuracy to which the distance traveled per revolution of the fifth wheel can be determined. The number of fifth wheel revolutions should be determinable to ±0.1 revolution in 0.8-km (0.5-mile) distance, measured using a device whose calibration is traceable to the National Institute of Standards and Technology (NIST). This calibration should be accomplished by adjustments of electronics rather than tire pressure or other mechanical means. Adjustment of tire pressure may affect the dynamics of the fifth wheel suspension and may disrupt optimum tire-road contact. However, tire pressure changes of less than 34 kPa (5 psi) may