



Designation: F 377 – 94a (Reapproved 1999)

Standard Practice for Calibration of Braking/Tractive Measuring Devices for Testing Tires¹

This standard is issued under the fixed designation F 377; 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 practice covers the calibration of the following:

1.1.1 Reference load cells by using certified weights,

1.1.2 Calibration platform systems by using a reference load cell, and

1.1.3 Static calibration of braking/tractive force on locked wheels of tire test trailers, instrumented vehicles, and laboratory tire testing machines by using the calibration platform system as a calibration fixture.

1.2 The values stated in SI units are to be regarded as standard. The values in parentheses are for information only.

1.3 *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:*

E 74 Practice for Calibration of Force-Measuring Instruments for Verifying the Force Indication of Testing Machines²

E 178 Practice for Dealing with Outlying Observations³

E 556 Test Method for Calibrating a Wheel Force or Torque Transducer Using a Calibration Platform (User Level)⁴

3. Summary of Practice

3.1 Reference-load cells are calibrated according to a dead-weight procedure using Class F weights, the calibration of which is traceable to the National Institute of Standards and

Technology (NIST), or they may be sent to NIST for calibration. Practice E 74 may be used as an alternative method for load-cell calibration.

3.2 The calibrated reference-load cell is used to calibrate the calibration-platform systems.

3.3 The tire test trailer, instrumented vehicle, or laboratory tire testing machine is calibrated with the calibration platform (see Test Method E 556).

4. Significance and Use

4.1 The practice may be used for the following:

4.1.1 Calibration of test trailers used in tire testing,

4.1.2 Calibration of instrumented braking and driving traction vehicles used in tire testing,

4.1.3 Calibration of torque axles and hubs on automobiles used to measure braking or acceleration forces, and

4.1.4 Calibration of laboratory tire-testing machines where the tire-road interface friction force is measured.

5. Apparatus

5.1 The calibration system shall consist of three basic components as follows:

5.1.1 *Platform*—The platform on which the test wheel is placed shall have a flat top able to support the entire tire patch width, but no less than 152 mm (6 in.) wide by 254 mm (10 in.) long with a high friction surface. The platform shall be supported by air or by an arrangement of bearings permitting longitudinal motion, and capable of sustaining a vertical load equal to the largest anticipated wheel load. The longitudinal movement shall be a minimum of 127 mm (5 in.), limited only by the stroke of the horizontal-drive mechanism.

5.1.2 *Horizontal-Drive Mechanism*—A force or displacement-type driving system capable of developing a force of 80 % of the wheel load shall be provided. The force shall be applied along the longitudinal centerline of the platform.

5.1.3 *Force Transducer*—A force transducer shall link the horizontal-drive mechanism to the platform. The force transducer shall have a capacity equal to or greater than 80 % of the

¹ This practice is under the jurisdiction of ASTM Committee F-9 on Tires and is the direct responsibility of Subcommittee F09.10 on Structural Integrity.

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² *Annual Book of ASTM Standards*, Vol 03.01.

³ *Annual Book of ASTM Standards*, Vol 14.02.

⁴ *Annual Book of ASTM Standards*, Vol 04.03.

wheel load, but with a capacity of at least 4448 N (1000 lbf). The force transducer shall be mounted in a manner appropriate of its type to ensure that cross-axis forces cannot adversely affect the accuracy.

6. Calibration of Braking/Tractive Force on a Locked Wheel (Fig. 1)

6.1 Turn on the test vehicle system instrumentation and calibration system instrumentation suitably in advance to allow warm-up before attempting calibration. Check the system stability with the calibration network in accordance with 7.1 where applicable.

6.2 Position the test vehicle with the test tire resting on the geometric center of the platform. As necessary, to maintain normal vehicle orientation and to prevent movement, place blocks with a high friction surface under the other vehicle wheels so that the vehicle will remain level with the platform. In the case of a trailer, the hitch point may be supported.

6.3 Level the platform to within $\frac{1}{2}^\circ$ and align it within 3° of the trailer or vehicle longitudinal axis. As appropriate, engage the brakes of the towing vehicle and block the platform to prevent slippage.

6.4 Ensure that the system-force transducer is not stressed by lifting the test wheel from the platform (or for an air-supported platform by unbraking the test wheel). Lock the test wheel brake and attempt to rotate the wheel to ensure brake engagement, lower the test wheel onto the platform, and adjust the zero of all systems.

6.5 Operate the drive mechanism to increase the force on the test wheel in 445 N (100 lbf) increments up to 80 % of the wheel load or until the plate begins to slip under the tire, whichever occurs first. The 445 N (100 lbf) increments need only be approximate. When the forces have stabilized, take simultaneous readings of both the loads indicated by the trailer/traction truck instrumentation and the calibration platform force transducer. In the event a load increment is exceeded, decrease the force below the desired value, then approach it again in the increasing-force direction. Direction of calibration forces must be the same as the direction(s) of usage.

7. Procedures

7.1 Two procedures are covered. The first is for calibration of the reference-load cell; the second is for calibration of the calibration platform. Repeat these calibrations when either system breaks down, drifts (greater than 0.20 % of full scale based on calibration network), or when any component is changed or altered (see ASTM Manual 7).⁵ Record the ambient temperature during load cell calibration. Obtain the temperature characteristics of the reference-load cell from the manufacturer and use to correct the load-cell calibration information when applying the force-plate calibrator.

7.2 Reference Load Cell Calibration:

7.2.1 Connect the load cell and the indicator.

7.2.2 Set the bridge-excitation voltage and gain, or its equivalent, in accordance with the instructions on the unit being used.

7.2.3 Adjust the "bridge zero," or its equivalent, to "zero." Be certain that the load cell is not being stressed.

7.2.4 Using Class F weights traceable to NIST, make a dead-weight calibration on the load cell (see Table 1 for results). Do not use values less than 10 % of full scale for this graph. See Practice E 178 for a method of determination of outliers.

7.2.5 Provide a correction curve similar to Fig. 2 as follows:

7.2.5.1 Provide an inaccuracy value defined as the maximum deviation from the actual load expressed as a percent of full load.

7.2.5.2 Provide a nonlinearity value defined as the maximum deviation. From the linear least squares curve of inaccuracies of the reference load cell versus actual dead weights traceable to NIST, when the least squares curve is forced through the origin.

7.2.6 The inaccuracy and nonlinearity of the reference-load cell and indicator system shall be less than 0.1 % of the maximum wheel load or load-cell capacity, whichever is less.

⁵ Manual on Presentation of Data and Control Chart Analysis, Manual 7, ASTM, 1991.

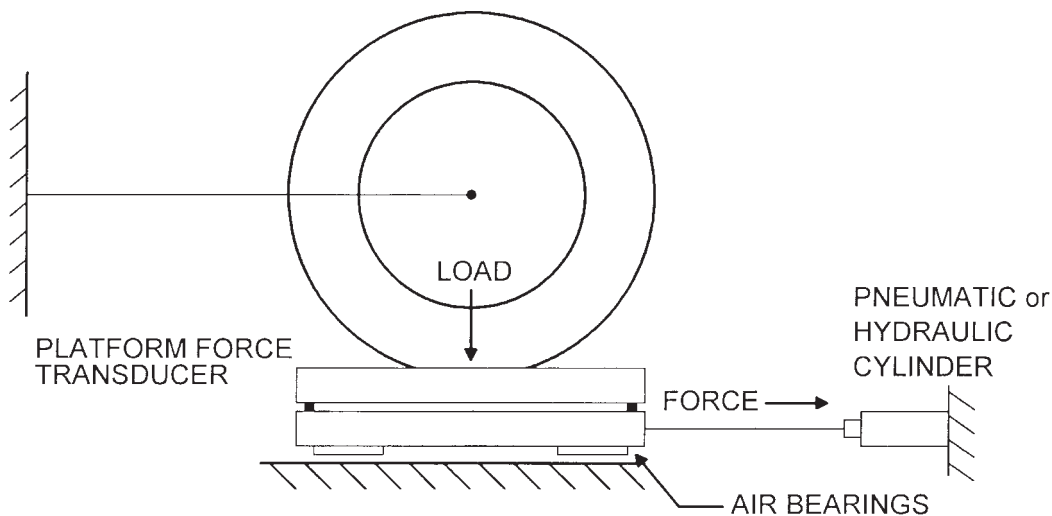


FIG. 1 Force Calibration of a Locked Wheel