



SURFACE VEHICLE RECOMMENDED PRACTICE

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Tire Quasi-Static Envelopment of Triangular/Step Cleats Test

RATIONALE

This technical report is being Stabilized because it covers technology which is mature and not likely to change in the foreseeable future.

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1. SCOPE

This SAE Recommended Practice describes a test method for determining properties of a non-rolling tire quasi-statically enveloping either a set of triangular cleats or a single step cleat. In the case of the triangular cleats the normal force and vertical deflection of the non-rolling tire are determined. In the case of the step cleats the normal force, longitudinal force, and vertical deflection of the non-rolling tire are determined. The method applies to any tire so long as the equipment is properly sized to correctly conduct the measurements for the intended test tire.¹ The data are intended for use in determining parameters for road load models and for comparative evaluations of the measured properties in research and development.

NOTE: Herein, road load models are models for predicting forces applied to the vehicle spindles during operation over irregular pavements. Within the context of this document, forces applied to the pavement are not considered.

1.1 Procedures

A single procedure is specified. The differences in the test from the standpoint of the two cleat designs are whether the wheel is free to rotate about the spindle and what data must be measured and reported. These are spelled out in the body of this document.

1.2 Test Machines

This document is test machine neutral. It may be applied using any type of test machine capable of fulfilling the requirements stated in this document. The test machine must be capable of accommodating the tire sizes to be tested, along with the required cleats.

NOTE: Test results are a function of the Tire/Wheel assembly, not just a function of the Tire alone.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

¹ Proper cleat height sizing requires that the test tire only contact the test cleat, and not the surface to which the cleat is fastened.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J2047 Tire Performance Technology

SAE J2429 Free-Rolling Cornering Test for Truck and Bus Tires

SAE 770870 Marshall, L., Phelps, R., Pottinger, M., and Pelz, W., "The Effect of Tire Break-In on Force and Moment Properties," SAE Technical Paper 770870, 1977, <https://doi.org/10.4271/770870>.

SAE 810066 Pottinger, M. and Marshall, K., "The Effect of Tire Aging on Force and Moment Properties of Radial Tires," SAE Technical Paper 810066, 1981, <https://doi.org/10.4271/810066>.

2.1.2 Other Publications

Available in wall chart form as #TTMP-7/95 from the Rubber Manufacturers Association, 1400 K St., N.W., Washington, DC 20005.

OSHA Standard 1910.177 - Servicing Multi-Piece and Single Piece Rim Wheels

Copies of these documents are available online at <http://webstore.ansi.org/>.

ISO/IEC 17025:2005 - General requirements for the competence of testing and calibration laboratories

3. DEFINITIONS

The definitions that follow are of special meaning in this document and are either not contained in other Recommended Practices or are worded somewhat differently in this practice.

3.1 CLEAT DIMENSIONS

3.1.1 Cleat Height (H)

Cleat Height is the vertical distance from the crest of the cleat to the supporting Simulated Roadway, see Figures 1 and 2.

3.1.2 Cleat Width (W)

Cleat Width is the physical left-to-right width of the crest of the cleat.

3.2 TEST

A test is the execution of the procedure described in this document one time on one tire at a single set of test conditions.

3.3 TEST PROGRAM

A Test Program is a designed experiment involving multiple tests of the type described in this practice.²

4. NOMENCLATURE

Table 1 lists the symbols used in this document. For definitions not in Section 3 of this practice please refer to SAE J2047.

Table 1 - Symbols defined

Symbol	Defined Term
δ_z	Vertical Deflection
F_x	Longitudinal Force
F_z	Normal Force
H	Cleat Height
θ	Triangular Cleat Apex Half Angle
p	Inflation Pressure
R_i	Loaded Radius
σ	Standard Deviation (Note Subscripts)
W	Cleat Width

5. LABORATORY QUALITY SYSTEM REQUIREMENT

The laboratory performing the procedure specified in this document shall have a quality system either conforming to ISO/IEC 17025 or which can be shown to be functionally equivalent to ISO/IEC 17025. The elements of such a system are assumed below and are not, therefore, specifically called out within this practice.

6. APPARATUS

The required apparatus consists of a loading machine, a set of cleats, and test rims.

6.1 Loading Machine

The loading machine consists of a tire loading and positioning system, a measuring system, a flat surface simulated roadway, and the space housing the machine, which shall be maintained at $22\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.

6.1.1 Loading and Positioning System

The system shall maintain the tire with the tire/wheel plane within ± 0.05 degree of perpendicular to the simulated roadway during all loading. Loading shall produce normal forces accurate to within $\pm 1.0\%$ of the test machine's full-scale normal force range. The machine's full-scale normal force range shall allow imposition of loads equivalent to at least 400% of the test requester specified 100% load. The machine's hub must be fixed with respect to rotation about the wheel spindle when testing with the triangular cleats, as described in 6.2.1, and free to rotate around the spindle when testing with the step cleat that is described in 6.2.2.

² There are many experimental possibilities: repeated test of the same tire, tests of the same tire under multiple test conditions, tests of tires with different specifications (design details), application of this test as part of a series of different tests, etc.