



Designation: D1871 – 04

Standard Test Method for Adhesion Between Tire Bead Wire and Rubber¹

This standard is issued under the fixed designation D1871; 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 procedures for testing the strength of adhesion of single-filament wire to vulcanized rubber compounds. The method applies to, but is not limited to, wire made from brass, bronze, or zinc coated steel wire. The adhesion strength is expressed as the magnitude of the pull-out force for the single filament of wire.

1.2 This test method is applicable to single-filament wires used in reinforced rubber products as single filaments and is normally used to evaluate the adhesion of samples of wire to a standard rubber applied under specified conditions. It is primarily used to evaluate tire bead wire and may be applied, with modifications and by agreement between supplier and customer, to various wire types used in rubber product reinforcing.

1.3 This test method is written in SI units.

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. See 6.5.1.*

2. Referenced Documents

2.1 *ASTM Standards:*

D76 Specification for Tensile Testing Machines for Textiles

D123 Terminology Relating to Textiles

D1566 Terminology Relating to Rubber

D2906 Practice for Statements on Precision and Bias for Textiles²

D3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets

D4392 Terminology for Statistically Related Terms

D6477 Terminology Relating to Tire Cord, Bead Wire, Hose Reinforcing Wire, and Fabrics

E456 Terminology Relating to Quality and Statistics

¹ This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.19 on Tire Cord and Fabric. Current edition approved Oct. 1, 2004. Published October 2004. Originally published as D1871 – 61 T. Last previous edition D1871 – 02. DOI: 10.1520/D1871-04.

² Withdrawn. The last approved version of this historical standard is referenced on www.astm.org.

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms relating to tire cord, bead wire, hose wire, and tire cord fabrics, refer to Terminology D6477.

3.1.1.1 The following terms are relevant to this standard: adhesion, curing, holland cloth, hose reinforcing wire, mill grain, rubber, rubber compound, as used in the manufacture of rubber articles, tire bead, tire bead wire, and vulcanization.

3.1.2 For definitions of terms relating to rubber, refer to Terminology D1566.

3.1.3 For definitions of terms relating to testing and statistical concepts, refer to Terminology D4392 or E456.

3.1.4 For definitions of other terms related to textiles, refer to Terminology D123.

4. Summary of Test Methods

4.1 The wires are vulcanized into a block or pad of rubber and the force necessary to pull the wires out of the rubber is measured. The direction of pull-out is axial, that is, along the wire.

5. Significance and Use

5.1 To contribute to the mechanical properties required in a product, tire bead wire must have good adhesion to the rubber matrix. This allows the rubber to absorb part of the energy, distributing it uniformly between the reinforcing material and the rubber compound. This test method is considered satisfactory for acceptance testing of commercial shipments of wire since it has been used extensively in the trade for this purpose. This test method may be used for purchase specification requirements or manufacturing control of bead wire.

5.1.1 If there are differences of practical significance between reported test results for two laboratories (or more), comparative tests should be performed to determine if there is a statistical bias between them, using competent statistical assistance. As a minimum, test samples should be used that are as homogeneous as possible, that are drawn from the material from which the disparate test results were obtained, and that are randomly assigned in equal numbers to each laboratory for testing. Other materials with established test values may be used for this purpose. The test results from the two laboratories should be compared using a statistical test for unpaired data, at

a probability level chosen prior to the testing series. If a bias is found, either its cause must be found and corrected, or future test results for that material must be adjusted in consideration of the known bias.

5.2 The characteristics of single filament steel wires that affect the adhesion property are wire diameter, coating composition, and coating mass. The storage conditions, age, and vulcanization conditions of the rubber compound will affect the test results and must be specified by the supplier of the rubber compound.

6. Apparatus and Materials

6.1 *Mold*,³ designed as shown in Fig. 1 for a 12.5-mm thick block of rubber, 200 mm long, and 50 mm wide, with 15 beveled slots across the width of the mold spaced 12.5 mm apart at the middle of the mold thickness, and with top and bottom plates for the mold. If more than five wires break when testing with the standard mold, the purchaser and the supplier may agree to use a mold cavity that is less than 50 mm wide.

6.2 *Tensile Testing Machine*, CRE (Constant-Rate-of-Extension) type, of such capacity of the load cell in use that the maximum force required to pull out the wires shall not exceed 85 % nor be less than 15 % of the rated capacity. The rate of travel of the power actuated grip shall be 50 ± 5 mm/min, or up to 150 ± 15 mm/min by agreement between the purchaser

and the seller. The specifications and methods of calibration and verification shall conform to Specification D76.

6.3 *Top Grip*,³ designed as shown in Fig. 2 shall be a special holder made for the vulcanized block sample. The bottom grip may be any type clamp of sufficient capacity to handle the specimen and designed to prevent its slippage in the grip⁴ or to prevent premature filament breakage.

6.4 *Vulcanizing Press*, large enough to accommodate the mold, and capable of exerting at least 70 kN total force on the mold.⁵ Electrical or steam heat for the top and bottom platens shall be provided, of sufficient capacity for maintaining the mold components at a temperature within 3°C of the requirements for the rubber compound being used.

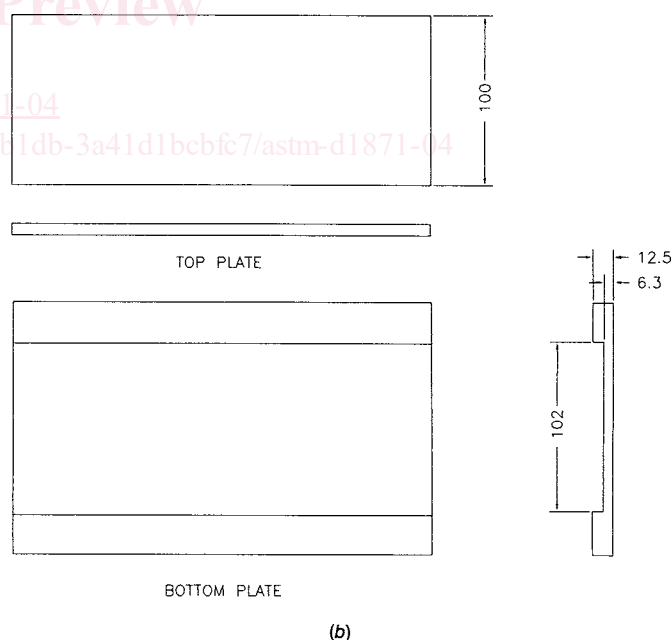
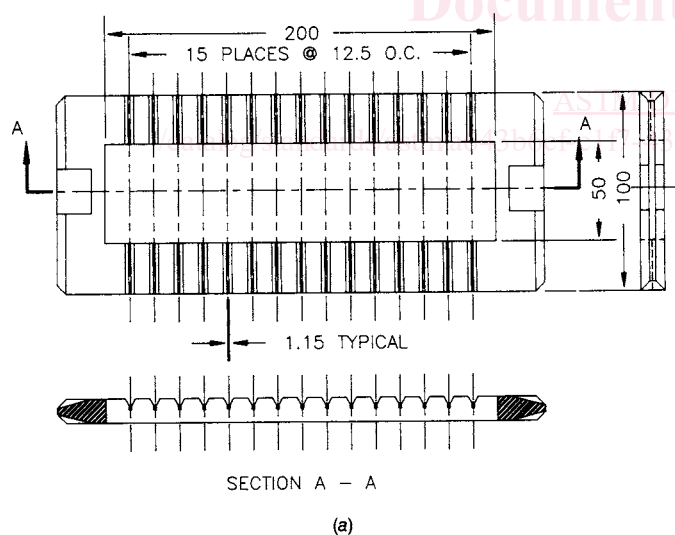
6.5 *Solvent*, used for the preparation of the rubber and wire in this test method shall be such that the surface of the rubber will be freshened and the wire surface cleaned without adversely affecting the adhesion. If remilled or freshly milled compound is used, the use of a solvent can be left to mutual agreement between the user and the supplier of the compound.

6.5.1 A suitable solvent has been found to be lead-free gasoline (normal heptane) with a distillation range from 40 to 141°C and a maximum recovery of 97 %, available from most

³ Suitable molds and block holder are available from Bartell Machinery Systems Corp., Rome, NY 13440.

⁴ Series 2710 screw action grips, Series 2716 wedge action grips from Instron Corp., 2500 Washington St., Canton, MA 02021, and Scott A420 clamps from GCA/Precision Scientific, 3737 W. Cortland St., Chicago, IL 60647, have been found practical for testing single filament wire.

⁵ Suitable vulcanizing presses are manufactured by Given P-H-I, Pasadena Presses, 1100 John Reed Court, City of Industry, CA 91745.



TOLERANCES
All dimensions ± 0.2
Angular $\pm \frac{1}{2}^\circ$
Except where noted

NOTE 1—Material—Steel.

NOTE 2—Break all sharp corners.

NOTE 3—All dimensions in millimetres except where noted.

FIG. 1 Mold with Top and Bottom Plates