



Designation: D378 – 24

Standard Test Methods for Rubber (Elastomeric) Conveyor Belting, Flat Type¹

This standard is issued under the fixed designation D378; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 These test methods (and references) cover the procedures for evaluating the physical properties of flat conveyor belting. Performance criteria for belting will not be detailed here, but can be found through the RMA (Rubber Manufacturers Association) Conveyor and Elevator Belt Handbook, ANSI (American National Standards Institute), various governmental authorities, and the International Organization for Standardization (ISO). Belting for conveying and elevating materials generally is designated and defined as follows:

1.1.1 *Heavy Duty Conveyor*—A heavy duty belt is defined as belting designed for bulk haulage of materials, such as stone, crushed rock, sand, metals ores, coal, wood chips, etc., and has a carcass strength (design) substantial enough to withstand conveyor system tensions of 160 PIW and above.

NOTE 1—PIW is an abbreviation for pounds per inch of width commonly used in the conveyor belt industry.

1.1.2 *Light Duty Conveyor*—A light duty belt is defined as belting designed for conveying a variety of lower weight materials, packages, industrial and electronic goods, and food products. These belts often are shorter in length and width, with less overall thickness than heavy duty belting, and are generally used in conveyor systems with tensions less than 160 PIW.

1.1.3 *General Description*—Belting can have elastomeric coverings on one side, both sides, or neither side depending upon the specific application requirements. Belt coverings are comprised of various synthetic or natural rubber polymers, PVC, or other elastomeric materials, dependent upon application or customer requirements. The load bearing member(s) of most belting is generally a woven or interwoven carcass of synthetic or natural fibers such as, but not limited to, polyester, nylon, polyaramid, cotton, as well as steel (cable/cord type or woven mesh).

1.1.4 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.2 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.3 *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

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

D413 Test Methods for Rubber Property—Adhesion to Flexible Substrate

D471 Test Method for Rubber Property—Effect of Liquids

D573 Test Method for Rubber—Deterioration in an Air Oven

D624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

D865 Test Method for Rubber—Deterioration by Heating in Air (Test Tube Enclosure)

D1149 Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment

D1415 Test Method for Rubber Property—International Hardness

D1894 Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheet (Withdrawn 2023)³

D2240 Test Method for Rubber Property—Durometer Hardness

D3183 Practice for Rubber—Preparation of Pieces for Test Purposes from Products

D3767 Practice for Rubber—Measurement of Dimensions

D4483 Practice for Evaluating Precision for Test Method

¹ These test methods are under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and are the direct responsibility of Subcommittee D11.31 on Rubber Hose and Belting.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. 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.

Standards in the Rubber and Carbon Black Manufacturing Industries

D5963 Test Method for Rubber Property—Abrasion Resistance (Rotary Drum Abrader)

2.2 ISO Standards:⁴

ISO 282 Conveyor Belts—Sampling

ISO 283 Textile Conveyor Belts—Full Thickness Tensile Strength, Elongation at Break and Elongation at the Reference Load—Test Method

ISO 284 Conveyor Belts—Electrical Conductivity—Specification and Test Method

ISO 340 Conveyor Belts—Laboratory Scale Flammability Characteristics—Requirements and Test Method

ISO 505 Conveyor Belts—Method for the Determination of the Tear Propagation Resistance of Textile Conveyor Belts

ISO 4649 Rubber—Determination of Abrasion Resistance Using a Rotating Cylindrical Drum Device

ISO 7590 Steel Cord Conveyor Belts—Methods for the Determination of Total Thickness and Cover Thickness

ISO 7622–1 Steel Cord Conveyor Belts—Longitudinal Traction Test—Part 1: Measurement of Elongation

ISO 7622–2 Steel Cord Conveyor Belts—Longitudinal Traction Test—Part 2: Measurement of Tensile Strength

ISO 7623 Steel Cord Conveyor Belts—Cord-to-Coating Bond Test—Initial Test and After Thermal Treatment

ISO 8094 Steel Cord Conveyor Belts—Adhesion Strength Test of the Cover to the Core Layer

ISO 9856 Conveyor Belts—Determination of Elastic and Permanent Elongation and Calculation of Elastic Modulus

2.3 RMA Technical Bulletins and Test Methods:⁵

RMA IP-1 Conveyor and Elevator Belt Handbook

2.4 U.S. Mine Safety and Health Administration (MSHA):⁶

30 CFR 14 Requirements for the Approval of Flame-Resistant Conveyor Belts

30 CFR 18.65 Flame Test of Hose

3. Summary of Test Methods

3.1 ASTM test methods are specified to the extent that they can be applied to the testing of flat belts.

3.2 Some of the test methods specified for flat belts are specific to flat belts only and do not appear in any other ASTM standard; however, some of these may involve the use of ASTM test methods.

3.3 The test methods include the following:

Test Methods	Section
Measurement of Dimensions	8
Physical Properties of Elastomeric Covers	9
Immersion Tests	10
Adhesion Tests	11
Breaking Strength and Modulus Testing	12
Flame Test for Belting	13
Carcass Tear Test	14
Troughability Test	15

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁵ Available from the Rubber Manufacturers Association, 1400 K St. N.W., Suite 900, Washington D.C. 20005, www.rma.org.

⁶ Available from Mine Safety & Health Administration, U. S. Department of Labor, 1100 Wilson Boulevard, Arlington, VA 22209, www.msha.gov.

Breaking Strength of Mechanical Fastenings (Static Test Method)	16
Elevator Belt Bolt Holding Strength Test	17
Steel Cord/Cable Belt Testing	18

4. Significance and Use

4.1 Flat conveyor belts are used in many industrial applications in which they are subjected to a great variety of stresses and conditions. Service conditions can be calculated or measured. Design levels and test requirements are established by manufacturers, or end-users, or both. The test methods are used to measure the characteristics of conveyor belting as they relate to service conditions.

4.2 The tests outlined by these test methods are commonly applied by belt manufacturers to control the quality of their products.

4.3 Research and product development activities in flat belting involve extensive testing as outlined by these test methods.

4.4 In case of conflict between the provisions of these test methods and those of detailed specifications or test methods for a particular belt, the latter shall take precedence.

5. Sampling

5.1 Test samples shall be the full width and thickness of the belt and shall be of sufficient length and width to perform the desired tests.

5.2 The level or number of samples required from each belt or lot shall be sufficient to cover the primary characteristic(s) being tested. Adhesion, overall thickness, hardness, and cover thickness testing usually requires a sample from each end of the belt or lot as a minimum. Reference ISO 282 for international sampling requirements.

6. Number of Tests

6.1 When minimum requirements are established, one specimen shall be tested for each physical characteristic required in the detailed specifications for a particular belt.

6.2 If minimum requirements are not established, a median of the values for three specimens shall be taken as the characteristics of the piece, except that under referee conditions the mean value for five specimens shall be used.

6.3 When doing immersion and aging tests it is necessary to test three specimens both before and after immersion or aging to determine a percentage change.

7. Test Conditions

7.1 Unless otherwise specified, conditioning and testing shall be carried out at a temperature of $23 \pm 2^{\circ}\text{C}$ ($73.4 \pm 3.6^{\circ}\text{F}$) and $50 \pm 5\%$ RH. Sample specimens shall be conditioned for at least three days at the standard conditions, unless otherwise specified or for manufacturing quality control.

7.2 Test pieces shall be cut or prepared at least five days after the belt is manufactured, unless otherwise specified or for manufacturing quality control.

8. Measurement of Dimensions

8.1 Width—Determine the width using a steel rule or tape graduated in millimeters (or sixteenths of an inch) in conformance with Method C of Practice [D3767](#). Record the width in millimeters (or inches) to the nearest 1 mm (0.04 in.).

8.2 Belt Length—Belt length is determined using a calibrated wheel meter or calibrated tape rule. Length should be measured on a line parallel to the sides of the belt. Record the length in meters (or feet).

8.3 Total Belt Thickness—The thickness of a full width belt sample is determined as a mean average of measurements across the full width of the sample. The number of sample points required varies according to width: three equidistant measurement points for belt widths of 600 mm (24 in.) or less, five measurement points for belts greater than 600 mm (24 in.), up to 1200 mm (48 in.), and eight points for belts greater than 1200 mm (48 in.). Report the thickness to the nearest 0.02 mm (or 0.001 in.).

8.4 Thickness of Covers—The thickness of the top or bottom cover shall be determined as follows: first, measure the over-all thickness of the test specimen; then, strip the elastomeric cover from one surface and measure the thickness of the carcass, including the remaining cover. The difference between the first and second measurements will represent the thickness of the cover removed. Follow the same procedure on the test specimen from which the first cover has been removed when the thickness of the other cover is required. The test specimen may consist of a small section cut from the belt. In many cases, especially with PVC or TPE (thermoplastic elastomer) belting of interwoven (solid woven) carcass construction, the covers cannot be removed without distorting the sample. Buffing, to remove thermoplastic cover(s) from the specimen, may be necessary. In other cases, a hand-held micrometer or optical micrometer is used to measure the thickness of the components.

8.5 Thickness of Cover When a Breaker Is Used—The thickness of the cover shall include the breaker, unless otherwise specified.

9. Physical Properties Of Elastomeric Covers Or Belt Surfaces

9.1 Tensile Strength and Elongation:

9.1.1 Apparatus—The dies, bench marker, stamp, pad, micrometer, testing machine, testing machine grips, and calibration of the testing machine shall conform to Test Methods [D412](#).

9.1.2 Preparation of Cover Pieces—Separate the covers from the carcass according to Practice [D3183](#). Buff the covers if necessary to obtain smooth parallel surfaces. If possible, cover pieces should be approximately 150 mm (6 in.) long, at least 25 mm (1 in.) wide, and approximately 2.0 mm (0.08 in.) thick. In no case shall the thickness exceed 3 mm (0.12 in.) or be less than 1 mm (0.04 in.). A meat slicer or commercial skiving tool can be used to remove adequate sample specimens from the belt cover. If cover pieces cannot be obtained from the belt, molded sheets prepared from the same unvulcanized

rubber compound with an equivalent state of vulcanization may be requested from the belt manufacturer.

9.1.3 Preparation of Test Specimen—Five test specimens shall be die cut from the separated cover sample with a steel die conforming to Dies A, B, or C of Fig. 1 of Test Methods [D412](#). The long direction of the dumbbell specimens shall be parallel with the long direction of the belt. Die B shall be used when the size of the sample and the tension and stretch limits of the testing machine permit, with exceptions as explained below. If the tension limit is too low for the machine, Die A shall be used. If the stretch limit is too high for the machine, Die C shall be used. Die C shall be used for samples that are too small for Die A or B.

9.1.4 Marking—Dumbbell specimens shall be marked with the prescribed stamp pad and either of the prescribed bench markers described in Test Methods [D412](#). Aged or immersed dumbbell specimens shall be marked after oven aging or immersion testing.

9.1.5 Procedure—Use the procedure for tensile testing, measuring and recording in accordance with Test Methods [D412](#). Measure and record the force at break in newtons (pound force), and the elongation at break to the nearest 10 %.

9.1.6 Calculations—Calculate the tensile strength of each specimen as specified in Test Methods [D412](#), in MPa (psi), and the elongation at break as a percent.

9.1.7 Report—Report the tensile strength in megapascals (pounds per square inch) and the elongation in %. Also report the die type used, the tensiometer speed, and any deviations from specified test parameters.

9.2 Cover Hardness—Refer to either Test Method [D1415](#) or [D2240](#) for procedures and calculation. The values should be expressed in International Hardness or Durometer Hardness units.

9.3 Cover Tear Test—Preparation of the sample is accomplished as described in [9.1.2](#). Test per Test Method [D624](#).

9.4 Procedure For Physical Properties Of Elastomeric Covers After Heat Aging—Use either Test Method [D573](#) or Test Method [D865](#).

9.5 Coefficients Of Friction, Static And Kinetic—Use Test Method [D1894](#).

9.6 Abrasion Resistance—Use Test Method [D5963](#) or ISO 4649.

9.7 Ozone Resistance—The effect of exposure to ozone is determined by Test Methods [D1149](#) with results reported as pass/fail for crack development after exposure to specified ozone concentrations, at specific temperatures and time durations.

9.8 Electrical Surface Resistance—Test per ISO 284.

NOTE 2—ISO 284 was originally adopted from procedure RMA 808 (Rubber Manufacturers Association).

10. Immersion Tests

10.1 Purpose—Immersion tests are necessary when determining the effects of various fluids, oils, and service media on elastomeric belt covers and belts.

10.2 Test Method—Use Test Method [D1149](#).

10.3 *Specimens*—Cover samples are obtained and prepared as in 9.1.

10.4 *Test Liquids*—For standard oil exposure use IRM 901 or IRM 903. For non-oil applications, use the actual service fluid or representative test media. Designate this medium for the test report.

10.5 *Test Conditions*—For IRM 901 or IRM 903, the test shall be 70 h at 100°C (212°F). When the actual service fluid is used, the user and the manufacturer should agree on the test conditions.

10.6 *Report*—Report the changes in tensile strength, elongation, and volume after exposure to the test fluid as a percent change. Report the test fluid and the time and temperature of exposure.

11. Adhesion Tests

11.1 *Test Method*—Use the Static Mass or Machine Method specified in Test Methods D413, using either the Type A or Type B Strip options.

11.2 *Test Specimens*—One 25 mm (1 in.) wide by 150 mm (6 in.) minimum long test specimen shall be cut with the longer dimension longitudinally from belts less than 150 mm (6 in.) wide but transversely from belts 150 mm (6 in.) and greater in width. Separate each layer a sufficient distance to permit securing it in the jaws of the testing clamp.

11.3 *Conditions*—In accordance with Section 7.

11.4 *Report*—Report the following information:

11.4.1 Identification of the belt, belt type, number of plies, cover thickness, condition (new or used), and any significant characteristics that may have an effect on the test results.

11.4.2 Test method (Static-Mass or Machine, Type A or Type B) and direction of separation.

11.4.3 Mean value of cover to carcass adhesion (if applicable) in kilonewtons per meter of width (pounds force per inch of width), as well as the thickness (top or bottom) of the cover.

11.4.4 The mean value of the ply to ply adhesion (if applicable) in kilonewtons per meter of width (pounds force per inch of width).

12. Breaking Strength and Modulus Testing of Conveyor Belting

12.1 *Apparatus*—The apparatus shall be a tensile testing machine or dynamometer capable of applying stress sufficient for the belt being tested. The clamps used for holding the test pieces should ensure perfect fixing of the pieces without slippage during the test. A transverse serrated grip surface is usually required. The heads of the testing machine shall be constructed to provide uniform lateral alignment of the clamps. The inner surfaces of the wedge-shaped slots shall be machined to within 0.1 mm (0.004 in.) of a true plane. The included angle of the two sides shall be from 17.5° to 22°. This angle must be identical to the angle of the clamps.

NOTE 3—The test apparatus, sample configuration, and procedures for testing very high tension belting, such as steel cable or aramid cord type, may be substantially different from that described here. Please refer to the

manufacturers for appropriate test protocol.

12.2 *Test Specimens*—A minimum of three test specimens. No specimen shall contain a ply joint.

12.2.1 *Conditioning*—For other than quality control, testing shall take place after conditioning the specimens for three days at standard conditions, unless otherwise agreed to by the manufacturer and the user.

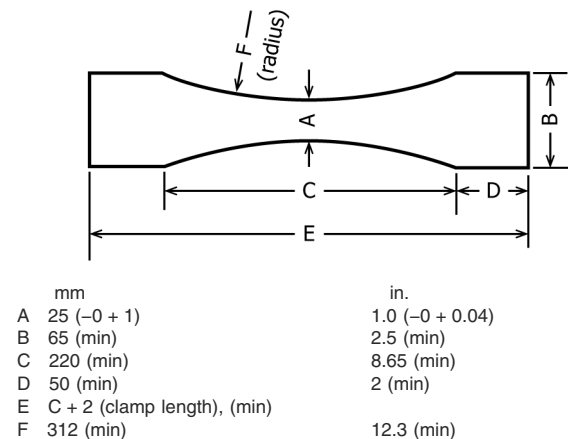
12.2.2 *Rubber Covers*—Rubber cover in excess of 3-mm (0.12-in.) thickness can be removed from the test specimen as it may be conducive to slippage in the clamps.

12.2.3 *Longitudinal (Warp) Test Specimen*—The longitudinal test specimen shall not be cut closer than 50 mm (2 in.) from the belt edge. The test specimen shall be cut parallel to the longitudinal belt axis.

12.2.4 *Transverse (Weft or Filling) Test Specimen*—The transverse test specimen shall be cut perpendicular to the longitudinal belt axis.

12.2.5 *Shape and Dimension of Test Specimens*—Test samples shall be of rectangular or dumbbell configuration (see Fig. 1). The rectangular test piece generally obtains the highest strength values but tends to show breaks at the edges of the test piece or in the clamps. The waisted or dumbbell specimen should be used when the sample exhibits excessive slippage or jaw breaks.

12.2.5.1 *Rectangular Test Specimen*—The rectangular test specimen shall be not less than 50 mm (2 in.) wide or not less than 150 mm (6 in.) plus two times the clamp length. The rectangular test specimen shall be used for elongation and modulus testing, as well as breaking strength until the specimen slips or breaks in the clamps. Specimen slippage in the clamps can be minimized by rubbing rosin on the portion of the specimen that will be in the clamps, removing any excess rosin and enclosing both sides of the rosin coated specimen with coarse emery cloth. Fold the emery cloth over the ends of the specimen with the coarse side of the cloth next to the rosin coated surfaces as the specimen is inserted into the clamps. When the rosin/emery cloth treatment will not prevent the rectangular specimen from slipping out of the clamps use the dumbbell type specimen. The ratio of specimen width in the



Other recommended dimensions are 1000 mm (39 in.), 560 mm (22 in.), and 350 mm (14 in.) (For other dimensions see ISO 2831).

FIG. 1 Dimensions of Dumbbell Test Specimen