Designation: D8115 – 17 (Reapproved 2021)

Standard Test Method for Rubber Property—Abrasion Resistance (Multi-Directional Platform Abrader)[1]

This standard is issued under the fixed designation D8115; 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 measurement of abrasion resistance of rubbers (vulcanized thermoset rubbers and thermoplastic elastomers) that are subject to abrasive/frictional wear in actual service. The abrasion resistance is measured by simultaneously moving 4 test pieces across the surface of abrasive sheets in a soft lissajous movement, and is expressed as volume loss in cubic millimeters where a smaller number indicates better abrasion resistance.

1.2 Test results obtained by this test method shall not be assumed to represent the wear behavior of rubber products in actual service.

1.3 Results obtained by this test have shown to be similar to those obtained using Test Method D5963 and ISO 4649.

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

1.5 *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.*

1.6 *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]

D297 Test Methods for Rubber Products—Chemical Analysis

D2240 Test Method for Rubber Property—Durometer Hardness

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

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 *ISO Standards:*[3]

ISO 868 Plastics and Ebonite—Determination of Indentation Hardness by Means of a Durometer (Shore Hardness)

ISO 2781 Rubber, Vulcanized—Determination of Density

ISO 4649 Rubber, vulcanized or thermoplastic—Determination of abrasion resistance using a rotating cylindrical drum device

ISO 7619 Rubber—Determination of Indentation Hardness by Means of Pocket Hardness Meters

3. Terminology

3.1 *Definitions:*

3.1.1 *abrasion loss, A, (mm^3), n*—the volume loss of a defined rubber test piece determined by sliding the test piece under specified conditions over the surface of an abrasive sheet mounted to an abrading table of specified dimensions.

4. Summary of Test Method

4.1 This test method provides procedures for preparing test pieces of specified dimensions from vulcanized thermoset rubbers or thermoplastic elastomers and for evaluating their abrasion resistance by sliding a test piece across the surface of an abrasive paper attached to an abrading table.

4.2 The test is performed under specified conditions of contact pressure, sliding distance, travel speed of the test piece, and the degree of abrasiveness of the abrasive sheet. These are outlined in 7.1.

4.3 The abrasion resistance is reported as abrasion loss (volume) in cubic millimeters and is calculated from the mass

[1] This test method is under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and is the direct responsibility of Subcommittee D11.15 on Degradation Tests.

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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] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

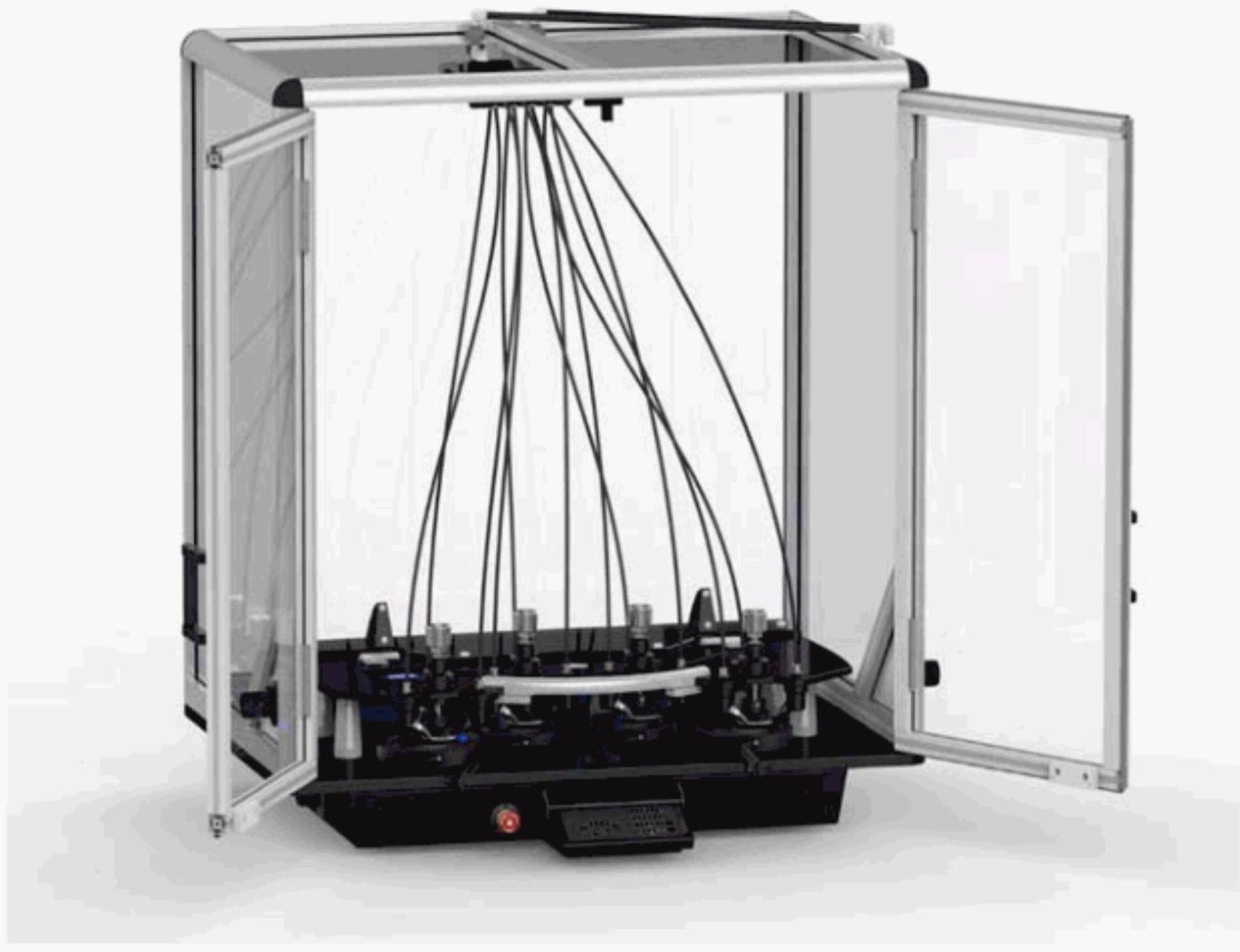

FIG. 1 Multi-Directional Platform Abrader

loss of the test piece and density of the test rubber. A smaller number indicates a higher resistance to abrasion.

5. Significance and Use

5.1 Abrasion resistance is a performance factor of paramount importance for many rubber products, such as tires, conveyor belts, power transmission belts, hoses, footwear, and floor covering. A test capable of measuring resistance to abrasion of rubber, including uniformity of wear behavior under abrasive/frictional service conditions is therefore highly desirable.

5.2 This test method may be used to estimate the relative abrasion resistance of different rubbers. Since conditions of abrasive wear in service are complex and vary widely, no direct correlation between this accelerated test and actual performance can be assumed.

5.3 This test method is suitable for comparative testing, quality control, specification compliance testing, referee purposes, and research and development work.

6. Limitations

6.1 Test pieces containing voids or porosity, or both, will yield unreliable test results.

6.2 Test pieces that bounce (chatter) over the surface of the abrasive sheet rather than running smoothly will produce inaccurate test results and are not candidates for this test method.

6.3 Test pieces that tend to extensively smear the surface of the abrasive sheet will provide meaningless test results.

6.4 Test results obtained under any of the above conditions shall not be used to reach conclusions regarding the relative abrasion resistance of rubbers.

7. Apparatus and Materials

7.1 *Multi-Directional Platform Abrader:*

7.1.1 The Multi-directional Platform abrader[4] consists of a machine frame holding one or more test piece holders moving in a soft lissajous pattern, a corresponding number of abrasion tables to which an abrasive sheet can be fastened, and a drive system (example shown in Fig. 1).

7.1.2 The non-rotating test piece holders grip the specimens (example shown in Fig. 2). Sample protrusions of 2.0 ± 0.2 mm are set by shims. The combined weight of the test piece holder and spindle assembly apply a force of 6 ± 0.1 N on the specimen.

7.1.3 The soft lissajous pattern, measuring 60 mm by 60 mm ± 1 mm is shown in Fig. 3.

7.1.4 The abrasion tables, measuring 121 ± 1 mm diameter are shown in Fig. 4.

7.1.5 Air nozzles are provided for each abrasion table to blow away any debris and help to prevent clogging of the abrasive paper. Air pressure should be sufficient to remove debris from the abrasive paper, up to a maximum of 8 Bar. Care should be taken that the air pressure does not lift the specimen off of the abrasive paper.

7.1.6 The machine operates at 48 rpm.

7.1.7 The abrasive sheet shall be secured tightly to the abrading tables using clamp rings or an equivalent method. See Fig. 4.

[4] The sole source of supply of the apparatus known to the committee at this time is James Heal, Lake View, Halifax, UK HX3 6EP. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

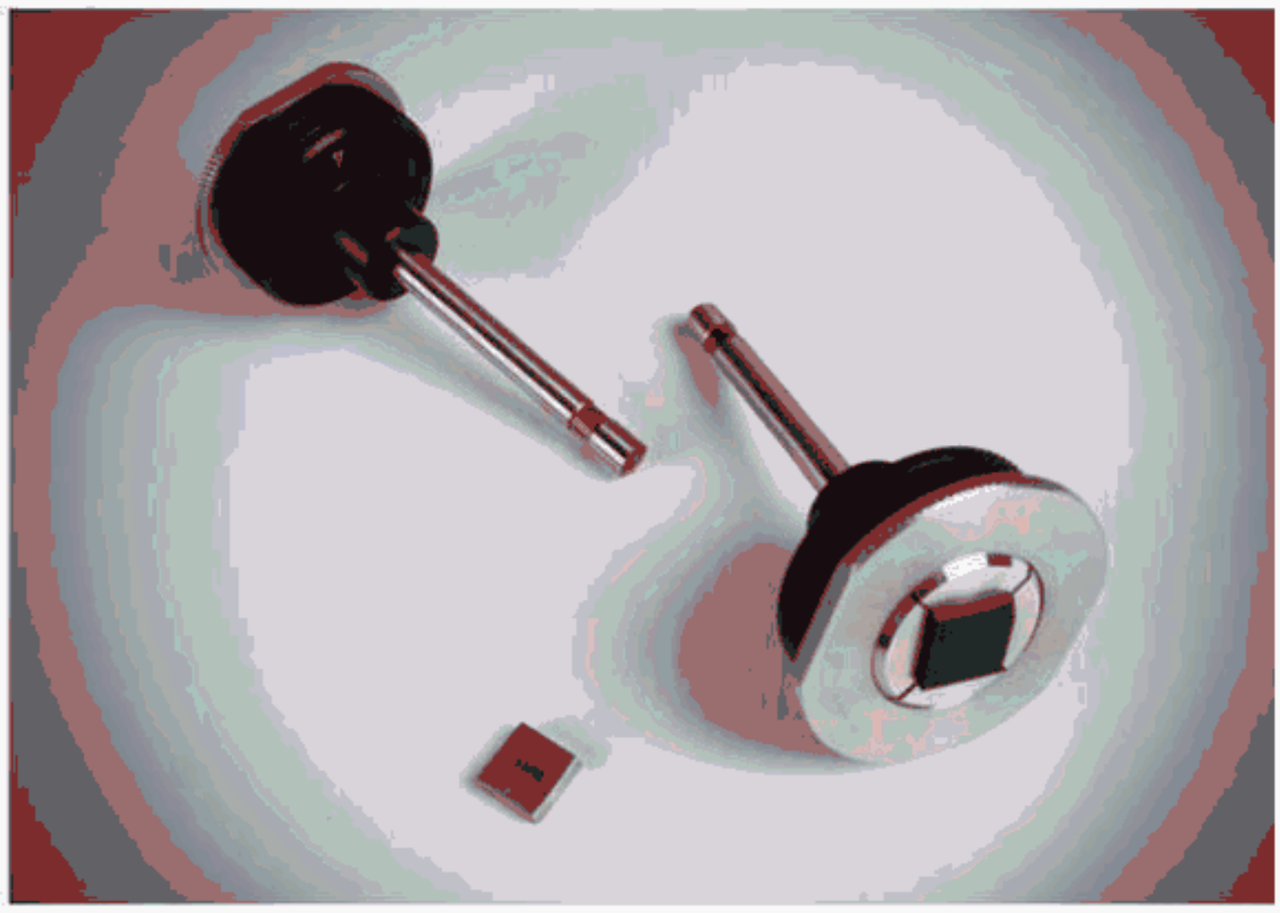

FIG. 2 Test Piece Holder and Spindle Assembly

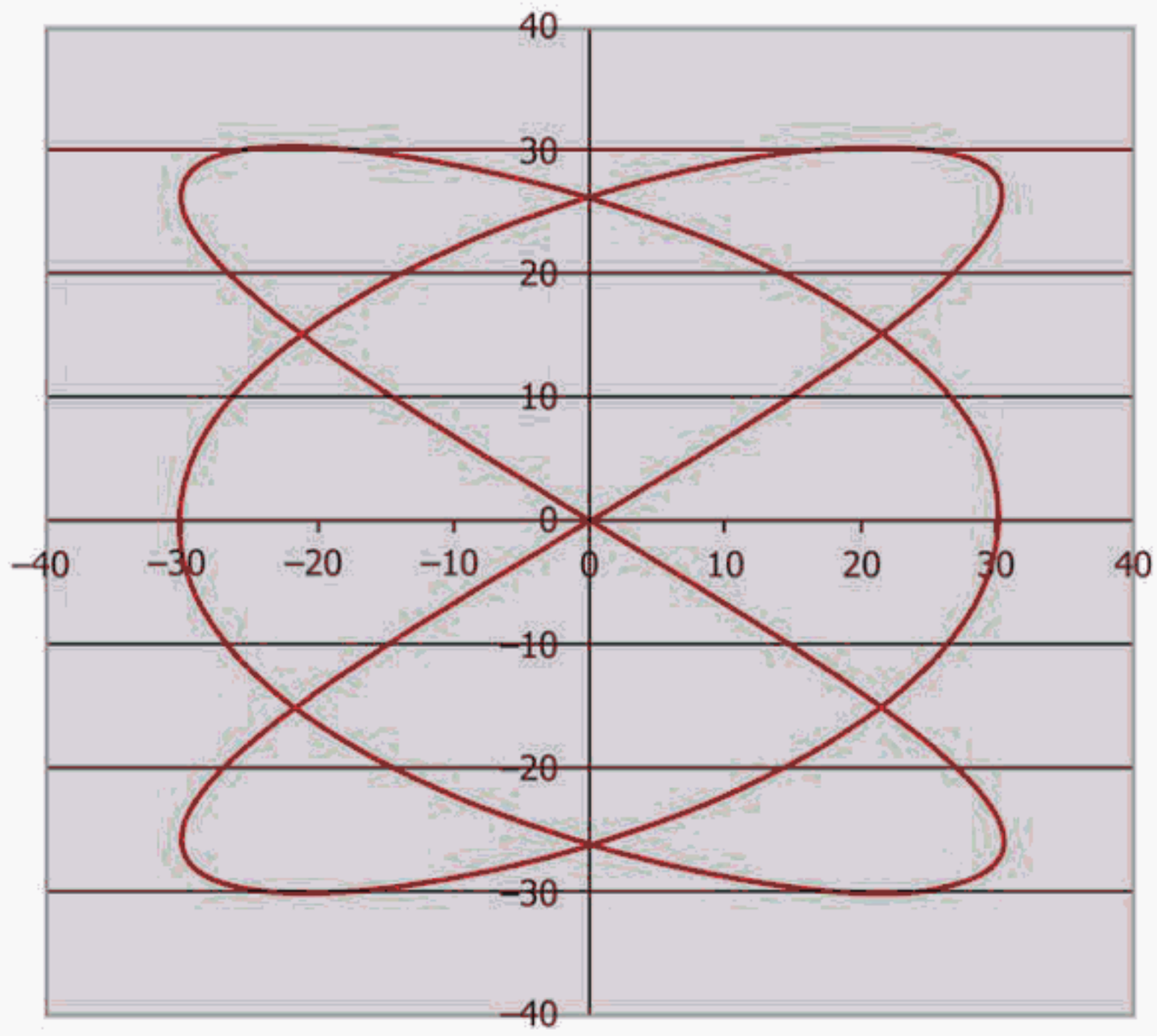

FIG. 3 Soft Lissajous

7.1.8 The test piece holder shall be mounted on to the spindle assembly which is then inserted into position in the machine frame. See the final assembly in Fig. 4.

7.1.9 The center axis of the test piece holder shall be perpendicular to the abrading table.

7.1.10 The test piece holder shall consist of an aperture sufficient to grip the specimen without distortion of the specimen.

7.1.11 A vacuum hose may be used to aid removal of debris.

7.2 *Abrasive Paper*—Silicon carbide abrasive paper of 140 mm diameter shall be used as the abrasive medium.

7.2.1 The abrasive paper shall be of an abrasiveness as to cause a mass loss between 190 and 210 mg on Standard Rubber #1 specified in Section 8. As this abrasive paper is commercially available it is possible that the abrasiveness may change between lots and therefore the number of rubs required to achieve between 190 and 210 mg weight loss when tested on Standard Rubber #1 specified in Section 8 may change and shall be recorded in the test report.

7.3 *Test Specimen Cutting:*

7.3.1 When obtaining test specimens a cutting jig may be used. See Fig. 5.

FIG. 4 Abrasion Tables with Air Nozzles

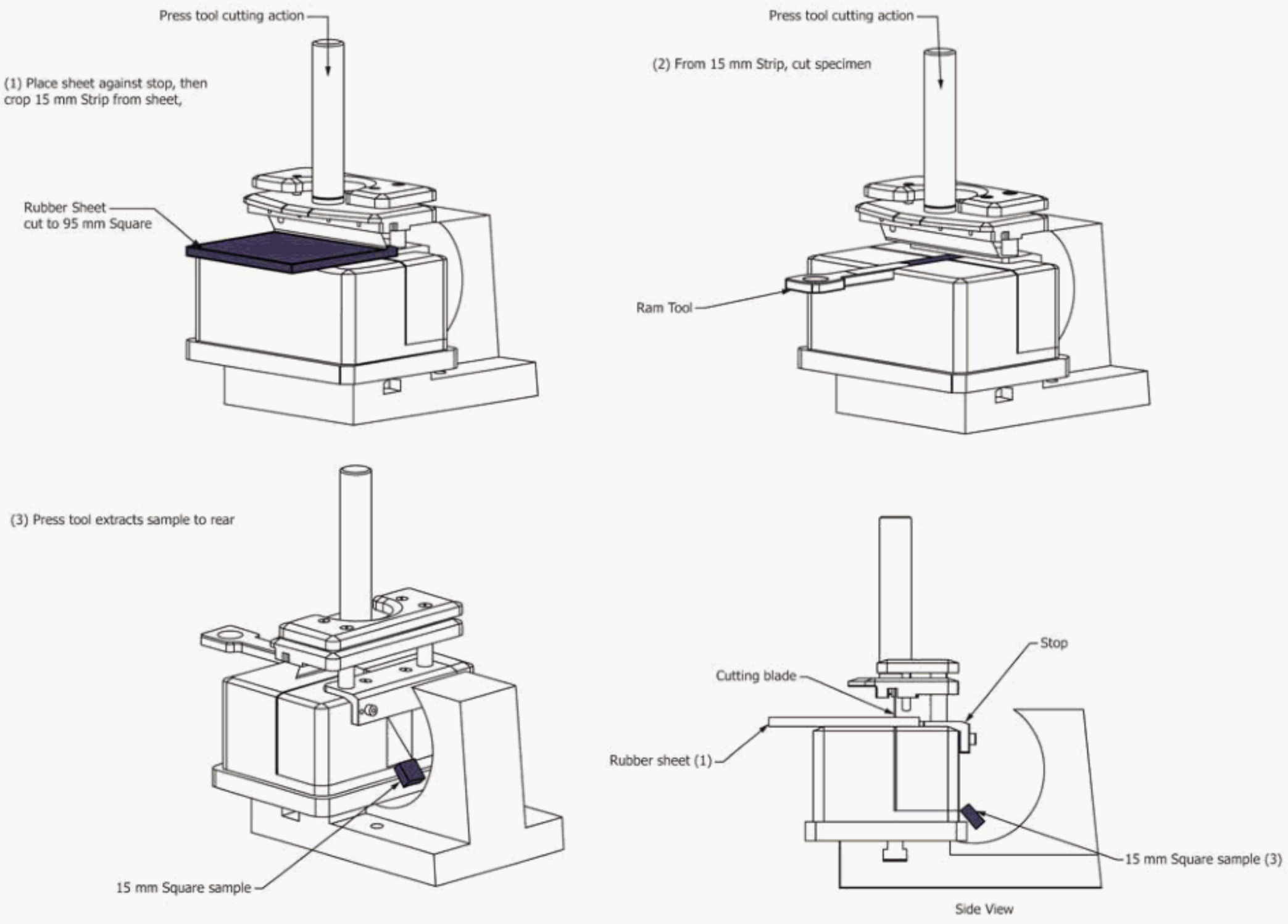

FIG. 5 Specimen Cutting Jig

7.3.2 Alternative means of cutting specimens, such as molding, maybe used so long as the specimen dimensions are within the tolerances allowed. See Section 9.

8. Standard Rubber

8.1 Standard Rubber #1 as specified in Test Method D5963 is used to verify the abrasiveness of the abrasive paper sheet.

9. Preparation of Test Specimens

9.1 Test specimens are rectangular blocks with dimensions of 15 mm by 15 mm (±0.2 mm) and a depth between 6 mm and 10 mm (±0.2 mm).

9.2 Test specimens are obtained from sheets, vulcanized or formed in an appropriate mold, between 6 mm and 10 mm in thickness, using the cutting jig in accordance with 7.3.

9.3 If test specimens of the required thickness are not available, the necessary thickness may be obtained by bonding specimen of at least 2 mm (0.08 in.) to a base piece having a durometer hardness of no less than Type A80/1 (see Test Method D2240, ISO 868, or ISO 7619).

9.3.1 Care shall be taken that test specimens prepared in this manner are not abraded to the bond line during the course of the testing procedure.

9.3.2 Exposing the bond during the test procedure invalidates the test determination.

9.4 When testing finished products, such as fabric-reinforced conveyor belts, test specimens shall be obtained directly, when possible, from the entire finished product, including the fabric or any integral layers. They may be obtained from test pieces, when necessary.

9.4.1 In this case, it is also important that test specimens (having been obtained from the finished product or sample) are not abraded to an adhesive layer, layer of fabric, or other integral, but heterogeneous material, and that only the rubber layer being tested for abrasion is subjected.

9.4.2 Exposing bonded or heterogeneous layers during the test procedure invalidates the test determination.

10. Procedure

10.1 The test shall be carried out at 23 ± 5°C (73 ± 9°F) and no sooner than 16 h after vulcanization or forming of the test compounds.

10.2 The density of the rubbers to be tested shall be determined using a hydrostatic method (see Test Methods D297 or ISO 2781).

10.3 *Method:*

10.3.1 The abrasive sheet shall be tested for abrasiveness to ensure a mass loss between 190 and 210 mg on Standard Rubber #1, as specified in 7.2.1 and 8.1.

10.3.2 If the mass loss of the Standard Rubber #1 falls between 190 and 210 mg then the specimen are abraded for 270 rubs. If the number of rubs required to achieve between 190 and 210 mg mass loss differs from 270 rubs then the specimens are tested according to the required number of rubs and the number of rubs is recorded in the test report.

10.3.3 The abrasive sheets shall be mounted on the four abrading tables. The sheets shall remain free from folds and creases during mounting. Secure with the clamp rings.

10.3.4 Four test pieces shall be run. The results shall be expressed as the mean value.

10.3.5 The test pieces shall be weighed to the nearest 1 mg and firmly fixed into the holder so that it protrudes 2.0 ± 0.2 mm (0.08 ± 0.008 in.) from the opening of the holder.

10.3.6 Test the specimens to 270 rubs, unless an alternative number of rubs is required (see 10.3.2).

10.3.7 After the test the test piece is reweighed to the nearest 1 mg. Any loose material shall be removed from the test piece prior to weighing.

10.3.8 If very high mass losses are encountered (600 mg or more per 270 rubs), it may be necessary to terminate the test after 135 rubs. This shall be noted in the test report and the volume loss reported for 270 rubs by multiplying the value by two.

11. Calculation of Test Results

11.1 *Calculation of Abrasion Loss*—Calculate the abrasion loss, *A*. A loss in mass (mean value of 4 simultaneous tests) shall be converted into volume loss using the density (volume loss equals mass loss divided by density) of the test rubber.

$$\Delta V = \frac{m_1 - m_2}{\rho} \times 1000 \quad (1)$$

where:

ΔV = wear volume (mm^3)
m_1 = mass of the specimen before (g)
m_2 = mass of the specimen after (g)
ρ = density of the sample (g/cm^3)

NOTE 1—The volumetric wear is determined at each of at least four samples.

NOTE 2—The volume loss of non-porous test pieces may also be determined by forced immersion in a buoyant medium, such as water, before and after the test run, instead of weighing the loss in mass and converting this from the density. The volume for the test piece is then obtained by weighing the displaced mass of the buoyant medium.

12. Test Report

12.1 Report the following information:

12.1.1 Type and identification of the product under test,

12.1.2 Date and temperature of testing,

12.1.3 Rubber compound details, if available (rubber type, vulcanization temperature, and time),

12.1.4 Density of the test rubbers,

12.1.5 Method of test piece preparation (cut or molded),

12.1.6 The lot number of the abrasive paper,

12.1.7 The numbers of rubs for test specimens,

12.1.8 The number of rubs required to cause a mass loss between 190 and 210 mg for Standard Rubber #1,

12.1.9 The mean value of the abrasion loss in mm^3,

12.1.10 The standard deviation of the test result (optional), and

12.1.11 Any deviations from standard test methods, that is, speed, type of abrasive paper, air pressure.

13. Precision and Bias[5]

13.1 The precision of this test method is based on an intralaboratory study conducted in 2016. A single laboratory participated in this study, testing three different types of rubber sheets. Every "test result" represents an individual determination. The laboratory reported three replicate test results for each material. Except for the use of only one laboratory, Practice E691 was followed for the design and analysis of the data.

13.1.1 *Repeatability (r)*—The difference between repetitive results obtained by the same operator in a given laboratory applying the same test method with the same apparatus under

[5] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D11-1140. Contact ASTM Customer Service at service@astm.org.

constant operating conditions on identical test material within short intervals of time would in the long run, in the normal and correct operation of the test method, exceed the following values only in one case in 20.

13.1.1.1 Repeatability can be interpreted as maximum difference between two results, obtained under repeatability conditions, that is accepted as plausible due to random causes under normal and correct operation of the test method.

13.1.1.2 Repeatability limits are listed in Table 1.

13.1.2 *Reproducibility (R)*—The difference between two single and independent results obtained by different operators applying the same test method in different laboratories using different apparatus on identical test material would, in the long run, in the normal and correct operation of the test method, exceed the following values only in one case in 20.

13.1.2.1 Reproducibility can be interpreted as maximum difference between two results, obtained under reproducibility conditions, that is accepted as plausible due to random causes under normal and correct operation of the test method.

TABLE 1 Mean Value of Abrasion Loss (mm^3)

Material	Average	Repeatability Standard Deviation	Repeatability Limit
	$\bar{x}$	s_r	r
NR sheet	164.51	3.48	9.73
SBR/NR sheet #1	136.73	4.28	11.98
SBR/NR sheet #2	193.61	4.13	11.55

13.1.2.2 Reproducibility limits cannot be calculated from a single laboratory's results.

13.1.3 The above terms (repeatability limit and reproducibility limit) are used as specified in Practice E177.

13.1.4 Any judgment in accordance with 13.1.1 would normally have an approximate 95 % probability of being correct, however, the precision statistics obtained in this ILS must not be treated as exact mathematical quantities which are applicable to all circumstances and uses. The limited number of laboratories reporting replicate results essentially guarantees that there will be times when differences greater than predicted by the ILS results will arise, sometimes with considerably greater or smaller frequency than the 95 % probability limit would imply. Consider the repeatability limit as a general guide, and the associated probability of 95 % as only a rough indicator of what can be expected.

13.2 *Bias*—At the time of the study, there was no accepted reference material suitable for determining the bias for this test method, therefore no statement on bias is being made.

13.3 The precision statement was determined through statistical examination of 9 results, from a single laboratory, on 3 different materials.

14. Keywords

14.1 abrader; abrasion; abrasion resistance; frictional wear; mass loss; multi-directional platform abrader; rotary drum abrader; volume loss