



Designation: ~~D3939-08~~ Designation: D 3939 – 09

Standard Test Method for Snagging Resistance of Fabrics (Mace)¹

This standard is issued under the fixed designation D 3939; 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 This test method determines the snagging resistance of a fabric.

1.2 Studies of fabric snagging have shown that this test method is suitable for a range of woven and knitted fabrics made from textured or untextured filament yarns or spun yarns or combinations of these yarns.^{2,3} This test method is not suitable for (1) open construction fabrics (such as a net) because the points on the mace will snag the felt pad rather than the specimen, (2) very heavy or very stiff fabrics that cannot be made to fit tightly on the drum and felt pad, and (3) tufted or nonwoven fabrics because the apparatus is designed for woven and knitted fabrics.

1.3 If after using this test method it is found to be too severe for your fabrics, an alternative method can be used, such as BS 8479 Textiles: Method for Determination of the Propensity of Fabrics to Snagging and Related Surface Defects - Rotating Chamber Method.

1.4 The values stated in either acceptable metric units or in other units shall be regarded separately as the standard. The values stated in each system may not be exact equivalents; therefore, each system must be used independently of the other, without combining values in any way. In case of referee decisions, the metric units will prevail.

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 and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*⁴

D 123 Terminology Relating to Textiles

D 1335 Test Method for Tuft Bind of Pile Yarn Floor Coverings

D 1776 Practice for Conditioning and Testing Textiles

D 2724 Test Methods for Bonded, Fused, and Laminated Apparel Fabrics

D 3136 Terminology Relating to Care Labeling for Apparel, Textile, Home Furnishing, and Leather Products

D 4467 Practice for Interlaboratory Testing of a Textile Test Method That Produces Non-Normally Distributed Data

D 4850 Terminology Relating to Fabrics and Fabric Test Methods

D 5362 Test Method for Snagging Resistance of Fabrics (Bean Bag)

2.2 *AATCC Standards:*⁵

65 Test Method for Snag Resistance of Women's Nylon Hosiery (see Note 1)

135 Test Method for Dimensional Changes in Automatic Home Laundering of Woven and Knit Fabrics

NOTE 1—In 1988, the AATCC voted to withdraw this test method from its technical manual; however, the ASTM task group on fabric snagging decided it should be listed as an alternative for testing open construction fabrics.

3. Terminology

3.1 For definitions of textile terms used in this test method: (color contrast, in textiles; distortion, in fabrics; protrusion, in fabrics; snag, in fabrics; snagging resistance, in fabrics), refer to Terminology D 4850.

3.2 For definitions of other textile terms used in this test method, refer to Terminology D 123.

¹ This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.59 on Fabric Test Methods, General. Current edition approved July 1, 2008-2009. Published October 2008-June 2009. Originally approved in 1980. Last previous edition approved in 2004-2008 as D3939-03(2004)-D 3939 – 08.

² Finnigan, J. A., "Laboratory Prediction of the Tendency of a Fabric to Snag During Wear," *Textile Institute and Industry*, Vol 10, No. 6, 1972, pp. 164–167.

³ Leung, P., and Hershkowitz, R., "Snag- and Fuzz-Resistant Double Knits via Fabric Construction," *Textile Research Journal*, Vol 45, No. 2, 1975, pp. 93–102.

⁴ 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.

⁵ Available from American Association of Textile Chemists and Colorists (AATCC), P.O. Box 12215, Research Triangle Park, NC 27709, <http://www.aatcc.org>

4. Summary of Test Method

4.1 A tubular specimen is placed on a cylindrical drum. Then a mace (spiked ball) bounces randomly against the rotating specimen. Snags are produced to a degree affected by a variety of factors. The degree of fabric snagging is then evaluated by comparison of the tested specimens with visual standards that may be either fabrics or photographs of fabrics. The observed resistance to snagging is reported on a scale ranging from 5 (no or insignificant snagging) to 1 (very severe snagging).

5. Significance and Use

5.1 This test method is not considered satisfactory for acceptance testing of commercial shipments of fabrics because the between-laboratory precision of the test method is poor (see 15.1).

5.1.1 If there are differences of practical significance between reported test results for two laboratories (or more), comparative test should be performed to determine if there is a statistical significant difference between them, using competent statistical assistance. As a minimum, use the samples for such a comparative test that are as homogeneous as possible, drawn from the same lot of material as the samples that resulted in disparate results during initial testing and randomly assigned in equal numbers to each laboratory. The test results from the laboratories involved should be compared using a statistical test for unpaired data, at a probability level chosen prior to the testing series. If bias is found, either its cause must be found and corrected or future testing for that material must be adjusted in consideration of the statistically significant differences.

5.2 This test method may be used for quality control testing of fabrics during manufacturing and product comparisons of different fabrics by manufacturers, retailers, and users. This test method may also be used by researchers to examine the effect of new fibers, yarns, fabric constructions, and finishes on the snagging resistance of fabrics.

5.3 This test method may be used to test the snagging resistance of most apparel and home furnishings fabrics. However, a different test method may be needed for different types of fabrics and different end-uses (such as towels, pants, and upholstery) (see 5.3.1).

5.3.1 Some fabrics that may not be suitable for this test method are described in 1.2. Many open construction fabrics can be tested for snagging resistance using AATCC Test Method 65. The snagging resistance of many pile floor coverings can be tested by Test Method D 1335. Test Method D 5362 (Bean Bag) may also be considered as an alternative for testing the snagging resistance of fabrics. (Bean Bag) may also be considered as an alternative for testing the snagging resistance of fabrics. This test method does not apply to the ABC Snag Tester.

5.4 Since fabric snagging can be affected by laundering or drycleaning, it may be advisable to test the snagging resistance of a fabric before and after laundering or drycleaning.

5.5 The snagging resistance of a specific fabric varies with individual wearers and general conditions of use. Therefore, it can be expected that garments of the same fabric will show a fairly wide snagging resistance spectrum after wear and much greater variation in wear than in replicate fabric specimens subjected to controlled laboratory tests. This factor should be considered when adopting levels of acceptability for any specification that includes snagging resistance.

5.6 Snags observed in worn garments vary appreciably in number and appearance. The appearance of a snag depends particularly on (1) the degree of color contrast between the snag and the surrounding area of the fabric or (2) the presence of long distortions or long protrusions. These conditions are not evaluated when snagging is rated solely on the number of snags. See Section 13 for a description of color contrast, distortion, and protrusion as used in this test method; and see Figs. 1 through 3 in Test Method D 5362 for pictures of fabric defects due to snagging. Because the overall acceptability of a specific fabric is dependent on both the characteristics of the snags and other factors affecting fabric appearance, it is recommended that fabrics tested in the laboratory be evaluated with regard to the defects that may be observed visually and not rated solely on the number of snags developed. A series of visual rating standards (see 6.2.5.2.4) may be set up to provide a basis for the ratings. The visual rating standards are most advantageous when the tested laboratory specimens correlate closely in appearance with fabrics from a wear test, for example, when tested laboratory specimens and fabrics from a wear test show similar color contrasts. In the preceding example, a series of fabrics from the wear test would be a good choice for the fabric standards described in 6.2.5.2.4.2.

6. Apparatus and Materials

6.1 Procedure 1

6.1 ICI Mace Snag Tester (see Fig. 1):

6.1.1 ~~ABC Snag Tester~~—(see Fig. 1). Specimen Templates, 205 by 330 mm or 8 by 13 in. for weft knit fabrics and 205 by 320 mm or 8 by 12.5 in. for woven fabrics and warp knit fabrics.

6.1.2 ~~Specimen Template~~,⁶ 150 by 330 mm or 6 by 13 in. Felt Sleeves, Green, (70% wool, 30% rayon), 1.6 mm or 1/16th in. in thickness, approximately 235 g/m² or 7 oz/yd².

6.1.3 ~~Felt~~, for 150- by 330-mm or 6- by 13-in. pads. Gage, for setting position of mace (calibration block).

6.1.4 ~~Gage~~,⁶ for ABC Snag Tester, for setting position of mace (calibration block).

6.1.5 ~~Masking Tape~~, 25-mm or 1-in. single-face, and 50-mm or 2-in. double face.

6.2 Both Procedures:

6.2.1 Rubber O-rings.

6.2 ~~Sewing Machine~~, with a sewing needle that is appropriate for the fabric being tested for snagging resistance, or

6.2.2

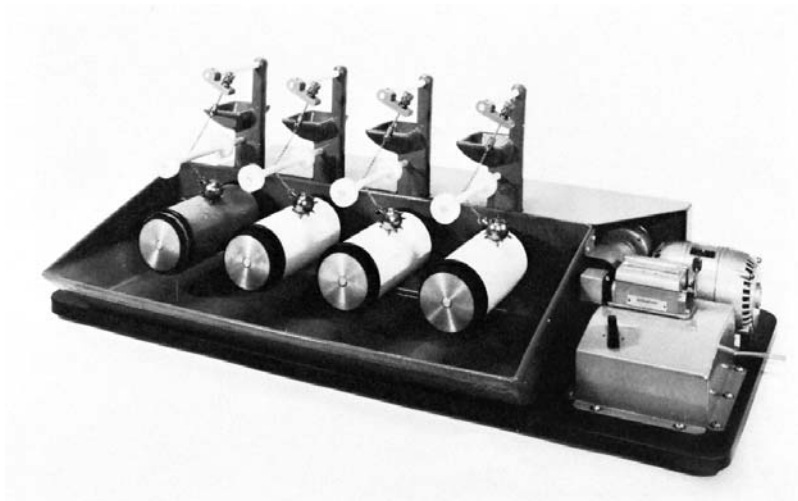


FIG. 1 ICI Mace Tester

6.2.1 *Sharps Hand Sewing Needle* .

6.2.3

6.2.2 *Sewing Thread*, cotton, Tex ticket 35 to 50, or equivalent polyester and cotton.

6.2.4

6.2.3 *Standard Calibration Fabric* , having an established snagging resistance rating that has been agreed upon by the purchaser and the supplier. (No standard calibration fabric has been specified by Subcommittee D13.59.)

6.2.5

6.2.4 *Visual Rating Standards*:

6.2.5.1

6.2.4.1 *Photographic Standards*—A series of photographs of tested specimens that show the degrees of snagging, such as the Imperial Chemical Industries (ICI) photographs;⁶or

6.2.5.2

6.2.4.2 *Fabric Standards*—A series of tested specimens or fabrics from a wear test that show the degrees of snagging (see 5.6 and Note 2).

NOTE 2—Fabric standards should be stored and handled under conditions that will preserve their original form and appearance. Mount the fabric standards using white poster board or plastic or metal framing.

6.2.6

6.2.5 *Apparatus for Fabric Evaluation* , for illumination and simultaneous viewing of specimens and visual rating standards:

6.2.6.1

6.2.5.1 *Apparatus for Fabric Evaluation*, (see Fig. 2),⁶having a single cool white fluorescent (CWF) tube with a correlated color temperature of 4100 to 4500 K, or

6.2.6.2

6.2.5.2 *ICI Viewing Cabinet*, (see Fig. 3),⁶having a single cool white fluorescent (CWF) tube with a correlated color temperature of 4100 to 4500 K.

6.3 *Optional Equipment*:

6.3.1 *Steam Iron*, weighted to 2.3 kg or 5 lb and an ironing board.

6.3.2 *Tumble Dryer*, as described in AATCC Test Method 135.

6.3.3 *Washing Machine*, as described in AATCC Test Method 135.

6.3.4 *Detergent, Heavy Duty Granule* , the 1993 AATCC Standard Reference Detergent as described in AATCC Test Method 135. When agreed upon by the purchaser and the supplier, a substitute detergent that does not include fabric softener or bleach may be used.

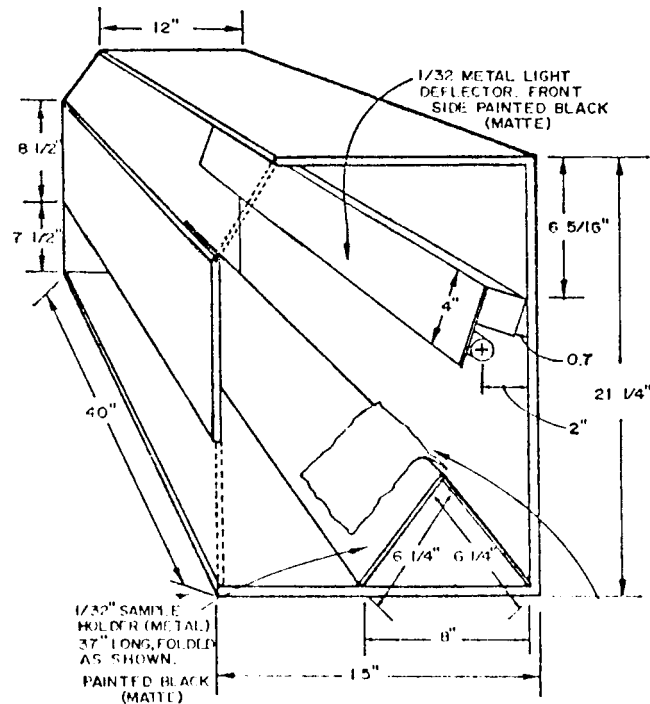
6.3.5 *Equipment for Drycleaning Specimens* , as described in Test Methods D 2724.

7. Hazards

7.1 Locate the mace snag tester in a low-traffic area because of the danger from the exposed mace and rotating drum.

⁶For additional information on obtaining apparatus, equipment, or supplies that may be suitable for use in this standard, please visit the ASTM Manufacturers' Equipment Directory at www.astm.org

⁶The sole source of supply of the apparatus known to the committee at this time is DL Atlas LLC, 1813A Associates Lane, Charlotte, NC 28217. 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, which you may attend.



Metric Equivalents

in.	mm	in.	mm
1/32	1	8	203
0.7	18	8 1/2	215
2	50	12	305
4	100	15	380
6 1/4	159	21 1/4	540
6 5/16	160	37	940
7 1/2	190	40	1020

FIG. 2 Apparatus for Fabric Evaluation

<https://standards.iteh.ai/catalog/standards/sist/c5ed45ce-d5ef-4cb5-ae36-3edf7339d760/astm-d3939-09>

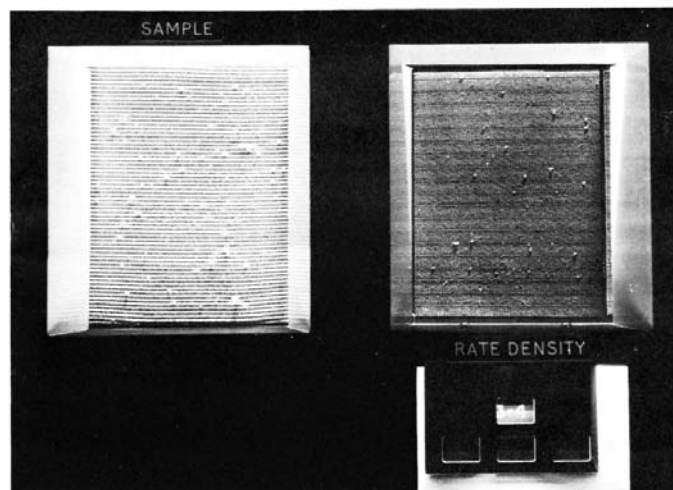


FIG. 3 ICI Viewing Cabinet

7.2 Check that all parts of the mace snag tester are secure and are in good working condition.

7.3 Wear protective gloves when examining the points on the mace snag tester or removing fibers and yarns from the mace points.

7.4 Observe the following safety precautions when operating the tester: (1) do not wear loose or dangling clothing that can get caught in the mace points or moving parts; (2) do not attempt to change a specimen while the drum is rotating; and (3) do not

injure your hands on the sharp mace points when placing a specimen on the drum.

8. Sampling

8.1 *Lot Sample*—As a lot sample for acceptance testing, take at random the number of rolls of fabric directed in an applicable material specification or other agreement between the purchaser and the supplier. Consider rolls of fabric to be the primary sampling unit.

8.2 *Laboratory Sampling Unit*—As a laboratory sampling unit for acceptance testing, take a full width swatch 1-m or 1-yd long from the end of each roll of fabric in the lot sample, after first discarding the outermost layer of fabric. When drycleaning and laundering are to be performed, take additional swatches for the laundering and drycleaning tests.

8.3 *Specimens*—Test four specimens from each swatch in the laboratory sampling unit. When drycleaning and laundering tests are to be performed, test four additional specimens for drycleaning and four additional specimens for laundering.

9. Preparation of the Specimens

9.1 When snagging resistance after laundering or drycleaning is to be evaluated, launder or dryclean the swatches as directed in 9.1.1 or 9.1.2 before cutting the specimens.

9.1.1 *Laundering*—Load the washer with a 3.5-kg or 8-lb total load of swatches that comprise a homogeneous load (for example, same manufacturer, same line, same finishing, and same previous care) or a homogeneous group of swatches for testing and a desized unsoftened group of ballast fabrics. Select normal cycle, warm water temperature, and the 1993 AATCC Standard Reference Detergent (see Terminology D 3136 and AATCC Test Method 135). Run one machine cycle and do not use softener. Load the dryer with the washed fabrics. Select normal cycle, medium temperature, and run the dryer for 20 min or until the fabrics are dry to the touch. Do not use softener in the dryer. Do not overdry the fabrics (see Note 3).

NOTE 3—When agreed upon by the purchaser and the supplier, other laundering and drycleaning procedures may be used.

9.1.2 *Drycleaning*—Follow the procedure given in Test Methods D 2724 (see Note 3).

9.2 Using the template (see 6.1.2), cut the following specimens: (1) for determination of the snagging resistance of the fabric in the lengthwise (machine) direction, cut two specimens, with the shorter dimension parallel to the lengthwise direction of the fabric; and (2) for determination of snagging resistance of the fabric in the widthwise direction, cut two specimens, with the shorter dimension parallel to the widthwise direction. Do not take the specimens nearer the selvage than one tenth the width of the fabric. If possible, randomize the specimens in such a manner that no two contain the same set of yarns. Mark each specimen near an edge to indicate the following: (1) the face side that will later be tested for snagging resistance, and (2) the type of specimen (lengthwise or widthwise direction).

9.2.1 Similarly cut specimens from laundered or drycleaned swatches, when required.

9.3 Fold each specimen face side in and form a sleeve by sewing a seam parallel to the shorter dimension of the specimen at a distance from the edge sufficient for a tight fit on the drum (see Note 4). Use a minimum of 0.4 stitches/mm or 10 stitches/in. when machine or hand sewing the seam.

NOTE 4—It might be necessary to vary the distance of the seam line from the short edges to have a good running test specimen that is smooth and snug on the drum. The ICI Mace Snag Tester is supplied with a template for cutting out and marking weft knit fabrics and a template for cutting out and marking woven fabrics and warp knit fabrics. The weft knit template provides a specimen 205 by 330 mm or 8 by 13 in., and the seam line is 30 mm or 1 1/8 in. from the short edge. The woven or warp knit template is 205 by 320 mm or 8 by 12.5 in., and the seam line is 15 mm or 5/8 in. from the short edge.

9.4 Turn each specimen (sleeve) inside out to expose the surface for testing.

10. Preparation of Apparatus

10.1 *Procedure 1 (ABC Snag Tester):*

10.1.1 Attach a piece of 50-mm or 2-in. wide double-face masking tape parallel to the axis of the long dimension of the drum.

10.1.2 Cut a piece of felt 150 by 330 mm or 6 by 13 in.

10.1.3 Wrap the felt around the drum and press the short ends into the double-face masking tape (see Fig. 4). Trim and butt the ends of the felt for a smooth fit.

10.1.4 Fasten the edges of the felt to the ends of the drum with 25-mm or 1-in. single-face masking tape. The tape should be half on the felt and half on the rubber-covered drum.

10.1.5 Replace the felt whenever its surface becomes rough, has holes, or shows excessive wear (see ICI Snag Tester).

10.1.1 Position the felt sleeve centrally on the drum, wet it with hot water, remove the surplus moisture, and allow to dry completely. Slight heat can be used to accelerate the drying, if necessary. The sleeve will fit tightly on the drum when shrunk.

10.1.2 Replace the felt whenever its surface becomes rough, has holes, or shows excessive wear (see Note 5).

10.2 *Procedure 2 (ICI Mace Snag Tester):*

10.2.1 Position the felt sleeve centrally on the drum, wet it with hot water, remove the surplus moisture, and allow to dry completely. Slight heat can be used to accelerate the drying, if necessary. The sleeve will fit tightly on the drum when shrunk.

10.2.2 Replace the felt whenever its surface becomes rough, has holes, or shows excessive wear (see Note 5).

NOTE 5—As a guide, replace the felt after no more than 200 h of running.

10.3

10.2 *Conditioning and Adjustment of Mace* (Procedures 1 and 2):

10.3.1

10.2.1 Check the points on the mace to be certain that there are no barbs or other damage by feeling the mace points for roughness. Inspect the mace points under a magnifying glass to show the bad points. Check the mace points daily, or whenever a mace position is suspected of snagging too severely or erratically. Replace the worn or damaged mace points.

10.3.2.2 Adjust the distance of the mace from the drag bar with the 45-mm or 1.8-in. calibration block, or measure as shown in Fig. 54 by adjusting the screw at the upper coupling. Check this distance daily or whenever a mace position is suspected of not working properly.

10.3.2.3 Check the mace for freedom of movement in its socket on the link chain.

10.3.2.4 Set the timing/counting mechanism for 600 total revolutions (approximately 10 min) and verify that the drum speed is 6.3 ± 0.2 rad/s or 60 ± 2 r/min.

10.4.1.3 *Calibration of Tester* (Procedures 1 and 2) (see Note 6):

~~Note 6—There are significant differences between the ABC and ICI snag testers. Consequently, the test results obtained from these two testers may or may not correlate with each other.~~

~~10.4.1 Check the operation of the snag tester with the standard calibration fabric. If the equipment is in daily use, check daily; if testing is infrequent, check the equipment each time it is used.~~

~~10.4.2 If the test result obtained on the standard calibration fabric is not within a ± 0.5 rating unit of the established value, run another specimen. If this second specimen is within limits, continue testing; if not, check 10.3.1-10.3.4.~~

10.3.1 Check the operation of the snag tester with the standard calibration fabric. If the equipment is in daily use, check daily; if testing is infrequent, check the equipment each time it is used.

10.3.2 If the test result obtained on the standard calibration fabric is not within a ± 0.5 rating unit of the established value, run another specimen. If this second specimen is within limits, continue testing; if not, check 10.2.1-10.2.4. Repeat, as required, until a specimen is within limits.

11. Conditioning

11.1 Preconditioning is not necessary. Place all of the specimens in the standard atmosphere for testing textiles, which is $21 \pm 1^\circ\text{C}$ ($70 \pm 2^\circ\text{F}$) and $65 \pm 2\%$ relative humidity (see Practice D 1776), for a minimum of 4 h before testing. While this conditioning

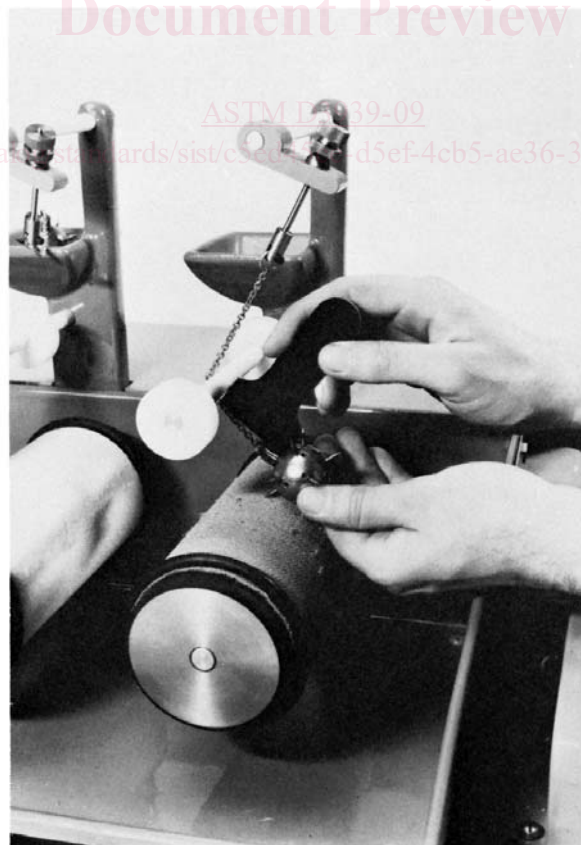


FIG. 4 Adjusting Mace on AB ICI Snag Tester is from opposite side.