



Designation: D 2130 – 90 (Reapproved 2001)

Standard Test Method for Diameter of Wool and Other Animal Fibers by Microprojection¹

This standard is issued under the fixed designation D 2130; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This test method covers a procedure, using the micro-projector, for the determination of the average fiber diameter and the fiber diameter variation on wool and other animal fibers, such as mohair, cashmere, alpaca, camel's hair, etc. (**Note 1**) in their various forms.

1.2 The values stated in inch-pound units are to be regarded as the standard. The metric equivalents of inch-pound units may be approximate.

NOTE 1—This test method may also be applied to any fibers having a round cross section and accordingly may be used many times for melt-spun man-made fibers such as polyamides, polyesters, and glass; also it may be applied to a limited number of polyacrylics and regenerated cellulose type fibers. The values given in **Appendix X1** for density and correction factors, however, apply only to wool and should not be used for other fibers. For suitable values for the density of other fibers, see Table 5 in Test Methods **D 629**, Quantitative Analysis of Textiles.²

NOTE 2—In subsequent sections of this test method, the term “wool” also signifies mohair or other fibers if the circumstances are applicable.

NOTE 3—For fineness specifications for wool, wool top, mohair, mohair top, alpaca, and cashmere, refer to Specifications **D 3991** and **D 3992**, Specification **D 2252**, Test Method **D 2816**.

1.3 *This standard does not purport to address 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.*

2. Referenced Documents

2.1 ASTM Standards:

D 123 Terminology Relating to Textiles²

D 584 Test Method for Wool Content of Raw Wool—Laboratory Scale²

D 629 Test Methods for Quantitative Analysis of Textiles²

D 1060 Practice for Core Sampling of Raw Wool in Packages for Determination of Percentage of Clean Wool Fiber Present²

¹ This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.13 on Wool and Felt. Current edition approved April 10, 2001. Published May 1990. Originally published as D 2130 – 61. Last previous edition D 2130 – 88.

² *Annual Book of ASTM Standards*, Vol 07.01.

D 1776 Practice for Conditioning Textiles for Testing²

D 2252 Specification for Fineness of Types of Alpaca²

D 2258 Practice for Sampling Yarn for Testing²

D 2816 Test Method for Cashmere Coarse-Hair Content in Cashmere²

D 2968 Test Method for Med and Kemp Fibers in Wool and Other Animal Fibers by Microprojection²

D 3510 Test Method for Diameter of Wool and Other Animal Fibers by Image Analyzer³

D 3991 Specification for Fineness of Wool or Mohair and Assignment of Grade⁴

D 3992 Specification for Fineness of Wool Top or Mohair Top and Assignment of Grade⁴

E 380 Practice for Use of the International System of Units (SI) (the Modernized Metric System)⁵

2.2 Other Standards:

Federal Standard, Official Standard of the United States for Grades of Wool, Section 31.0, Measurement Method for Determining Grade of Wool, Section 31.204⁶

IWTO-8-66(E) Method of Determining Wool Fiber Diameter by the Projection Microscope⁷

3. Terminology

3.1 Definitions:

3.1.1 *average fiber diameter, n*—in wool and other animal fibers, the average width of a group of fibers when measured on a projected image.

3.1.2 *grade, n*—in wool and mohair, a numerical designation used in classifying wool and mohair in their raw, semi-processed, and processed forms based on average fiber diameter and variation of fiber diameter.

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

³ Discontinued, see 1986 *Annual Book of ASTM Standards*, Vol 07.02.

⁴ *Annual Book of ASTM Standards*, Vol 07.02.

⁵ *Annual Book of ASTM Standards*, Vol 14.02.

⁶ *Service and Regulatory Announcement*, No. 135, U. S. Department of Agriculture, C & MS, April 1966.

⁷ International Wool Textile Organization, International Wool Secretariat, Raw Wool Services, Valley Drive, Ilkley, Yorkshire LS29 8PB, England.

4. Summary of Test Method

4.1 This test method describes procedures for sampling various forms of wool and other animal fibers, the reduction of the sample to small test specimens, and the measurement, at high magnification, of the diameter of a number of fibers from the test specimens. From the observed data, computations are made to obtain the average fiber diameter, a measure of variation of fiber diameter and the percentage of medullated and kemp fibers, if present, as directed in Test Method D 2968.

5. Significance and Use

5.1 This test method specifies a sampling and testing procedure for the measurement of average fiber diameter and variation in diameter of animal fibers as required in Test Method D 2968.

5.2 Test Method D 2130 for testing wool and other animal fibers for average fiber diameter is considered satisfactory for acceptance testing of commercial shipments since current estimates of between-laboratory precision are acceptable and the method has been used extensively in the trade for acceptance testing. In cases of disagreement arising from differences in values reported by the purchaser and the seller when using this method for acceptance testing, the statistical bias, if any, between the laboratory of the purchaser and the laboratory of the seller should be determined with each comparison being based on the testing of specimens randomly drawn from one sample of material of the type being evaluated.

6. Apparatus and Material

6.1 *Microprojector*⁸—The microscope shall be equipped with a fixed body tube, a focusable stage responsive to coarse and fine adjustments, a focusable substage with condenser and iris diaphragm, and a vertically installed adequate light source to give a precise magnification of 500×, that is, a 12.5× eyepiece and a 21×, 0.50 numerical aperture objective.

6.2 *Stage Micrometer*,⁹—calibrated in intervals of 0.01 mm for accurate setting and control of the magnification.

6.3 *Fiber Sectioning Apparatus*:

6.3.1 *Heavy-Duty Sectioning Device*¹⁰—An instrument comprised of a metal plate with slot and compressing key and equipped with a propulsion mechanism by which the fiber bundle may be extruded for sectioning. The instrument (Fig. 1) is designed to hold a sliver of top or equivalent bulk of fibers, yarn, or fabric.

6.3.2 *Safety Razor Blades*—Single-edge or double-edge blades (if used with blade holder).

6.3.3 *FRL Fiber Cutter*¹¹—A device comprised of two razor blades, a threaded pin and an assemblage that will hold the blades rigidly in position. The device (Fig. 2), which is operated by applying pressure vertically downward, cuts fibers approximately 250 μm (Note 4) in length.

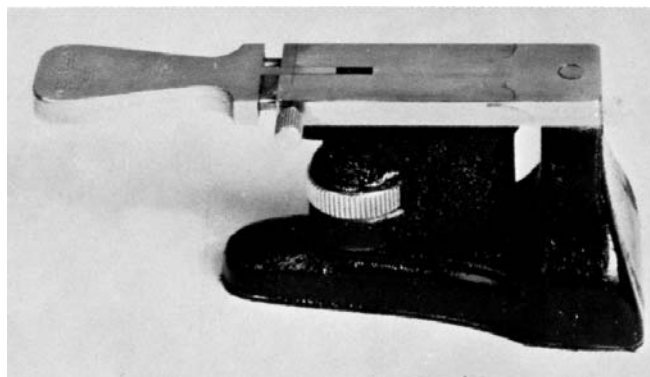


FIG. 1 Heavy-Duty Cross-Section Device

NOTE 4—A description of the Swiss Fiber Cutting device described in earlier editions can be found in Part 25 of the *Annual Book of ASTM Standards*, issued in 1971 and previous volumes.

6.4 *Microscope Slides*, 1 by 3 in. (25 by 75 mm).

6.5 *Cover Glasses*, No. 1 thickness, 7/8 by 2 in. (22 by 50 mm).

6.6 *Mounting Medium*¹²—Colorless immersion oil with a refractive index of 1.480 ± 0.005 at 68°F (20°C), and a viscosity of 78.81 SUS at 100°F (37.8°C).

6.7 *Wedge Scale*¹³—Strips of heavy paper or Bristol board, imprinted with a wedge for use at a magnification of 500× (Fig. 3).

6.8 *Box for Compressing Loose Fibers*—A box 12 by 6 by 15 in. (300 by 150 by 375 mm) deep, inside dimensions, equipped with a floating top which has 16 randomly spaced holes 0.75 in. (20 mm) in diameter over its area. The wool may be firmly compressed by applying pressure on the top. The top is held in place by two rods extending through holes in the side of the box and over the top. The coring tube is thrust through the holes in the top to sample the wool.

6.9 *Pressure Coring Tube*¹⁴—A 1/2-in. (13-mm) inside-diameter metal tube, approximately 30 in. (760 mm) long, reamed and tapped on one end to hold a sharp 3/8 or 1/2-in. (10 or 13-mm) cutting tip. The tube is fitted with a “T” cross bar about 20 in. (500 mm) long.

6.10 *Core Extruder*—A 0.25-in. (6-mm) wood dowel or aluminum rod slightly longer than the coring tube to extrude wool from tube.

7. Sampling

7.1 *Loose Fibers*—The method of obtaining a representative sample of wool will differ according to circumstances. The sampling procedures and major circumstances encountered are as follows:

7.1.1 *Lots of Packaged, Grease, Pulled, or Scoured Wool*—Take core samples as directed in Practice D 1060. Clean or

⁸ Obtainable from R and B Instruments, Leeds, Wortly. Low Mills, 318 Whitehall Rd., Leeds LS12 4RJ England.

⁹ Obtainable from most scientific laboratory instrument supply companies.

¹⁰ Obtainable from Joe Opheikens, 426 Adams, Ogden, UT 84404 and MICO Instruments, 1944 Main St. P.O. Box 451, Marshfield Hills, MA 02051-0451.

¹¹ Obtainable from Albany International Research Co., 1000 Providence Highway, Dedham, MA 02026.

¹² Obtainable from YoCOM-McColl Testing Laboratories, Inc., 540 West Elk Place, Denver, CO 80216.

¹³ Obtainable from E. J. Powers Press, 201 South St., Boston, MA 02111 and Visual Inspection Products, 50 High St., Lynn, MA 01902.

¹⁴ Obtainable from YoCOM-McColl Testing Laboratories, Inc., 540 W. Elk Place, Denver, CO 80216 and Aero Associates, Inc., 163 Merrimac St., Woburn, MA 01801.

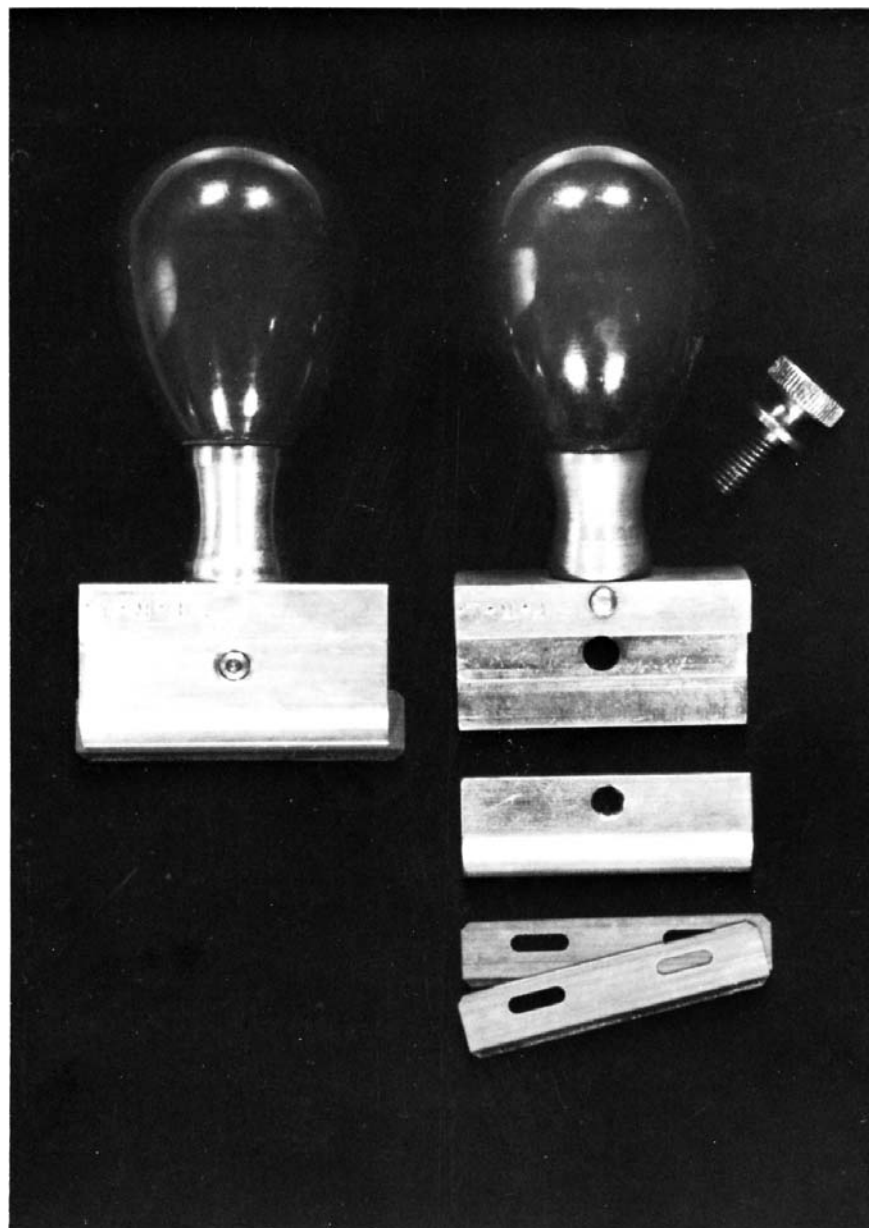


FIG. 2 FRL Fiber Cutter

scour the raw wool sample as directed in Test Method **D 584**. If a representative portion of the scoured wool core sample resulting from the test for clean wool fiber present is available, it may be used for fiber diameter determination. If core sampling is not feasible, take at random, by hand, at least 50 handfuls of wool from not less than 10 % of the packages. The aggregate mass of the sample shall be at least 3 lb (1.5 kg).

7.1.2 Major Sort—Packaged grease wool in fleece form for which a diameter test is desired for only the major sort of the fleece, hand sample by drawing one or more handfuls of wool from the major sort portion of at least 50 fleeces taken at random from the lot. The aggregate mass of the sample shall be at least 3 lb (1.5 kg).

7.1.3 Piles of Graded or Sorted Wool—Sample piles of graded or sorted wool by taking from random locations in the pile at least 50 handfuls of wool, the aggregate mass of which

shall be at least 3 lb (1.5 kg). If the wool is in fleece form and a test is desired for only the major sort, take the sample as directed in **7.1.2**.

7.1.4 Card Sliver—Sample the wool card sliver by drawing at random from the lot, preferably during the carding operation, ten 2-ft (600-mm) lengths of sliver.

7.1.5 Top—Sample the top by drawing from each 20 000 lb (9072 kg) or fraction thereof, four sections of sliver, each of which shall be at least 1 yd (1 m) in length and taken from different balls of top selected at random. Take only one ball from any one bale or carton. For broken top, take an equivalent aggregate length of sliver at random.

7.2 Yarns and Fabrics—Take a yarn sample as directed in Practice **D 2258**. Cut an approximately 3-yd (3-m) length of yarn sample into at least 20 sections of woolen-spun yarn, or 50 sections if worsted-spun yarn. For fabric take 1 yd (1 m) of

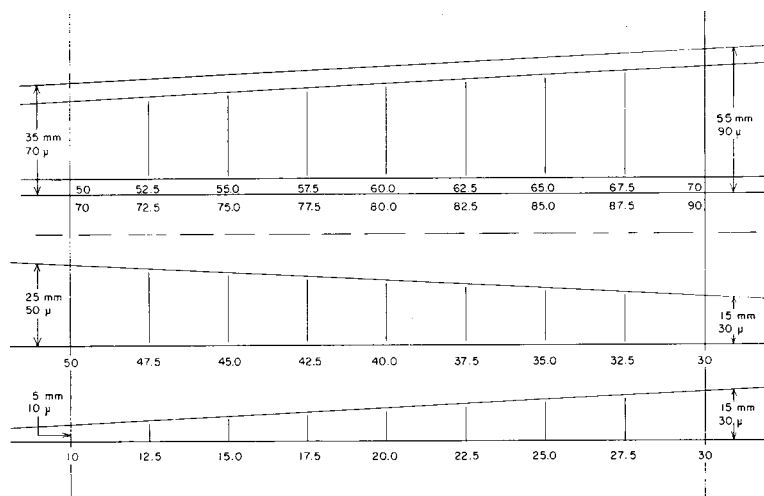


FIG. 3 Wedge Scale

at least 2 by 2 in. (50 by 50 mm) from areas at least 2 in. from a selvage and at a sufficient distance apart to represent filling yarn taken from at least two different bobbins. Remove 20 (if woolen-spun) or 50 (if worsted-spun) warp yarns from each sample. Remove 10 (if woolen-spun) and 25 (if worsted-spun) filling yarns from each sample.

8. Test Specimens

8.1 Grease Wool, Pulled Wool, Scoured Wool:

8.1.1 Sub-Coring—Randomly pack the core or hand sample (see 7.1.1-7.1.3), into a suitable container (see 6.8) and compress to approximately 2 psi (14 kPa) by loading a weight of 150 lbf (667 N) on the floating top. By means of a $\frac{3}{8}$ or $\frac{1}{2}$ -in. (10 or 13-mm) tube with sharp tip, extract a sufficient number of cores (at least five) to provide a test specimen of at least 20 g of scoured wool. Scour or otherwise clean the test specimen if it is grease wool or pulled wool as directed in Test Method D 584.

8.1.2 Gridding—Core Test Residue—If the sample comprises an adequate amount of scoured wool resulting from the core testing of a lot for clean fiber content (see 7.1.1), divide the sample into 40 portions of approximately equal size. From each portion, draw at random at least 0.5 g. Mix or blend these 40 portions to form the test specimen. Test specimens from samples obtained by means of 1.25 in. (30 mm) and larger coring tubes may be carded for homogenization; but do not card those from coring tubes smaller than 1.25 in. (30 mm) since loss of fiber may occur.

8.1.3 Gridding and Machine Blending—For samples other than those specified in 8.1.1 and 8.1.2, divide the sample into 40 portions of approximately equal size. From each portion draw at random a sufficient quantity of fiber to provide a test specimen of 20 g. Scour or otherwise clean the test specimen, of grease or pulled wool. Homogenize the clean specimen by carding 3 times, breaking the web, and feeding at right angles after the first and second passes; or by gilling 15 times, breaking, and combining the pieces of silver as required to maintain a convenient length.

8.2 Card Sliver—Strip off portions of each of the ten 2-ft (600-mm) lengths of sliver (see 7.1.4). Combine these portions to form a composite sliver about 2 ft in length. This constitutes the test specimen.

8.3 Top—Each of the four sections of sliver comprising the sample (see 7.1.5) constitutes a test specimen.

8.4 Yarn—The yarn sections (see 7.2) constitute the test specimen.

8.5 Fabric—The undisturbed piece of fabric or the teased out yarns of the fabric (see 7.2) constitute the test specimen.

9. Calibration of Microprojector

9.1 Adjust the microprojector to produce a magnification of 500 $\times$ in the plane of the projected image. Do this by placing a stage micrometer on the stage of the microprojector and bringing the microscope into such adjustment that the lines of the micrometer are sharply focused in the center of the image plane. An interval of 0.20 mm on the stage micrometer will then measure 100 mm on the image plane, or 0.01 mm on the micrometer will measure 5 mm on the image plane. All measurements must be made with the specimen in a plane at the same distance from the stage as the lines on the stage micrometer.

10. Conditioning

10.1 Precondition all test specimens to approximate equilibrium in an atmosphere having a relative humidity of 10 to 25 % and a temperature of not over 122°F (50°C), then condition the samples for at least 4 h in the standard atmosphere for testing textiles, 65 $\pm$ 2 % relative humidity and 70 $\pm$ 2°F (21 $\pm$ 1°C), as directed in Practice D 1776.

11. Test Provisions

11.1 Separate observations shall be made by two operators.

11.2 Each operator shall independently prepare at least one slide for each test specimen.

12. Preparation of Slides by Use of Heavy-Duty Cross-Section Device

12.1 Compacting Specimen: