



Designation: D 1118 – 95 (Reapproved 1999)

Standard Test Method for Magnetic Rating of Asbestos Fiber and Asbestos Textiles¹

This standard is issued under the fixed designation D 1118; 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 procedure for the determination of the magnetic rating of asbestos fiber and asbestos textile products. This test method is used primarily for testing asbestos insulating materials.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *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.*

2. Referenced Documents

2.1 ASTM Standards:

- D 123 Terminology Relating to Textiles²
- D 2100 Specification for Asbestos Textiles Used for Electrical Insulating Purposes³
- D 2590 Test Method of Sampling Chrysotile Asbestos³
- D 2946 Terminology Relating to Asbestos³
- D 2947 Test Method for Screen Analysis of Asbestos Fibers³
- D 3879 Test Method for Amphibole Asbestos Sampling³
- E 11 Specification for Wire-Cloth Sieves for Testing Purposes⁴

3. Terminology

3.1 For definitions of other textile terms used in this test method, refer to Terminology D 123. For terms relating to asbestos, refer to Terminology D 2946.

3.2 Definitions:

3.2.1 *asbestos fiber, n*—The hydrous magnesium silicate serpentine mineral designated as chrysotile and having the empirical formula $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4$.

3.2.2 *atmosphere for testing textiles, n*—for asbestos, air maintained at a relative humidity of $50 \pm 2\%$ at $70 \pm 2^\circ\text{F}$ ($21 \pm 1^\circ\text{C}$).

3.2.3 *magnetic rating (MR), n*—an empirical value reflecting the effect of the magnetic particles, such as magnetic iron compounds, in asbestos material as measured by a magnetic effect analyzer. It is not a quantitative measure of the magnetic particles in the material. — Magnetic rating is affected by the quantity, concentration, particle size, shape, and orientation of the magnetic particles in the material.

3.2.4 *unit magnetic rating (1 MR), n*—a calibrating standard with an MR of one is defined as containing 0.18 g of U.S. National Institute of Standards and Technology standard sample No. 29(a) or iron ore (magnetite) uniformly distributed over the space specified for a 10-g test specimen [19 mm (0.75 in.) diameter by 73 mm (2.875 in.) long], by dispersion in a magnetically inert material. A 10-g specimen has one unit magnetic rating when it produces a magnetic effect equivalent to that of 0.18 g of standard magnetite as described above. Conversely, a 10-g specimen producing a magnetic effect such that the resulting induced current in the magnetic analyzer galvanometer is k times that of the 0.18 g of standard magnetite as described above, would have a magnetic rating (MR) of k .

4. Summary of Test Method

4.1 The unknown electromagnetic effects of a sample of asbestos-containing material is compared with those of a reference standard in a magnetic analyzer. The inductive imbalance caused by the magnetic particles in the asbestos samples is amplified and measured with the magnetic analyzer.

5. Significance and Use

5.1 This test method for the determination of magnetic rating is considered satisfactory for acceptance testing of commercial shipments of asbestos fibers, papers, felts, yarns, rovings, textile products, rigid sheet products, and granular or powdered products.

5.2 Magnetic rating is one of the measurements used for determining the suitability of an asbestos material for electrical insulation.

5.3 The electrical insulating properties of asbestos materials vary inversely with the magnetic rating. Therefore, a low magnetic iron content is required for good electrical insulating.

¹ This test method is under the jurisdiction of ASTM Committee C17 on Fiber-Reinforced Cement Products and is the direct responsibility of Subcommittee C17.03 on Asbestos-Cement Sheet Products and Accessories.

Current edition approved Feb. 15, 1995. Published April 1995. Originally published as D 1118 – 50 T. Discontinued November 1989 and reinstated as D 1118 – 95.

² Annual Book of ASTM Standards, Vol 07.01.

³ Annual Book of ASTM Standards, Vol 04.05.

⁴ Annual Book of ASTM Standards, Vol 14.02.

5.4 The types of asbestos textiles classified by magnetic rating are described in Specification D 2100.

6. Apparatus

6.1 *Magnetic Analyzer*—Either the Mapes type analyzer or the Turner & Newall⁵ type analyzer may be used. Other analyzers using an inductance bridge and functioning on the same principles may be used if agreed upon by the interested parties.

6.1.1 The Mapes type analyzer is described in Annex A1.

6.1.2 The Turner & Newall⁵ type analyzer is described in Annex A2.

NOTE 1—The apparatus and procedure described in this revision of Test Method D 1118 are preferred. The method and apparatus described in previous issues of Test Method D 1118 may be used if agreed upon by the purchaser and the seller.

6.1.3 *Magnetic Analyzer Accessories*, including *specimen tube, holder, spacer rod, and stopper*.

6.1.4 *Calibration Standards*,⁶ supplied by the vendor of the magnetic analyzer, or prepared as in A3.5.1 to A3.5.10.

7. Hazards

7.1 When handling asbestos products, avoid creating dust or wear a respiratory protector. Frequent prolonged respiration of excessive airborne concentrations of asbestos may cause serious bodily harm.

8. Sampling, Test Specimens, and Test Units

8.1 Sampling:

8.1.1 *Chrysotile Fiber*—Sample chrysotile asbestos fiber in accordance with Test Method D 2590.

8.1.2 *Amphibole Fiber*—Sample amphibole asbestos fiber in accordance with Test Method D 3879.

8.1.3 Asbestos Textiles:

8.1.3.1 Refer to appropriate ASTM standards for the lot size of each type of material to be tested.

8.1.3.2 Take sufficient samples at random from each lot to prepare specimens as directed in 8.2.

8.1.3.3 Refer to Section 11 for conditioning requirements.

8.1.4 *Papers, Scrims, Felts, and other Nonwoven Products*—Refer to appropriate ASTM standards for the lot sizes and conditioning requirements.

8.2 *Test Specimens*—Test at least five specimens per sample.

8.2.1 Asbestos Textiles:

8.2.1.1 *Cloth and Lap*—Sample cloth or lap products by cutting across the warp strips 73 mm in width and of sufficient length to give a mass of 15 ± 0.1 g. Roll these specimens into a scroll with an external diameter just less than 19 mm for insertion into specimen holders.

8.2.1.2 *Roving, Wick, Rope, Yarn, Thread, Tubing, and Tape*—Cut enough pieces 73 mm in length to get a mass of 15 ± 0.1 g. To adjust the mass precisely, when sample dimensions allow it, cut the last portion of piece needed lengthwise. If dimensions are too small to cut lengthwise, as in the case of a thread, cut across the length. Cord the pieces to form a cylindrical bundle with a diameter just less than 19 mm and wrap this with a sheet of paper 73 mm in width to facilitate introduction into a specimen holder.

8.2.2 *Papers, Scrims, Nonwoven Products, and Felts*—Cut across the machine direction into strips 73 mm in width and long enough to give a mass of 15 ± 0.1 g. Roll these specimens into a scroll with an external diameter just less than 19 mm for insertion into specimen holders.

8.2.3 *Granular or Powdered Products*—To 15 ± 0.1 g specimens add sufficient nonmagnetic diluents, such as those described in A3.5.2, to increase the bulk enough to fill the specimen holder cavity with moderate compaction. Load the diluted specimen into a sample holder in small pinches by means of a funnel, and depress to the required volume by pressing with the stopper or with a tamper. Remove the tamper and maintain the volume required by means of the stopper.

8.2.4 Asbestos Fiber:

8.2.4.1 Take an approximately 2-kg (4-lb) sample of asbestos as directed in Test Method D 2590 for chrysotile or Test Method D 3879 for amphibole fiber.

8.2.4.2 Spread the sample of asbestos fiber on a smooth working surface in layers to form a pile of uniform thickness approximately 10 mm (0.5 in.) thick.

8.2.4.3 Using tweezers, take five 3 ± 0.1 -g pinches in small increments, being careful that the total cross section of the pile from top to bottom is taken, including all particles that may have become segregated.

8.2.4.4 Load the specimen into a holder by means of a wide-mouthed funnel, in several pinches, and pack each pinch into place with the spacer rod. Each pinch must include a complete cross section of the specimen and the specimen must not be sprinkled into the funnel. Adjust the height of the specimen with the spacer rod to 73 mm ($2\frac{7}{8}$ in.), and maintain the height with a stopper.

9. Preparation of Apparatus

9.1 For Mapes type analyzers, energize the apparatus and permit it to warm up for 20 min to become stable. Then balance the secondary coils with the balancing coil until the deflection of the indicating instrument is a minimum at full sensitivity.

9.2 For Turner & Newall⁵ type analyzers, turn the sensitivity switch S1A to the MR6 position (see Fig. A2.3), and energize the apparatus with a 115-V, 60 Hz supply. Balance the apparatus by adjusting the balance screw to bring the galvanometer deflection to zero. Throw the sensitivity switch to the MR1 position, and rebalance the apparatus, locking the balancing screw in place.

10. Calibration and Standardization

10.1 For Mapes type analyzers, proceed as in A1.5 to A1.8.7 of Annex A1.

10.2 For Turner & Newall⁵ type analyzers, proceed as in A2.8 to A2.8.2 of Annex A2.

⁵ The apparatus known as the “Turner and Newall Magnetic Analyzer” can be purchased from Turner and Newall Ltd., Asbestos Fiber Laboratory, Trafford Park, Manchester 17, England. Detailed drawings of the apparatus are available at nominal cost from ASTM Headquarters, Request Adjunct No. 12-411180-00.

⁶ Detailed information on the preparation of calibration standards is available from ASTM Headquarters, 100 Barr Harbor Drive, W. Conshohocken, PA 19428. Request Adjunct ADJD1118.

11. Conditioning

11.1 Condition all samples (without preconditioning) for a minimum period of 4 h, or until the material shows no progressive change in mass of more than 0.1 % after an exposure of an additional 0.5 h, in an atmosphere having a relative humidity of $50 \pm 2\%$ at $21 \pm 1^\circ\text{C}$.

12. Procedure

12.1 Using Mapes Type Apparatus:

12.1.1 Set the analyzer to give full-scale deflection with an MR6 standard, and insert the test specimen holder adjusting its position to produce maximum response.

12.1.2 Note the galvanometer reading.

12.1.3 If a voltage divider is fitted, and if the galvanometer reading is less than half scale, then switch the divider to the appropriate scale, calibrate with the corresponding standard, and determine the magnetic rating of the test specimen under these conditions.

12.1.4 Repeat the above procedure for the other four specimens.

12.2 Using Turner & Newall⁵ Type Apparatus:

12.2.1 Start with the selector switch in position 10 to establish the proper testing range and carefully insert the loaded specimen tube into the apparatus as far as it will go. If the reading exceeds 3.0 on the upper set of graduations of the meter scale, record the indicated reading as the MR of the specimen to the nearest 0.2 MR unit, otherwise proceed as follows:

12.2.1.1 When the reading in 12.2.1 is less than 3.0, turn the switch to the 3-MR range. If the reading exceeds 1.0 on the lower set of graduations, record the indicated reading as the MR of the specimen to the nearest 0.1 MR unit.

12.2.1.2 When the reading in 12.2.1.1 is less than 1.0, turn the switch to 1-MR range. If the reading exceeds 0.3 on the upper set of graduations, record the indicated reading as the MR of the specimen to the nearest 0.02 MR unit.

12.2.1.3 When the reading in 12.2.1.2 is less than 0.3, turn the switch to 0.3-MR range and record the indicated reading on the lower set of graduations as the MR of the specimen to the nearest 0.01 MR unit.

12.2.2 After obtaining a reading in the above manner, remove the specimen tube, verify the zero point, and recheck the calibration using the appropriate magnetic calibration standard for that range. Reinsert the specimen tube and verify the MR value of the specimen.

12.2.3 Proceed as directed in 12.2.1 and 12.2.2 on the remaining specimens.

NOTE 2—The procedure here described is applicable only under those conditions wherein the magnetic particles being tested exhibit no directional properties or when the particle distribution is such as to give the ultimate in random orientation. The magnetic particles present in chrysotile asbestos, however, are most frequently needle-like or acicular, and as such exhibit directional properties with regard to magnetic permeability. Therefore, there must be an understanding as to the extent of the fibrous characteristics and the grain size distribution of the magnetic particles present in the sample under test if a proper evaluation of the resulting magnetic rating is to be truly factual. In view of the fibrous characteristics of the magnetic particles and the resultant directional magnetic properties, the method of sample preparation and the placement of the sample in the

sample holder must be carefully pursued in an endeavor to obtain a test specimen that will exhibit a maximum in random orientation.

13. Calculation

13.1 Results Obtained on a Mapes Type Analyzer:

13.1.1 Multiply the galvanometer reading by the value of the standard used to set full-scale deflection of the galvanometer, and divide this product by the maximum scale value produced by the specimen to obtain the magnetic rating of the specimen.

13.1.2 Example—Full-scale deflection was set with the MR3 standard. The scale is calibrated from 0 to 100. The reading on the specimen was 62. The magnetic rating is calculated as follows:

$$MR = 3 [m]P5 \ 62/100 = 1.86 \quad (1)$$

14. Report

14.1 Report whether the apparatus used was the Mapes or the Turner & Newall⁵, or some other type of apparatus.

14.2 Report the average magnetic rating of at least five specimens for each sample.

14.3 State that the specimens were tested as directed in ASTM Test Method D 1118. Describe the materials or products sampled and the method of sampling used.

14.4 Report the average magnetic rating.

15. Precision and Bias

15.1 *Interlaboratory Test Data*⁷—An interlaboratory test was run in 1969 in which 13 samples were each tested in 7 laboratories using 1 operator per laboratory; each operator tested 2 specimens of each sample. All 26 specimens of each material came from the same lot. The components of variance for magnetic rating results expressed as coefficients of variation were calculated to be:

Single-operator component	4.4 % of the average
Between-laboratory component	9.4 % of the average

15.2 *Precision*—For the components of variance reported in 15.1 two averages of observed values should be considered significantly different at the 95 % probability level if the difference equals or exceeds the critical differences listed below.

Number of Observations in Each Average	Critical Differences Percent of Grand Average for the Conditions Noted ^{A,B}	
	Single-Operator Precision (Repeatability)	Between-Laboratory Precision (Reproducibility)
1	12.2	28.7
2	8.6	27.4
5	5.5	26.6
10	3.8	26.3

^A The critical differences were calculated using $t = 1.960$ which is based on infinite degrees of freedom.

^B To convert the values as listed above to units of measure, multiply the average of the two specific sets of data being compared by the critical differences expressed as a decimal fraction.

NOTE 3—The values of the critical differences in this table should be considered to be a general statement particularly with respect to between-laboratory precision. Before a meaningful statement can be made about two specific laboratories, the amount of statistical bias, if any, between

⁷ ASTM Research Report No. D-13-1021. A copy is available on loan from ASTM Headquarters, 100 Bar Harbor Drive, West Conshohocken, PA 19380.