Designation: D3752 – 98 (Reapproved 2019)

Standard Test Method for Strength Imparted by Asbestos to a Cementitious Matrix[1]

This standard is issued under the fixed designation D3752; 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, on a laboratory scale, of the contribution of asbestos fibers to the strength of asbestos-cement products. The results obtained are used in the primary assessment of different fiber grades prior to their application on a larger scale.

1.2 This test method covers the determination of the modulus of rupture (*MR*), adjusted to a dry density of 1.60 Mg/m^3 (MR_A), of asbestos-cement test specimens that contain the asbestos fiber to be evaluated at a concentration of 10 mass %, whereby the degree of fiberization of that fiber is specified in terms of specific surface area as determined by Test Method D2752. The relative reinforcing value of the fiber under test is established by comparison with MR_A values obtained with a fiber of known characteristics at a fiber concentration of 10 % and a dry density of 1.60 Mg/m^3 (1.60 g/cm^3).

NOTE 1—The adjusted modulus of rupture (MR_A) at any intermediate fiber concentration may be interpolated from results suitably determined over a limited spanning range of fiber concentrations. For example, the MR_A at 10 % fiber concentration may be graphically determined from data at 3 and 17 %.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 **Warning—**Breathing of asbestos dust is hazardous. Asbestos and asbestos products present demonstrated health risks for users and for those with whom they come into contact. In addition to other precautions, when working with asbestos-cement products, minimize the dust that results. For information on the safe use of chrysotile asbestos, refer to "Safe Use of Chrysotile: A Manual on Preventive and Control Measures."[2]

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:*[3]

C150 Specification for Portland Cement

C184 Test Method for Fineness of Hydraulic Cement by the 150-µm (No. 100) and 75-µm (No. 200) Sieves (Withdrawn 2002)[4]

C204 Test Methods for Fineness of Hydraulic Cement by Air-Permeability Apparatus

D1193 Specification for Reagent Water

D2589 Test Method for McNett Wet Classification of Dual Asbestos Fiber

D2590 Test Method for Sampling Chrysotile Asbestos

D2752 Test Methods for Air Permeability of Asbestos Fibers

D2946 Terminology for Asbestos and Asbestos–Cement Products

D3879 Test Method for Sampling Amphibole Asbestos (Withdrawn 2009)[4]

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

2.2 *Other Standard:*[5]

Quebec Asbestos Mining Association (QAMA) Standard Designation for Chrysotile Asbestos Grades

3. Terminology

3.1 *Definitions*—For definitions of asbestos terms used in this test method, refer to Terminology D2946.

[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 April 15, 2019. Published May 2019. Originally approved in 1979. Last previous edition approved in 2011 as D3752 – 98 (2011). DOI: 10.1520/D3752-98R19.

[2] Available from The Asbestos Institute, http://www.chrysotile.com/en/sr_use/manual.htm.

[3] 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.

[4] The last approved version of this historical standard is referenced on www.astm.org.

[5] Available from the Asbestos Institute, 1002 Sherbrooke St. W, Suite 1750, Montreal, QC, Canada H3A 3L6.

4. Summary of Test Method

4.1 This test method covers the preparation and flexural testing of asbestos-cement specimens consisting of disks, 107 mm in diameter, which are obtained by vacuum filtration of an aqueous slurry of asbestos fiber, cement, and silica of standard composition. The disks are compressed to a designated nominal pressure (Note 2), and cured under standard conditions prior to testing in flexure. The calculation of the modulus of rupture (*MR*) and its adjustment to a common dry density of 1.6 Mg/m^3 (MR_A), based on the flexural strength and the density of the specimens, is also described.

NOTE 2—The spacer ring may support part or all of this pressure unless the mix being pressed is bulky enough to prevent full closure of the mold.

4.2 The preparation of the test specimens and the determination of the flexural modulus of rupture includes the following steps:

4.2.1 Treatment of the asbestos fiber including sampling, blending, and fiberizing in a suitable apparatus,

4.2.2 Dry blending of asbestos fiber, cement, and silica and the wet mixing of these materials using water saturated with lime and gypsum.

4.2.3 Formation of disk-shaped filter cakes from the aqueous slurry in a cylindrical filter vessel and the pressing of those cakes,

4.2.4 Curing of the pressed cakes by storage under conditions of high humidity and autoclaving,

4.2.5 Determination of the volume and density of the specimens based on dry mass, saturated mass, and immersed mass,

4.2.6 Testing of the flexural strength of the cured specimens after drying, and

4.2.7 Calculation of the flexural modulus of rutpure (*MR*) of the specimens and the modulus of rupture adjusted to a dry density of 1.6 Mg/m^3 (MR_A).

5. Significance and Use

5.1 This procedure facilitates the comparison of different types or grades of asbestos based on their contribution to the flexural modulus of rupture; that is, the reinforcing value, which is considered the most pertinent property for the manufacture of asbestos-cement products.

5.2 This test method is primarily intended for fiber grades used normally in asbestos-cement products (Group 6 to Group 4 fibers). Longer fibers (Group 3) or shorter fibers (Group 7) may present difficulties during the preparation of the filter cake because of poor dispersion and uneven settling.[6]

6. Apparatus

6.1 *Fiberizing*—Optimum fiberization in terms of reinforcing strength (based on measurement of specific surface area (as determined by Test Method D2752) varies with the type of asbestos fiber; for example, approximately 900 m^2/kg for amosite, 1200 to 1500 m^2/kg for crocidolite and 1000 to 1800 m^2/kg for chrysotile. It should be noted that optimum fiberization based on filtration properties may require different surface areas. It should also be noted that optimum fiberization in terms of reinforcing strength varies with the fiberizing procedure. To produce the desired degree of fiberization, the following types of apparatus have been found suitable:

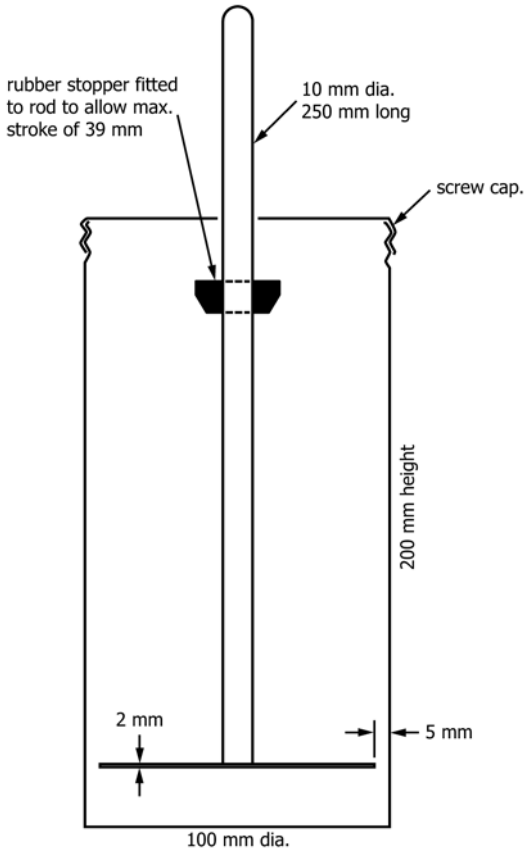

FIG. 1 Plastic Mixing Vessel and Mixing Rod

6.1.1 *Laboratory Fan Opener.*

6.1.2 *Pallman Mill.*

6.1.3 *Christie-Norris Mill.*

NOTE 3—The choice of the fiberizing method and the degree of fiberization is dependent upon the type of fiber under test, the application for which the fiber is intended, and the specific purpose of the test program. Increasingly higher surface areas obtained by fiberization produce increasingly higher modulus of rupture values up to an observed optimum. Beyond that point, due to the production of greater proportions of fines coinciding with increasingly higher surface areas, modulus of rupture values may diminish.

6.2 *Dry and Wet Mixing:*

6.2.1 *Wide-Mouth Plastic Containers,* 100 mm in diameter, 200 mm high, with screw lid.

6.2.2 *Metal Mixing Rod,* 10 mm in diameter, 250 mm long, with a disk fixed to its end, leaving 5-mm clearance to the inner wall of the plastic container (Fig. 1).

6.2.3 *Spare Screw Lids,* with 10-mm hole in center to receive stem of mixing rod.

NOTE 4—A Patterson-Kelly mixer with a one litre capacity shell has also been found to be suitable for dry and wet mixing, using mixing times of 5 min each.

6.3 *Forming of the of the Specimens:*

[6] The term "Group 3, 4, 5, 6, or 7" refers to the Standard Designation for Chrysotile Asbestos Grades by the Quebec Asbestos Mining Association (QAMA).

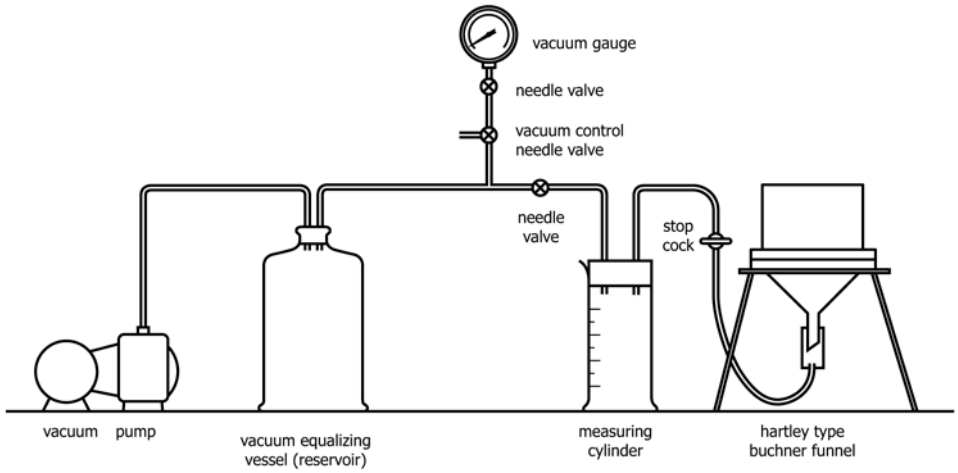

FIG. 2 Vacuum Filter system

6.3.1 *Vacuum Filtering System* (Fig. 2):

6.3.1.1 *Vacuum Pump,* capable of displacing 180 L/min and capable of attaining 9.5 kPa (710 mm Hg).

6.3.1.2 *Vacuum Gage Assembly,* consisting of one 10 kPa (0 to 750-mm Hg) vacuum gage, needle valves, or a vacuum controller.[7]

6.3.1.3 *Filter Funnel, Hartly-type,* three-piece Büchner funnel, 107 mm in diameter.

6.3.1.4 *Filter Papers,* 100 mm in diameter, hardened and fast filtering, or filter cloth.

6.3.2 *Spatula,* stainless steel, narrow blade, approximately 150 mm long.

6.3.3 *Stopwatch.*

NOTE 5—Test specimens of 100 to 150 mm may be prepared and tested by this test method, in which case appropriate changes should be made in the quantities of materials used and the size of the equipment, such as mold and filter paper.

6.4 *Pressing of Specimens:*

6.4.1 *Hydraulic Press,* capable of exerting 200 kN load.

6.4.2 *Mold Assembly* (Fig. 3)—The thickness, *t*, is in the order of 6 mm.

6.4.3 *Plastic Squares,* 130 mm wide by 3 mm thick.

NOTE 6—Although a spacer ring as shown in Fig. 3 is used to control the thickness of the specimen (see Note 2) and to obtain a dry density of approximately 1.6 Mg/m^3, an adjustment by calculation (see 13.4) to a dry density of exactly 1.6 Mg/m^3, although small, is still required.

6.5 *Curing of Specimens:*

6.5.1 *Humidity Cabinet,* designed for >90 % relative humidity at 20°C.[8]

6.5.2 *Laboratory Autoclave,* capable of maintaining a saturated steam pressure of 834 to 1079 kPa for 16 h and with a capacity of approximately 100 L.[9] If an autoclave is not available, the disks can be water-cured (see 11.3).

6.5.3 *Drying Oven,* standard mechanical or gravity-convection oven, capable of maintaining 105 ± 2°C and with an internal capacity of approximately 0.2 m^3.

6.6 *Testing of Specimens:*

6.6.1 *Laboratory Balance,* capable of weighing 0.6 kg to 100 mg.[10]

6.6.2 *Flexural Tester,* capable of applying 600 g to 100 mg[11] accuracy for a transverse load up to 2.5 kN to the center of a span of 82.6-mm with a steady crosshead speed of 5 mm/min. The loading bar and supports should be 25-mm diameter steel rods.

6.6.3 *Micrometer,* approximately 50-mm throat, 0.02-mm graduations.

6.6.4 *Graduated Cylinder,* 500-cm^3 capacity.

7. Reagents and Materials

7.1 *Portland Cement,* Type 1 in accordance with Specification C150, or equivalent, with a Blaine surface area of 340 ± 20 m^2/kg as determined by Test Method C204, and pulverized silica passing the 180 µm (No. 80) sieve but retained on the 75 µm (No. 200) sieve as determined by Test Method C184, with a Blaine surface area of 300 ± 20 m^2/kg as determined by Test Method C204 shall be used when the test results are intended for comparisons between laboratories. Other portland cements and silica may be used for in-house laboratory comparisons.

[7] An Edwards Model 1A has been found suitable. 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.

[8] A Harshaw No. H-18877 stainless steel desiccating cabinet has been found satisfactory for this purpose. 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.

[9] A Cenco laboratory autoclave Model 126X has been found suitable. 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.

[10] A Mettler top-loading balance Model P-1200N with a capacity of 1.0 kg and a 0.2-kg tare, has been found suitable. 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.

[11] A 250-g proving ring with a Carver press has been found suitable.