Designation: D3880/D3880M – 90 (Reapproved 2017)

Standard Test Method for Asbestos Strength Units[1]

This standard is issued under the fixed designation D3880/D3880M; 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 gives a procedure for the evaluation of the strength-giving properties of asbestos fibers used to reinforce asbestos-cement products.

1.2 The purpose of this test method is to determine the number of strength units that may be assigned to the sample tested.

1.3 Asbestos fiber possesses the ability to impart strength to an asbestos-cement product. Every fiber grade may be regarded as possessing a certain quantity of strength-giving units. The quantity of fiber required in an asbestos-cement composition varies inversely with the number of strength units it possesses. For example, if an amount, designated by *X*, of a fiber possessing 100 strength units produces a product of a given strength, 2*X* would be required to produce a product of equivalent strength from fiber possessing only 50 strength units.

1.4 The following definition is the basis for the strength unit test: An asbestos fiber that gives the standard strength at the standard density when used as 10 % of the furnish is defined as having 100 strength units. Therefore, by knowing the percent fiber required in the mix to give standard strength at the standard density, it is possible to calculate the strength units of a sample of asbestos.

1.5 This procedure is intended primarily for chrysotile asbestos; it has not been verified whether or not it is applicable to other types.

1.6 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.7 **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 chrysoltile asbestos, refer to "Safe Use of Chrysotile Asbestos: A Manual on Preventive and Control Measures."[2]

1.8 *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.* For specific precautionary statements see 6.7.2, 7.5, 9.2.2, and 1.7.

1.9 *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

C430 Test Method for Fineness of Hydraulic Cement by the 45-µm (No. 325) Sieve

C1120 Test Method for Wash Test of Asbestos

C1121 Test Method for Turner and Newall (T and N) Wet-Length Classification of Asbestos

C1162 Test Method for Loose Density of Asbestos

D1193 Specification for Reagent Water

D1655 Specification for Aviation Turbine Fuels

D2590 Test Method for Sampling Chrysotile Asbestos

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

Current edition approved June 1, 2017. Published July 2017. Originally approved in 1980. Last previous edition approved in 2009 as D3880/D3880M – 90(2009)ε1. DOI: 10.1520/D3880_D3880M-90R17.

[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.

D2946 Terminology for Asbestos and Asbestos–Cement Products
D2589 Test Method for McNett Wet Classification of Dual Asbestos Fiber
D3639 Test Method for Classification of Asbestos by Quebec Standard Test
D3752 Test Method for Strength Imparted by Asbestos to a Cementitious Matrix
E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

2.2 *Other Standards:*
Quebec Asbestos Mining Association (QAMA) Standard, Designation for Chrysotile Asbestos Grades[5]

3. Terminology

3.1 *Definitions:*

3.1.1 *point value, n—in asbestos*, an index of commercial value of asbestos fiber used in asbestos-cement products. Point value = (SU-10)/1.39 where SU stands for strength units.

3.1.2 *strength unit, n—in asbestos*, unit of reinforcing potential of asbestos fiber in asbestos-cement products. An asbestos fiber that yields a flexural modulus of rupture of 27 MPa at a product density of 1.6 g/cm^3 when used as 10 % of the furnish (dry ingredients) is defined as having 100 strength units. Therefore, the number of strength units of a given asbestos is equal to 1000/(% fiber required in the dry mix to yield 27 MPa at 1.6 g/cm^3).

3.1.3 Refer to Terminology D2946 for other terms relating to asbestos.

4. Summary of Test Method

4.1 This test method covers the fabrication and flexural testing of asbestos-cement test specimens that contain asbestos fiber from the sample being evaluated. The calculation of strength units of the asbestos, based upon the flexural strength, density and composition of the test specimens, is also described.

4.2 The specimen fabrication process includes the following steps:

4.2.1 *Asbestos fiber preparation,* including ball milling, fiberizing, and blending.

4.2.2 *Compounding,* including dry mixing, the preparation of saturated water, and wet mixing.

4.2.3 *Test specimen formation,* including the pressing of asbestos-cement cakes in a semi-automatic press.

4.2.4 *Specimen curing,* including a stage in a humidity cabinet, autoclaving, air cooling, and saturating in a water bath.

4.3 *Specimen testing,* including the determination of immersed mass, saturated mass, flexural strength, specimen thickness and width, and dry mass.

4.4 *Calculations,* involving the determination of specimen volume, modulus of rupture, density, modulus of rupture adjusted for density, asbestos fiber content required to attain standard strength, fiber ratio required, point value, and strength units.

5. Significance and Use

5.1 This test method facilitates the comparison of different types and grades of chrysotile asbestos by the property most pertinent to its use in asbestos-cement, namely, the strength or reinforcing value it imparts to the product.

5.2 While similar comparative results could be obtained on any given production equipment, this method allows the testing of small samples, avoids costly interruptions in production for numerous trial runs, and allows test values to be obtained by a single standard method so that results can be compared among different locations.

5.3 Strength Unit (SU) value of a fiber blend used in asbestos-cement products may be estimated by taking the proportionate SU value of each component of the fiber blend.

5.4 If the fiber blend is formulated with the aim to optimize another fiber property such as filterability, the SU calculation will assure that the blend will not fall below an acceptable strength level.

5.5 This test method is restricted to grades of asbestos used in asbestos-cement products. Very long (Group 3) fibers are difficult to evaluate by this method because the test specimens produced may not be sufficiently homogeneous. Similarly, very short (Group 7) grades may not be retained satisfactorily in the mold during the pressing of test specimens or may not provide sufficient strength to meet the test requirements.

NOTE 1—The term Group 3 or 7 refers to the standard designation for chrysotile asbestos grades established by the Quebec Asbestos Mining Association, See 2.2.

5.6 Because of certain differences between this method and the many variations in plant production procedure commonly used in asbestos-cement manufacture, it is emphasized that the strength values obtained by this standardized procedure will not necessarily give exactly the same strength values as obtained at any one specific manufacturing plant.

6. Apparatus

6.1 *Ball Milling:*

6.1.1 *Porcelain Ball Mill Jars,* [6] meeting the following specifications:

Capacity	11 000 cm^3 [671 in. ^{3}]
External diameter	280 mm [11.02 in.]
Internal diameter	230 mm [9.06 in.]
Internal height	210 mm [8.27 in.]

[5] Available from Asbestos Institute, 1130 Sherbrooke St. West, Montreal, Q.C., H3A2 M8.

[6] The sole source of supply of the apparatus (Type KU5a ball mill jars, and machine-made balls, manufactured by Staatliche Porzellan Manufaktur, Berlin Werk Seld, Selb/afr. Hartmannstrasse 1–3, German Federal Republic (West Germany)) known to the committee at this time is Fish-Schurman, 70 Portman Road, New Rochelle, NY. 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.

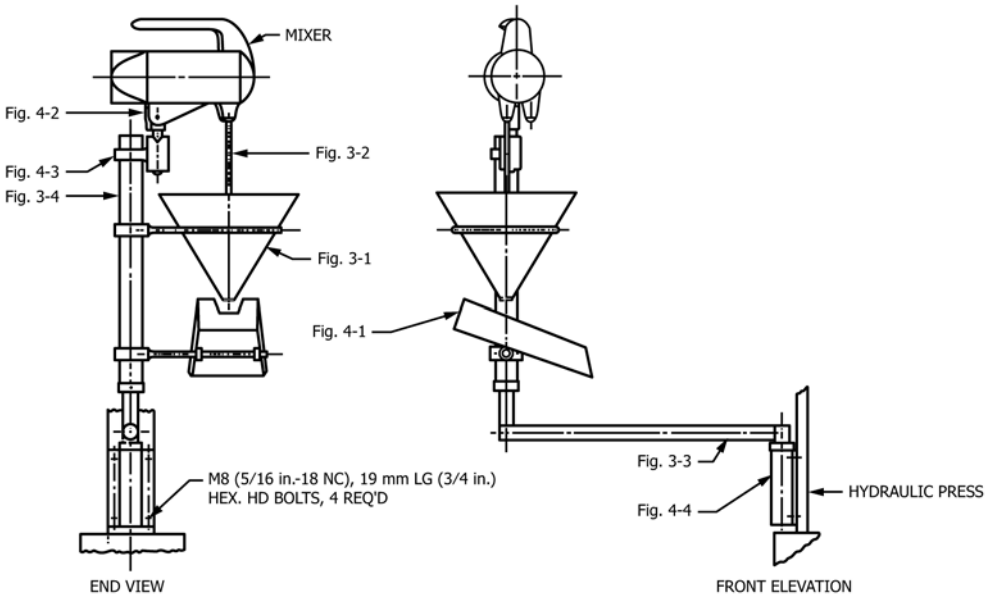

FIG. 1 Wet-Mixer Assembly

6.1.2 *Porcelain Balls,* [7] machine made, meeting the following specifications:

Diameter	40 mm [1.575 in.]
Mass (each)	74 to 75 g [0.163 to 0.165 lb]
Specific activity	2.3 ± 0.1 (The manufacturer specifies a nominal specific gravity of 2.22.)

Alternatively, handmade balls approaching these specifications may be used.

6.1.2.1 Discard balls when their diameter is 35 mm [1.38 in.] or less.

6.1.3 *Roll Table,* to rotate the ball mill jars at 6.81 ± 0.21 rad/s [65 ± 2 r/min]. See Note 2.

6.2 *Fiberizing:*

6.2.1 *Disintegrator,* [8] B.O.P. (Ball, Opener, Penmen) Type O, driven at 565 ± 21 rad/s [5400 ± 200 r/min] by a squirrel-cage induction motor rated at no less than 1.492 kW [2 hp].

6.2.2 *Perforated Steel Discharge Plates,* for the fiberizer. One each of the following opening diameters: 3, 5, 7 and 10 mm, ± 3 %. Holes must be on an equilateral triangular pitch with wire edges pointing outward.

6.2.3 *Cardboard Drum,* approximately 410 mm [16 in.] in diameter by 400 mm [15 in.] in height with removable ring clamp on top, and canvas dust cover (transition piece) to serve as a receiver for the fiberizer discharge. Other arrangements for receiving the fiberizer discharge that are satisfactory with respect to relief of static pressure generated by the fiberizer rotor and with respect to the prevention of sample losses and contamination are acceptable. The free area of cloth while in operating position must be within the limits from 1300 to 4500 cm^2, and the cloth must be square weave, unbleached cotton duck weighing 0.41 ± 0.02 kg/m^2 [12 oz/yd^2], or a cloth of equivalent permeability.

6.3 *Blending:*

6.3.1 *Polyethylene Jar with Cover,* [9] meeting the following specifications:

Inside diameter	311 mm [12.25 in.]
Outside diameter	327 mm [12.875 in.] (wall thickness 8 mm [0.3 in.])
Inside height	311 mm [12.25 in.]

Other containers, such as stainless steel blenders, with similar internal dimensions may be used.

6.3.1.1 The jar may be fitted with a circumferential rubber tension band 100 mm [3.94 in.] wide by 3 mm [0.125 in.] thick to retain the cover. This band may be rolled down, turtleneck fashion, when the cover must be opened. Alternatively, the cover may be retained by mechanical clamps. In that case, the use of a gasket to seal the cover may be necessary.

6.3.1.2 The jar must be fitted with tires around the outer diameter to allow it to roll on a roll table in a horizontal attitude and to allow any clamps or projections to clear the rolls.

6.3.2 *Roll-Table,* to rotate the blending jar at a speed of 5.87 ± 0.21 rad/s [56 ± 2 r/min]. See Note 2.

6.3.3 *Rolling Sheet,* 1 m^2 [1 yd^2] or larger, made of rubber, plastic, or some other flexible elastomer.

6.4 *Dry Mixing:*

[7] The sole source of supply of the apparatus known to the committee at this time is Ateliers de Lessines S.A., Division BOP, 55 rue de Wauthier 1020, Bruxelles, Belgium. 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] The sole source of supply of the apparatus known to the committee at this time is Canadian Laboratory Supplied Limited, Box 2090 Stn. St. Laurent, Montreal 307, P. Q., Canada. Specify dimensions required, request a design similar to Catalog No. J3028, and refer to Canlab Quotation No. 2713 (1969). 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] The sole source of supply of the apparatus known to the committee at this time is Canadian Laboratory Supplies Limited, Box 2090, Stn. St. Laurent, Montreal 307, P. Q., Canada, (Catalog No. J3028-14). These must be fitted with suitable vanes. 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.