



## Standard Test Method for Asbestos Content of Asbestos Textiles<sup>1</sup>

This standard is issued under the fixed designation D 1918; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This test method covers the determination of the asbestos content of untreated chrysotile asbestos textile materials which are usually blends of asbestos and organic fibers. This test method is also applicable to treated asbestos textile materials provided the treatment can be completely removed prior to testing.

1.2 This test method is limited to those asbestos textile materials in which asbestos is the only inorganic fiber present, or in which any other inorganic fiber or wire used as reinforcement can be removed prior to testing.

1.3 If carbonates are present, a correction is made for the loss on ignition in the calculation for asbestos content.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:

D 123 Terminology Relating to Textiles<sup>2</sup>

D 1193 Specification for Reagent Water<sup>3</sup>

D 2946 Terminology Relating to Asbestos<sup>4</sup>

### 3. Terminology

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

#### 3.2 Definitions:

3.2.1 *asbestos, n*—1. *general*—a group of impure silicate minerals occurring in fibrous form. 2. *textile*—the hydrous magnesium silicate serpentine mineral designated as chrysotile and having the general empirical formula  $Mg_3Si_2O_5(OH)_4$ .

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee C-17 on Fiber-Reinforced Cement Products and is the direct responsibility of Subcommittee C17.03 on Asbestos-Cement Sheet Products and Accessories.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 07.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 11.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 04.05.

3.2.2 Small amounts of carbonates, which may be present, are calculated as asbestos.

### 4. Summary of Test Method

4.1 When carbonates are not present in the fibers, a specimen is dried to constant mass, heated to 800 to 840°C (1470 to 1540°F) for 1 h and the loss in mass determined. The mass of the ignited specimen divided by 0.86 (see 5.2) is assumed to equal the mass of asbestos fiber originally present. This corrected mass is calculated as a percentage of the weight of the original specimen.

4.2 When carbonates are present they are included in the amount of asbestos reported. While carbonates are not determined and reported separately, the amount of carbon dioxide included in the carbonates is measured and used to determine the correct residue from ignition of the asbestos when calculating asbestos in presence of carbonates.

4.3 Both of the alternate procedures (4.1 and 4.2) are applicable in the presence of organic fibrous material.

### 5. Significance and Use

5.1 The asbestos content of asbestos textile materials is of major significance, since the percentage of asbestos present defines the grade of the textile and the approximate serviceability temperature for such materials.

5.2 This test method is considered satisfactory for acceptance testing of commercial shipments because: (1) current estimates of between-laboratory reproducibility are acceptable, (2) the test method has been used extensively in the trade for acceptance testing. In cases of dispute, 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 testing randomized specimens from one sample of material.

5.3 The factor of 0.86 is based upon a measured average of 14 % for the loss of water of crystallization on heating chrysotile asbestos to a temperature of at least 800°C (1470°F). The calculated asbestos content may be in error if the actual mass loss differs from the 14 % average.

5.4 If the specimen includes calcium carbonate ( $CaCO_3$ ), this compound is decomposed at 800°C (1470°F) and higher temperatures. No other carbonates are present in appreciable amounts.

5.5 If the textile specimen includes carbonates, the loss of mass observed during ignition will include the water of

crystallization of the asbestos and carbon dioxide from the carbonates. If the specimen includes both carbonates and organic fiber the loss of mass will include water of crystallization of the asbestos, carbon dioxide from the carbonates, and the combustible part of the organic fibers. Failure to take proper account of these losses will result in lower grading of the material.

5.6 Asbestos textiles as used in normal applications are not subjected to a temperature where  $\text{CaCO}_3$  will decompose. Any  $\text{CaCO}_3$  contained will remain unchanged and as such offers excellent thermal insulation. It is therefore included in the calculation as part of the asbestos content.

5.7 The mass of the original carbonate and the residual oxide formed on ignition of the carbonate in any specimen can be calculated from the amount of carbon dioxide evolved from a known mass of the specimen. The calculated values are used in the determination of the asbestos content of specimens which include carbonate.

## 6. Apparatus

6.1 *Knorr Alkalimeter*, for determining carbon dioxide as shown in Fig. X1.1 and Fig. X1.2 and described in Appendix X1.

6.2 *Muffle Furnace*, capable of maintaining a temperature range from 800 to 840°C (1470 to 1540°C).

6.3 *Crucibles*, 50-cm<sup>3</sup> glazed porcelain or equivalent.

## 7. Reagents and Materials

### 7.1 Purity:

7.1.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.<sup>5</sup> Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.1.2 *Purity of Water*— Unless otherwise indicated, references to water shall be understood to mean reagent water as defined by Type IV of Specification D 1193.

### 7.2 Reagents:

7.2.1 *Hydrochloric Acid*, HCl, concentrated sp gr 1.19.

7.2.2 *Hydrochloric Acid*, HCl, solution (one volume of sp gr 1.19 concentrated acid added to one volume of reagent water).

7.2.3 *Silver Sulphate*,  $\text{Ag}_2\text{SO}_4$ , solution (5 to 10 mass percent in hydrochloric acid, HCl, concentrated sp gr 1.19).

### 7.3 Materials:

7.3.1 *Calcium Sulphate*,  $\text{CaSO}_4$ , anhydrous, desiccant, 8-mesh solid, indicating.<sup>6</sup>

7.3.2 *Copper Sulphate*,  $\text{CuSO}_4$ , anhydrous, absorbent for hydrogen sulfide,  $\text{H}_2\text{S}$ ; or penahydrate,  $\text{CuSO}_4 \cdot \text{H}_2\text{O}$ .

<sup>5</sup> *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmaceutical Convention, Inc. (USPC), Rockville, MD.

<sup>6</sup> Drierite has been found suitable for this purpose.

7.3.3 *Soda-Asbestos Absorbent* (such as ascarite).

## 8. Hazards

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

8.2 When handling sulfuric acid, wear protective goggles, gloves, and clothing to protect against corrosion.

8.3 The reagents and materials in 7.2 to 7.3.3 may be toxic in sufficient doses.

## 9. Sampling and Test Specimens

9.1 Take a laboratory sample from each lot and from this sample take the number of specimens prescribed in the applicable material specification. In the absence of applicable material specification, take two specimens, believed to be representative of the lot to be tested.

9.2 Remove all treatments and all inorganic or wire reinforcements, or both, from the specimen before testing.

## 10. Conditioning

10.1 Preconditioning and conditioning of the test specimens are not necessary.

## 11. Procedure

### 11.1 Procedure for Determining Presence of Carbonates:

11.1.1 Place a specimen of approximately 0.5 g in a test tube. Wet the specimen thoroughly with 10 cm<sup>3</sup> of distilled water by stirring and tamping with a glass rod, so that no air bubbles are visible in the wet specimen. Add 5 cm<sup>3</sup> of HCl (sp gr 1.19) and again stir and tamp gently with a glass rod, taking care not to introduce any air bubbles. Warm gently.

11.1.2 If no gas bubbles are detected, proceed as directed in 11.2.

11.1.3 If gas bubbles form on the surface of the submerged specimen, proceed as directed in 11.3 and 11.4.

### 11.2 Procedure for Asbestos Content by Ignition (Carbonates Absent):

11.2.1 Take two test specimens, each weighing not less than 5 g, both representative of each lot or unit samples. Place the specimens in tared crucibles that have been previously heated to 800 to 840°C (1470 to 1540°F) for 1 h, cool in a desiccator, and weigh to the nearest 0.001 g. Dry each specimen to constant mass at 105 to 110°C (220 to 230°F) and record the mass to the nearest 0.001 g. Subtract the mass of the crucible to obtain the weight of the oven-dry specimen and record as mass *M*.

11.2.2 Place the crucibles containing the specimens in the muffle furnace and heat for not less than 1 h at 800 to 840°C (1470 to 1540°F). Remove the specimen and crucible from the furnace, and cool in a desiccator to room temperature. Weigh to the nearest 0.001 g and subtract the tared mass of the crucible to obtain the mass of the residue (ash). Record this mass as *A*.

11.2.3 *Calculations*— When carbonates are not present, calculate the asbestos content to the nearest 0.1 % by Eq 1 as follows:

$$\text{Asbestos content, \%} = (A/0.86 M) \times 100 \quad (1)$$

where:

- $M$  = mass of specimen after drying but prior to ignition, g,
- $A$  = mass of residue (ash) from the specimen after ignition, g, and
- 0.86 = factor to correct for 14 % water of crystallization lost when heating.

11.3 Procedure for Quantitative Test for Carbon Dioxide:

11.3.1 Check the Knorr alkalimeter (Fig. X1.1) to ensure freedom from leaks. Aspirate a current of air through the system at the rate of about two bubbles per minute for a period of 10 min. Stop the air current and remove the absorption tube. Place the absorption tube  $G$  in the balance case and allow it to stand for several minutes. Just before weighing, open the stopcocks momentarily and then close them. Weigh the tube and repeat the above procedure. The second mass should agree with the first within 0.05 g. If it does not, repeat this process until the two successive weighings agree. When a constant mass is reached, replace the absorption tube in the gas train.

11.3.2 Place a specimen of approximately 1 g weighed to the nearest 0.001 g in the distillation flask. Wash down any adhering particles on the inside neck of the flask with distilled water. Add enough distilled water to the flask to that when the apparatus is reconnected the tip of the dropping funnel will be 5 to 10 mm below the surface of the liquid. Place 50 cm<sup>3</sup> of dilute HCl (1 + 1) in the dropping funnel and replace the guard gas-absorption tube at the top of the funnel. Start the flow of water in the condenser and open all stopcocks fully except the one in the dropping funnel. Turn on the aspirator for medium suction. Adjust the stopcock on the dropping funnel so that the suction will draw the acid slowly into the flask. When all the acid is in the flask, open the funnel stopcock fully and adjust the aspirator to pull air through the system at a rate of two or three bubbles per second. After the reaction in the flask has subsided, heat the contents slowly to boiling. When condensation appears in the condenser, turn off the heat. Continue to draw air through the apparatus for 30 to 35 min. Reweigh the absorption tube  $G$  as before. The gain in mass represents the carbon dioxide in the specimen. Record this mass as  $D$ .

11.3.3 Calculate the mass of carbon dioxide recovered per gram of specimen by Eq 2 as follows:

$$E = D/F \tag{2}$$

where:

- $F$  = mass of the specimen used for the Knorr alkalimeter test, g,
- $D$  = gain in mass of the absorption tube  $G$ , g, and
- $E$  = mass of carbon dioxide released per gram of specimen, g.

11.3.4 Repeat the procedure on another specimen of similar size and calculate the average value of  $E$  in the two determinations. If desired, use the mass of the absorption tube  $G$  after the first determination as the starting point for the second determination without repeating the initial process of obtaining constant mass of the tube  $G$ .

11.4 Procedure for Asbestos Content by Ignition (Carbonates Present):

11.4.1 Proceed as directed in 11.2.1 and 11.2.2.

11.4.2 Calculation for Asbestos Content—Use the values

for carbon dioxide content as determined in 11.3.3 and calculate the asbestos content using Eq 3 or Eq 4 as follows: Asbestos content, %

$$= \frac{\frac{A - 1.27 ME}{0.86} + 2.27 ME}{M} \times 100 \tag{3}$$

$$= \frac{A + 0.68 ME}{0.86 M} \times 100 \tag{4}$$

where:

- $M$  = mass of specimen after drying but prior to ignition, g,
- $A$  = mass of residue (ash) from the specimen after ignition, g,
- $E$  = mass of carbon dioxide recovered per gram of specimen as calculated in 11.3.3, g,
- 1.27 = factor to calculate from  $E$  the grams of calcium oxide per gram of specimen, and
- 2.27 = factor to calculate from  $E$  the grams of calcium carbonate per gram of specimen.

12. Report

12.1 State that the tests were tested as directed in ASTM Test Method D 1918. Describe the material or product that was sampled and the method of sampling.

12.2 Report the following information:

12.2.1 The asbestos content of each specimen tested and the average of all tested,

12.2.2 Mass of carbon dioxide per gram of specimen when determined, and

12.2.3 The quantity of specimens tested.

13. Precision and Bias

13.1 Interlaboratory Test Data<sup>7</sup>—An interlaboratory test was conducted in 1966 in which one material was tested in five laboratories using one operator per laboratory; each tested 20 specimens per material. All 100 specimens of each material came from the same sample. The components of variance for asbestos content results expressed as standard deviations were calculated to be:

Single-operator component 0.36 percentage point

Between-laboratory component 0.21 percentage point

13.2 Precision—For the components of variance reported in 13.1, 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.

Critical Differences Percentage Points for the Conditions Noted<sup>4</sup>

Number of Observations in Each Average	Single-Operator Precision (repeatability)	Between-Laboratory Precision (reproducibility)
1	1.00	1.16
2	0.71	0.92
5	0.47	0.74
10	0.32	0.67

<sup>4</sup> The critical differences were calculated using  $t = 1.960$ , which is based on infinite degrees of freedom.

<sup>7</sup> ASTM Research Report No. D-13-1022 is available on loan from ASTM Headquarters, 1916 Race St., Philadelphia, PA 19103.

NOTE 1—The tabulated values of the critical differences 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 them must be established, with each comparison being based on recent data obtained on randomized specimens from one sample of the material to be tested.

13.3 *Bias*—No justifiable statement on the accuracy of Test

Method D 1918 for asbestos content can be made since the true value cannot be established by an accepted referee method.

14. Keywords

14.1 asbestos; asbestos textile; content; ignition loss; test; textile

APPENDIX

(Nonmandatory Information)

XI. DESCRIPTION OF KNORR ALKALIMETER

X1.1 *Knorr Alkalimeter*, consisting of the following parts connected as shown in Fig. X1.1 and Fig. X1.2.

X1.1.1 *Gas Washing Bottle, A*, containing concentrated  $H_2SO_4$  that serves to indicate the rate of gas flow and to prevent any water vapor entering the system from the atmosphere.

X1.1.2 *Drying Tube or Cylinder, B*, filled two thirds full of soda-asbestos absorbent (Ascarite) and one third full of drying agent to remove all  $CO_2$  from the air.

X1.1.3 *Knorr Alkalimeter Unit, C*, that consists of a dropping funnel, a distillation flask, and a condenser fitted with standard-taper joints to form a unit assembly.

X1.1.4 *Gas Washing Bottle, D*, containing a solution of 5 to 10 weight % of  $Ag_2SO_4$  in concentrated  $H_2SO_4$ . This serves to absorb any water vapor that escapes from the condenser and to remove any HCl from the evolved gases.

X1.1.5 *Drying Tube, E*, containing  $CuSO_4$ , to absorb any  $H_2S$  generated by the absorption of HCl.

X1.1.6 *Drying Tube, F*, filled with a suitable drying agent<sup>6</sup> to effect complete drying.

X1.1.7 *Absorption Tube, G*, filled two thirds full of soda-asbestos absorbent (Ascarite) and one third full of a drying agent<sup>7</sup> to absorb the  $CO_2$ .

X1.1.8 *Absorption Tube, H*, filled with a drying agent and soda-asbestos absorbent (Ascarite) in the reverse direction to prevent  $CO_2$  from entering the system.

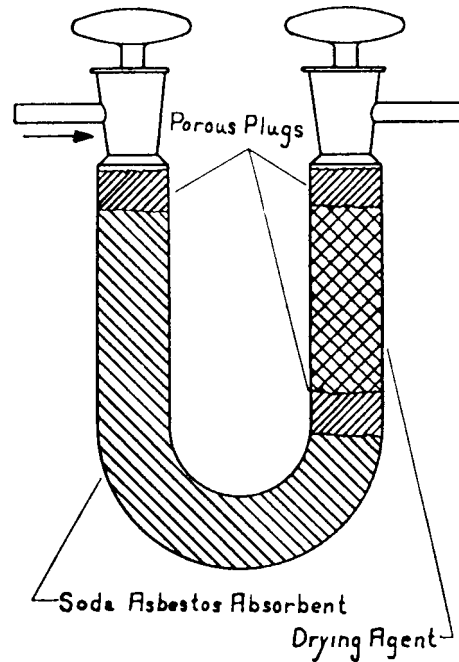


FIG. X1.2 Absorption Tube for Carbon Dioxide Determination

X1.1.9 *Trap, I*, to prevent back flow of water from the aspirator.

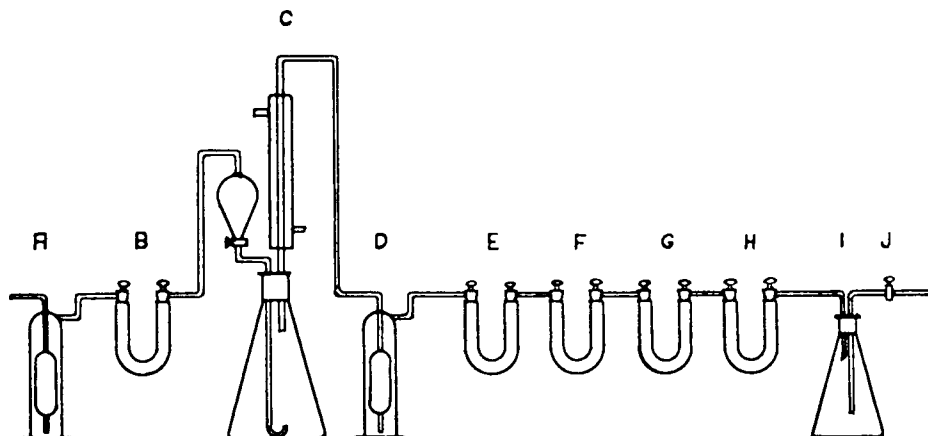


FIG. X1.1 Knorr Alkalimeter for Determination of Carbon Dioxide

X1.1.10 *Valve or Pinched Tubing, J*, to control the rate of air flow pulled through the system by the aspirator.

X1.1.11 *Source of Suction*, suction pump with regulator.

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