



Standard Test Method for Penetration Index of Asbestos¹

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^{ε1} NOTE—Asbestos warning was moved from 7.1 to 1.4 in September 2004.

1. Scope

1.1 To determine the efficiency with which asbestos fibers increase the consistency when mixed into a liquid asphaltic vehicle, relative to fibers chosen as standard.

1.2 This test method is applicable to Quebec Standard Group 7 asbestos fibers as determined by Test Method D 3639.

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

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 Asbestos: 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 and health practices and determine the applicability of regulatory limitations prior to use.* For a specific hazard warning, see 1.4.

2. Referenced Documents

2.1 ASTM Standards:³

D 217 Test Method for Cone Penetration of Lubricating Grease

D 396 Specification for Fuel Oils

D 2026 Specification for Cutback Asphalt (Slow Curing Type)

D 2027 Specification for Cutback Asphalt (Medium Curing Type)

D 2590 Test Method for Sampling Chrysotile Asbestos

D 2946 Terminology Relating to Asbestos

D 3639 Test Method for Classification of Asbestos Fibers by Québec Standard Test

D 3879 Test Method for Sampling Amphibole Asbestos

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

2.2 Other Standard:

Québec Standard Designation of Chrysotile Asbestos Fiber Grades⁴

3. Terminology

3.1

3.1.1 *Definitions*—Refer to Terminology D 2946.

4. Significance and Use

4.1 The objective of the test is to determine what quantity of the fiber under evaluation must be mixed with 100 g of cutback asphalt to give the same penetration as a target penetration.

4.2 The target penetration is determined with the same cutback asphalt as used for the test using standard calibrated asbestos fiber.

4.3 This test method determines the efficiency with which the asbestos tested will increase the consistency when mixed with a liquid asphalt.

5. Apparatus

5.1 *Penetrometer*—Calibrated in 0.1 mm divisions and fitted with a 102.5 ± 0.05 g grease penetration cone conforming to requirements⁵ stated in Test Method D 217.

5.2 *Asphalt Sample Cups*—55 mm in diameter and 35 mm in height, made of seamless tin plate as described in Test Method D 217.

6. Reagents and Materials

6.1 *Cutback Asphalt*—Containing non-volatile solvent.

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.

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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 Available from the Asbestos Institute, 1130 Sherbrooke St. West, Suite 410, Montreal, QC Canada H3A 2M8.

⁵ An automatic clutch is a permissible optional accessory.

NOTE 1—Cutback asphalt SC-70 specified in Specification D 2026, or MC-0 cutback asphalt specified in Specification D 2027, have been found satisfactory.

NOTE 2—The workability of the above cutback asphalts can be improved by dilution with No. 2 fuel oil as specified in Specification D 396, up to a proportion of 1/3 with SC-70 or 1/3 with MC-0, by weight.

6.2 *Standardized Asbestos Fiber*—Of known penetration index.⁶

7. Hazards

7.1 Warning—1.4.

8. Sampling, Test Specimens and Test Units

8.1 *Sampling*—Take samples in accordance with Test Methods D 2590 in the case of chrysotile asbestos or Test Method D 3879 in the case of amphibole asbestos.

8.2 *Test Specimens*—The quantity of asbestos required is a function of its penetration index. The quantity required will usually range between 20 to 100 g for each trial. The number of trials required is generally five or less. Experienced operators testing known fibers of constant quality can succeed with only one trial using one specimen. In general, a 500 g sample should be ample for all the trials required even under adverse conditions.

9. Calibration and Standardization

9.1 Insert the shaft of the grease cone into the hollow shaft of the penetrometer and fasten securely. The shaft and movable attachments of the penetrometer weigh 47.5 g and the grease cone 102.5 g, thus the total moving load is 150 g.

9.2 Set the penetrometer to an approximate height to ensure the sample cup can be positioned under the penetration cone. Determine that the penetrometer is level.

9.3 Determine the tare weight of a No. 6 porcelain evaporating dish.

9.4 Agitate the cutback asphalt to ensure uniformity.

9.5 Weigh out 10 g of cutback asphalt into the evaporating dish. A teaspoon may be used to adjust the mass.

9.6 Weigh out the designated quantity of standardized fiber on top of the cutback asphalt. The designated quantity may be determined from the following formula:

$$\text{Standardized fiber quantity} = 5000/(\text{Penetration Index}), \text{ in grams}$$

9.6.1 Examples:

9.6.1.1 If the penetration index is 80, the designated quantity is $5000/80 = 62.5$ g.

9.6.1.2 If the penetration index is 125, the designated quantity is $5000/125 = 40.0$ g.

9.7 Mix thoroughly the fiber and asphalt with a spatula.

9.8 Fill a sample cup with the mixture, ensuring there are no voids or air pockets. This may be accomplished by adding the mixture in four of five increments, filling the bottom corners first, and smoothing the mixture with the spatula, using a rotary motion, after each addition. Fill level to top of cup, and strike it off smooth with the spatula held at an angle to avoid pulling the surface of the material.

9.9 Adjust the penetrometer so that the tip of the grease penetration cone just touches the surface of the mixture in the center of the cup.

9.10 Depress the clutch and allow the grease cone to drop for exactly 5 s. Record the amount of drop to 0.1 mm.

9.11 Reposition the grease cone and remove the cup from under the penetrometer. Clean the grease cone. Paper towels may be used for this purpose.

9.12 Add a small quantity of mix to the contents of the sample cup, 5 to 10 cm³, so as to have an excess. Using the spatula, remove the top half of the mixture from the sample cup and replace it upside down. Strike off smooth and take another reading as in 9.9 to 9.11.

9.13 Again add a small quantity of mix to the sample cup so as to have an excess. Using the spatula, remove nearly all of the mixture from the cup and replace it upside down in the cup. Strike off smooth and take another reading as in 9.9 to 9.11.

9.14 Compare the three readings and if the variation does not exceed 0.4 mm, calculate their average. This average is to be used as the target penetration against which samples to be tested will be compared.

NOTE 3—If the three readings are not within the allowable variation of 0.4 mm, another fresh surface should be turned up and the test repeated. If three of the four readings fall within the allowable variation, those three values shall be averaged. If not, the test shall be entirely repeated using a new mixture.

NOTE 4—Cups and evaporating dishes may be cleansed with kerosene, and are to be dry when used. Determine the tare weight of the dish for each test.

10. Procedure

10.1 The objective of the test is to determine what quantity of fiber under evaluation must be mixed with 100 g of cutback asphalt to give the same penetration as the target penetration.

10.2 The final weight of fiber required for determination of the penetration index is calculated by interpolation from results on two different mixtures. These two readings have to be above and below the target, and must be within 20 penetration units (2 mm) from the target.

10.3 Mix the cutback asphalt and weigh out 100 g into the evaporating dish.

10.4 Weigh out a quantity of the fiber to be tested. If this fiber is thought to be more absorbent than the standardized fiber, weigh out a quantity less than the amount of standardized fiber used. Conversely, if this fiber is thought to be less absorbent than the standardized fiber, weigh out a quantity greater than the amount of standardized fiber used.

10.5 Mix and test as for the standard reference fiber.

10.6 Repeat with new quantities of fiber until mixes are arrived at which will give within 20 penetration units (2.0 mm) of the target penetration.

NOTE 5—The test should be performed at room temperature, and the asphalt cutback and fiber should be conditioned to this temperature.

NOTE 6—The cone should be thoroughly cleaned after each penetration.

NOTE 7—The calibration and procedure should be performed as a continuous operation, without delay or interruption, thereby avoiding any risk of the mixture thickening due to exposure.

NOTE 8—The calibration should be repeated daily, or more often if laboratory conditions change significantly. Each operator who performs the test must perform his own calibration.

⁶ Available at a nominal cost from Centre Spécialisé en Technologie Minérale, CEGEP 671 Smith Blvd. South, Thetford Mines, QC Canada G6G 1N1.

11. Calculation or Interpretation of Results

11.1 The penetration index is calculated as follows:

$$\text{Penetration index} = 5000/A$$

where:

A is the quantity of fiber, in grams, required to give the target penetration as described in Section 10.

12. Precision and Bias

12.1 *Precision*—The single-apparatus multi-operator precision is ± 9 index units (two sigma limits) as defined in Practice E 177 over the penetration index range of 50 to 148.

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12.2 *Bias*—No justifiable statement on the bias of this test method can be made since the true values cannot be established by an accepted referee method.

13. Keywords

13.1 asbestos; asphalt; efficiency; index; penetration; penetration index; test