Designation: D2752/D2752M – 88 (Reapproved 2011)$^{\varepsilon 1}$

Standard Test Methods for Air Permeability of Asbestos Fibers[1]

This standard is issued under the fixed designation D2752/D2752M; 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.

ε[1] NOTE—Units information was editorially corrected in February 2012.

1. Scope

1.1 These test methods cover the measurement of the relative degree of openness or degree of fiberization of milled asbestos fiber by air permeability instruments.

1.2 Method A is the recommended procedure and describes a determination by means of the Rapid Surface Area apparatus. This test method is limited to fibers with an effective surface area in the range from 10 to 250 dm^2/g [490 to 12 000 ft^2 /lb].

1.3 Method B is an alternative procedure and covers the use of the Dyckerhoff apparatus. This test method is limited to fibers within the range from 10 to 600 Dyckerhoff seconds.

1.4 Only those asbestos specimens which are of similar specific gravities will bear strict comparison by these air permeability methods since differences in density result in specimens being tested under different conditions of porosity.

1.5 Samples containing excessive quantities of nonfibrous particles or contaminants will not give reliable or meaningful results.

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 chrysotile asbestos, refer to "Safe Use of Chrysotile: 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.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D2590 Test Method for Sampling Chrysotile Asbestos

D3879 Test Method for Sampling Amphibole Asbestos (Withdrawn 2009)[4]

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

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

2.2 *Other Standard:*[5]

NNN-P-1475B Federal Specification for Paper, Filter, Analytical

3. Summary of Test Methods

3.1 In both test methods the resistance to air flow of a compressed specimen of fixed weight and volume is determined.

3.2 *Test Method A:*

3.2.1 The apparatus is arranged so that the total resistance to air flow remains equal to a fixed hydraulic pressure head. Total resistance includes the resistance of the specimen and the pressure drop across a calibrated capillary tube of known resistance. The contribution of the specimen to total resistance is measured on a manometer calibrated in specific surface area units.

3.2.2 Optional calibration of the manometer in equivalent Dyckerhoff seconds, which are the units of Test Method B, permits comparison of results by both test methods on the same basis.

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[1] These test methods are under the jurisdiction of ASTM Committee C17 on Fiber-Reinforced Cement Products and are 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] The last approved version of this historical standard is referenced on www.astm.org.

[5] Available from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

3.3 *Test Method B:*

3.3.1 The time required to draw a given volume of air through the specimen under specified conditions of varying hydraulic head is determined. This time is taken as a measure of the air permeability of the specimen.

4. Significance and Use

4.1 The degree of fiberization or subdivision of the asbestos fiber bundles in a specimen is related to its resistance to air flow. The number and size of the pores in the specimen are a function of the size of the fiber bundles and determine the resistance to air flow through the plug. Test specimens that have undergone a higher degree of fiberization will yield higher results provided the specimens compared are of similar specific gravities and other properties are not markedly different.

4.2 These test methods are suitable for specification acceptance, manufacturing control, development, and applied research.

4.3 It must not be assumed that all test specimens with equal test results have undergone equivalent degrees of fiberization. Some types of asbestos fiberize more readily than others. Particle size distribution and harshness can also influence permeability.

5. Sampling

5.1 Take a sample in accordance with the sampling procedure in Test Method D2590 for chrysotile fibers and Test Method D3879 for amphibole fibers. (**Warning—**See 1.7.)

6. Test Specimen

6.1 Spread the sample on a smooth working surface in layers to form a flat pile of uniform thickness 13 mm [0.5 in.] thick, and quarter the pile.

6.2 Set aside opposite quarters and repeat 6.1 with the remaining quarters.

6.3 Select two 50 ± 0.01-g [0.1102 ± 0.00002-lb] specimens (Note 1) by taking pinches from each quarter of the pile until a quantity is obtained that will require minimum adjustment to the desired weight.

NOTE 1—The metric system of units shall be used for referee testing.

6.4 When pinches are taken be careful to include the total cross section of the pile from top to bottom at the point where it is taken, including any grit or fines which may have segregated at the bottom.

6.5 Any lumps or knots of matted fiber still remaining in the specimen should be disentangled before cell loading is begun.

7. Calibration and Standardization

7.1 *Calibrating Standards*[6]:

7.1.1 The calibrating standards for both test methods consist of capillary glass tubing mounted in a holder which suitably fills the specimen cavity in the permeability cell.

7.1.2 The low standards have an equivalent surface area range from 45 to 55 dm^2/g [2200 to 2700 ft^2/lb]. This corresponds to a Dyckerhoff time of efflux in the range from 20 to 30 s. They are made from glass tubing with a bore of 0.311 ± 0.012 mm [0.01225± 0.0005 in.] and about 13 mm [0.5 in.] long.

7.1.3 The high standards have an equivalent surface area range from 200 to 230 dm^2/g [9770 to 11 200 ft^2 /lb]. The Dyckerhoff time of efflux is fixed in the range from 350 to 450 s. They are made from glass tubing with a bore of 0.178 ± 0.013 mm [0.0070± 0.0005 in.] and about 39.5 mm [1.55 in.] long.

7.1.4 A Dyckerhoff capillary tube holder is shown in Fig. 1. Holders for Rapid Surface Area standards are of similar design but are 38 ± 0.2 mm [1.496 ± 0.007 in.] in external diameter.

7.1.5 For accurate results keep calibrating standards in airtight containers or in a desiccator when not in use.

7.1.6 Clean capillary tubes with dry, compressed air, free from contaminants, at 1.4 kgf/cm^2[20 psig], if permanently mounted, or 0.35 kgf/cm^2 [5 psig] if temporarily mounted, prior to calibration. Allow the air to flow 1 min.

7.2 *Instrument Calibration for Rapid Surface Area Tester:*

7.2.1 Verify the apparatus as described in Section 9.

7.2.2 Insert a calibrating standard mounted in its capillary tube holder into the cell using the handle shown in Fig. 2(*a*). Insert the end cap of the cell, and screw down the retaining ring using the key and base provided, until there is a positive resistance indicating that the O-ring seal is fully compressed and that metal-to-metal contact has been established between the cell face and the end cap.

7.2.3 Proceed as directed in 10.4 and 10.5. If results differ from the nominal value of the standard by more than ±3.0 %, it may be concluded that the equipment is defective. The defect must be rectified before proceeding.

7.3 *Instrument Calibration for the Dyckerhoff Tester:*

7.3.1 *Fixed Electrode Apparatus:*

7.3.1.1 Verify the apparatus as described in Section 13.

7.3.1.2 Insert a calibrating standard mounted in its capillary tube holder into the cell using the handle shown in Fig. 2(*a*)

[6] Calibrating standards mounted in approved capillary tube holders are obtainable from Centre Spécialisé en Technologie Minérale, CEGEP, 671 South Smith Boulevard, Thetford Mines, QC, Canada, G6G 6X9. Standards may be permanently or temporarily mounted; however, permanent mountings are recommended. 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.

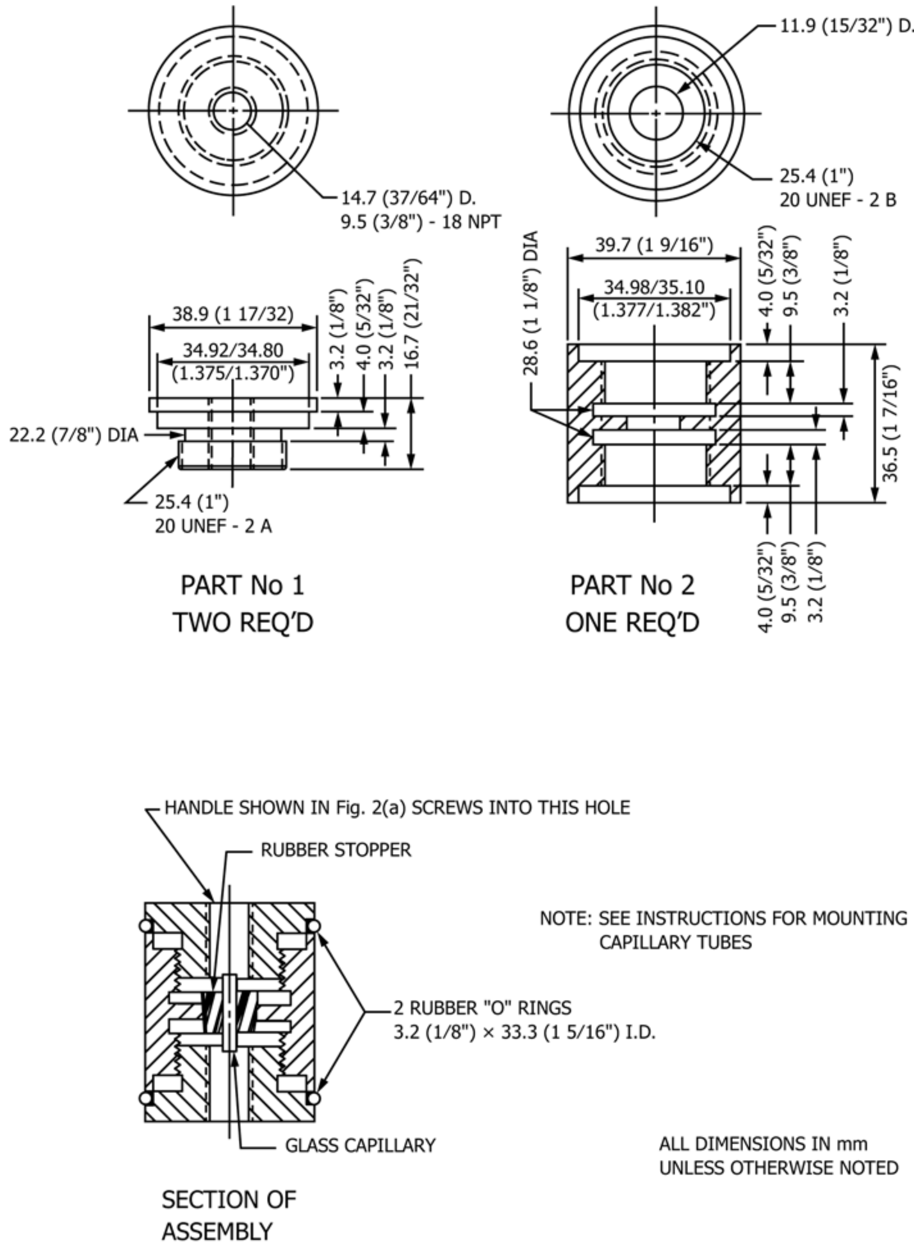


FIG. 1 Capillary Tube Holder

and clamp the cell in position on the apparatus. Omit the spacer from the assembly so that the plunger may seat perfectly.

7.3.1.3 The liquid level in the manometer must be at the indicated etch mark on the tube before the suction head is established.

7.3.1.4 Apply vacuum to the manometer until the lower liquid level in the manometer is just below the tip of the longest electrode.

7.3.1.5 Reset the stop clock to zero. Observe the reading on the dial after the level of the liquid has reached the shortest electrode, and the clock has stopped.

7.3.1.6 Take two readings. If the second reading differs appreciably from the cumulative average value of the standard, refer to the instructions supplied with the standards to locate and eliminate the source of variation.

7.3.1.7 Obtain readings on the calibrating standard as directed in 14.5 to 15.1.

7.3.1.8 Each time a working standard is used, and valid readings are obtained, the average reading must be recorded and the average of all previous readings, including the nominal value and the latest reading, must be computed. This all time average value of the working standard is referred to as the cumulative average value.

7.3.1.9 If the value obtained with the calibrating standard is within 3 % of the cumulative average, that value is accepted and the apparatus may be considered free from defects.

7.3.1.10 If the deviations exceed 3 %, examine the apparatus for defects and rectify as described in the instructions supplied with the standards. Then recheck the calibrating standards.

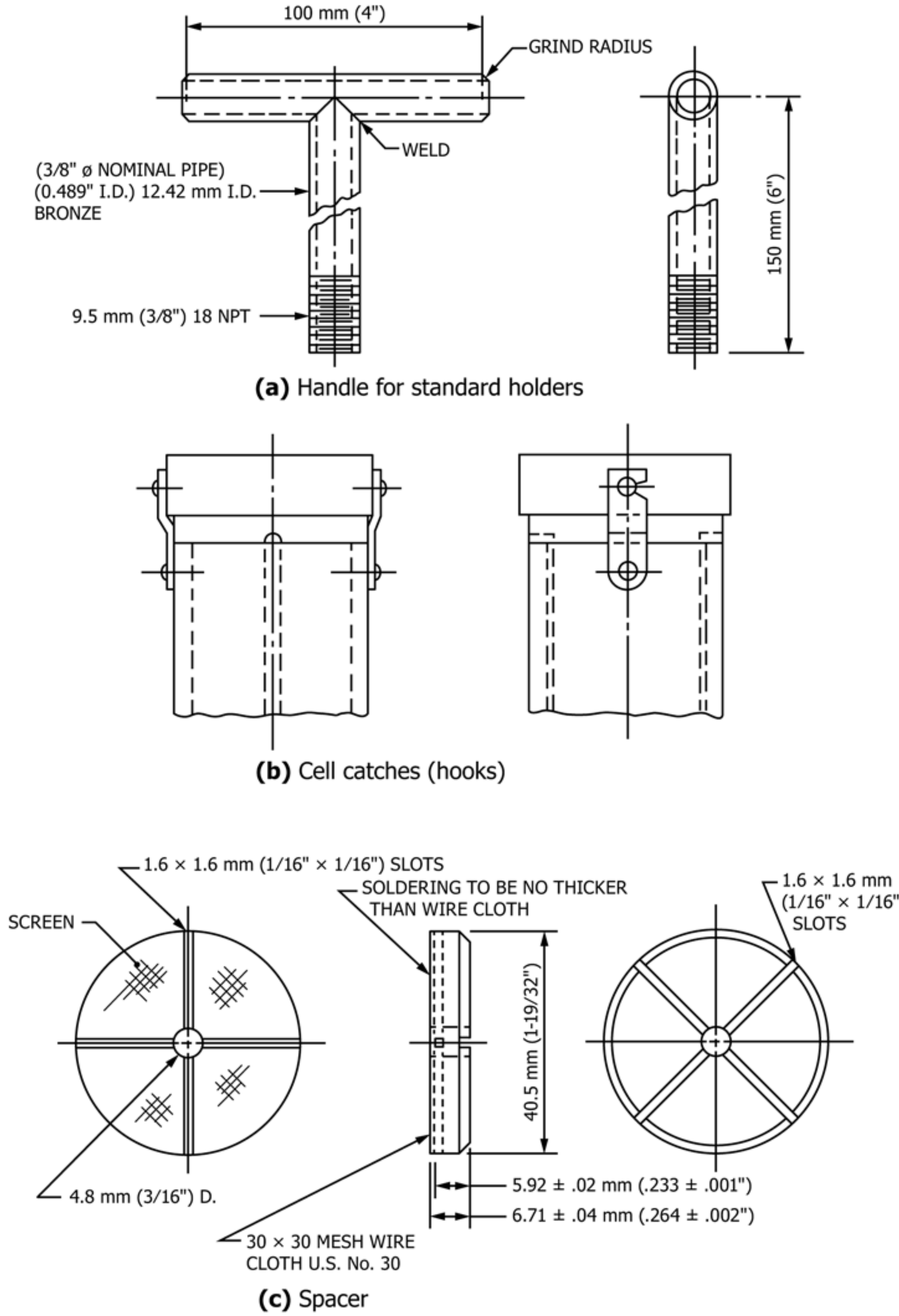


FIG. 2 Miscellaneous Details

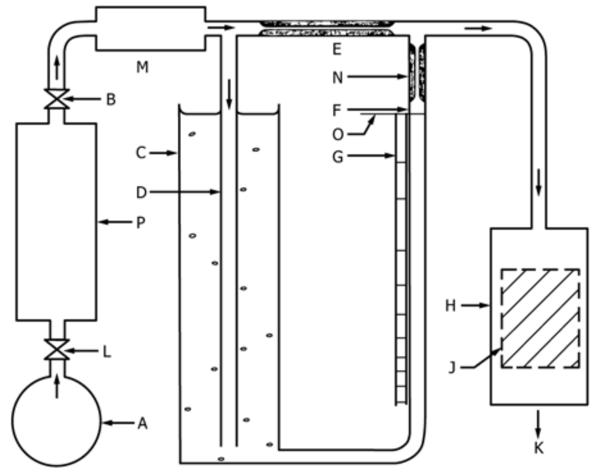
7.3.1.11 The difference between the average reading (initial or recheck) and the cumulative average, which may be positive or negative, must be applied as a correction to subsequent values obtained on unknown asbestos specimens.

7.3.1.12 When the correction exceeds 6 % of the nominal value, the standard should be returned to the calibrating laboratory for recalibration.

7.3.2 *Variable Electrode Apparatus:*

7.3.2.1 Adjust the electrodes so that valid readings obtained on the calibrating standard will coincide with the nominal value within 3 %.

7.3.2.2 Measure the position of the variable electrode relative to the apparatus housing whenever a new working standard is put into service, and record this vertical distance for later reference.



A—Supply of clean compressed air
B—Control valve
C—Water reservoir
D—Bubbler tube
E—Capillary resistance
F—Manometer leg
G—Manometer scale (exponential)
H—Permeability cell
J—Test specimen
K—Air outlet
L—Shut-off valve
M—Dust filter (fiber glass)
N—Capillary snubber
O—Zero mark on manometer
P—Air dryer or desiccator (Drierite)

NOTE 1—Items A, L, and P are not supplied with the apparatus.

FIG. 3 Schematic Diagram of Rapid Surface Area Tester

7.3.2.3 When electrode adjustments exceed 2.5 mm [0.1 in.], return the standard to the calibrating laboratory for recalibration.

7.3.2.4 Obtain readings on unknown asbestos specimens directly, without any corrections.

METHOD A

8. Apparatus

8.1 *Rapid Surface Area Tester,* [7] including 50-g [0.1102-lb] brass sample cell, complete with perforated plate, end cap, retaining ring, and base. A schematic diagram of the apparatus is shown in Fig. 3. The following accessories which are required are also supplied with the apparatus: filling funnel, tamping rod, and key.

8.2 *Source of Clean Air,* at approximately 140 gf/cm^2 [2 psig].

8.3 *Optional Cell Holder,* shown in Fig. 4 for use with a Dyckerhoff cell (Fig. 5).

8.4 *Standards,* as described in 7.1.

9. Preparation of Apparatus

9.1 Check the apparatus daily before using, and make the following adjustments when required (see Appendix X1 for additional verifications, to be carried out at longer time intervals):

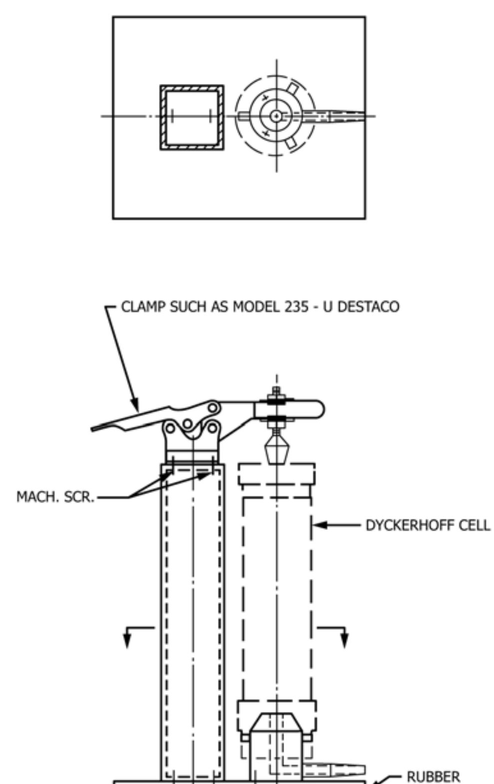


FIG. 4 Dyckerhoff Cell Holder

9.1.1 Verify the zero reading of the tester as directed in 10.4 and 10.5 but with the cell empty.

[7] Available from TAF International Ltd, PO Box 21, Ashburton Road West, Trafford Park, Manchester M17 1RQ, UK. 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.

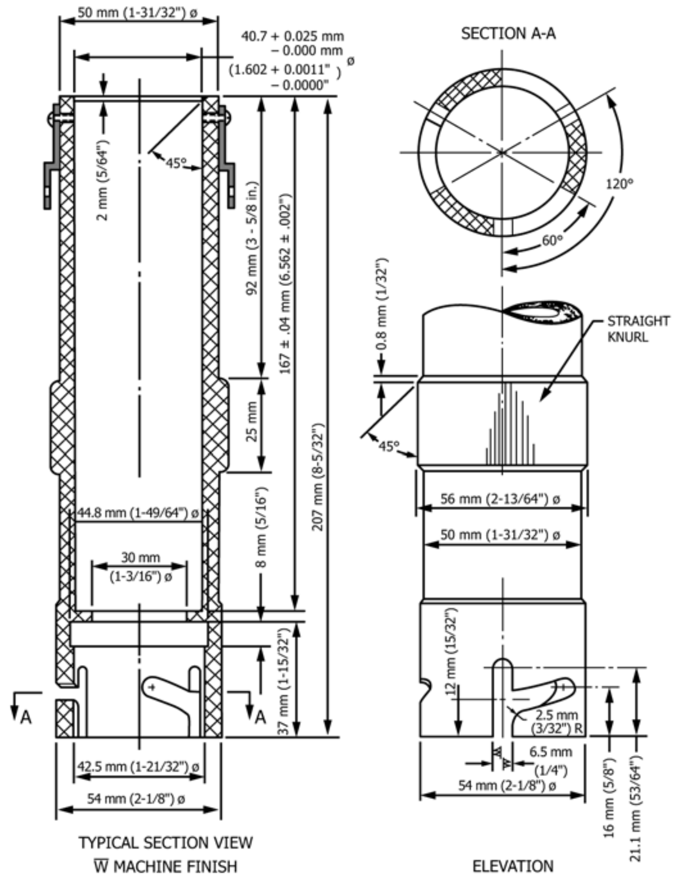


FIG. 5 Modified Permeability Cell

9.1.2 If the manometer does not read zero, check to determine if the manometer is out of plumb.

9.1.3 If the water level is below zero, adjust by adding distilled water through the hole in the reservoir cap.

9.1.4 If the level is above zero, correct it by inserting a wick through the hole to remove excess water. Do not tilt the apparatus.

9.1.5 Ensure that the perforated disk is perfectly seated at the bottom of the sample cell.

10. Procedure

10.1 Place the filling funnel over the open end of the cell and empty one 50-g specimen into it in stages, using the tamping rod at intervals to coax all the specimen past the neck of the funnel; avoid trapping any fiber between the rod and the funnel. In a single motion, press the specimen into the cell until the transverse bar touches the upper edge of the filling funnel.

10.2 Do not compress the fiber in the cell without the filling funnel in place.

10.3 Slowly withdraw the rod, rotating it slightly to ensure that the compressed fiber is not disturbed. Insert the end cap of the cell, and screw down the retaining ring using the key and base provided, until there is a positive resistance indicating that the O-ring seal is fully compressed and that metal-to-metal contact has been established between the cell face and the end cap.

TABLE 1 Examples

Readings, dm²/g	Example A	Example B	Example C
1st	46	46	46
2nd	44	42	42
3rd	...	48	44
Accepted readings	46	46	46
	44	48	42
	...	...	44
Average	45	47	44

10.4 Connect the cell to the rubber discharge tube of the tester and turn on the air supply. Open the control valve on the apparatus until the water level in the front manometer tube begins to fall. When air bubbles begin to issue from the escape holes at the bottom end of the brass tube in the transparent vertical cylinder at the rear of the tester, adjust the control valve until bubbles escape at a rate of not more than three per second.

10.5 When the water level in the manometer tube appears to be stationary, note the scale reading opposite this level. Wait 10 s and read the level again to make sure that it is constant; if not, take another reading after a further 10 s. Estimate the scale reading to half a division, and record this reading as the effective surface area in square decimetres per gram.

10.6 When the reading has been recorded, close the shutoff valve, and disconnect the cell from the apparatus. Do not change the setting of the control valve unless required.

10.7 Repeat 10.1 to 10.6 for the second test specimen.

10.8 *Procedure Using the Optional Cell Holder and Dyckerhoff Cell*—If it is desired to compare results obtained by means of the Rapid Surface Area Tester with the results obtained by Method B, proceed as follows:

10.8.1 Determine the Dyckerhoff air permeability on a fiber sample, or on a Dyckerhoff capillary calibrating standard, as desired, by Method B.

10.8.2 Transfer the cell from the Dyckerhoff Tester to the cell holder shown in Fig. 4 and test with the Rapid Surface Area Tester, as described in 10.4 to 10.7.

NOTE 2—Use of the optional cell holder and Dyckerhoff cell with the Rapid Surface Area Tester instead of the standard cell will give slightly different results due to differences in geometry of the interior of these cells.

11. Calculation

11.1 If the two results obtained differ by more than two scale divisions, test a third specimen.

11.2 If three tests are made, reject any reading that lies more than two scale divisions from the nearest of the others, and record the average of the remaining readings in square decimetres per gram. Examples are given in Table 1.

NOTE 3—The Rapid Surface Area Tester may be correlated with the Dyckerhoff Air Permeability Tester by taking readings as described in 10.8 or as in 10.1 to 10.7 and plotting the Dyckerhoff time readings against the effective surface area results obtained. An example of a correlation graph for two given instruments is shown in Fig. 6.

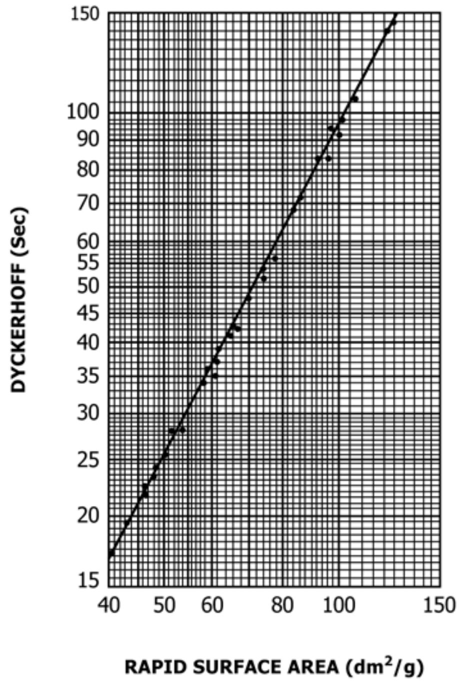


FIG. 6 Plot of Dyckerhoff Time Versus Rapid Surface Area

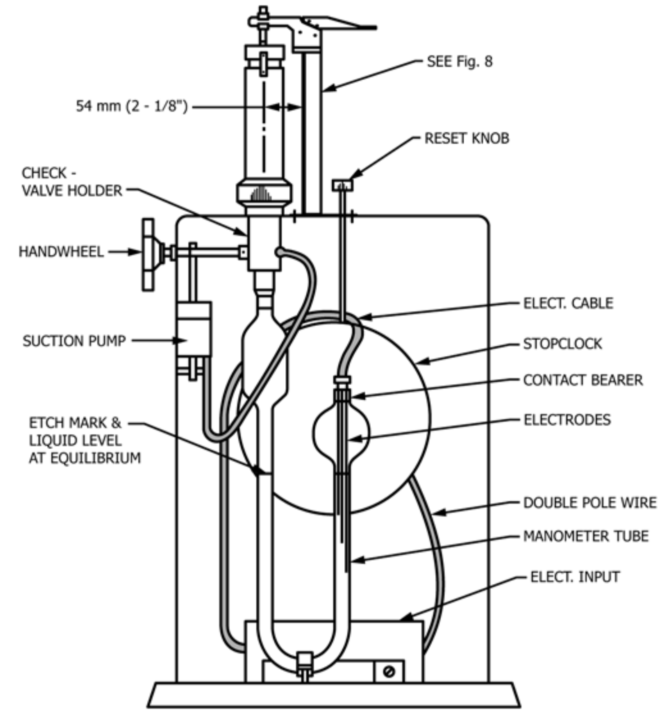


FIG. 7 Dyckerhoff Apparatus

12. Precision and Bias

12.1 *Precision:*

12.1.1 At the 50 dm^2/g air permeability level the differences in results reported by a single operator using a single sample and a single apparatus in a single laboratory should not exceed 2.9 dm^2/g in 95 % of the cases.

12.1.2 For products with an air permeability value level of 250 dm^2/g the difference between two test results obtained by a single operator, apparatus and laboratory should not exceed 3.6 dm^2/g in 95 % of cases.

12.2 *Reproducibility (as defined in Practice E177):*

12.2.1 At the 50 dm^2/g air permeability level the differences in results reported by different operators using multiple samples intra-laboratory should not exceed 4.2 dm^2/g in 95 % of cases.

12.2.2 At the 250 dm^2/g level, the multiple operator, multiple sample, intra-laboratory difference in results should not exceed 11.6 dm^2/g in 95 % of cases.

12.3 *Bias:*

12.3.1 Bias cannot be established for asbestos fibers for lack of a suitable referee method.

METHOD B

13. Apparatus

13.1 *The Dyckerhoff Air Permeability Apparatus* is essentially a means of drawing a definite quantity of air through a prepared bed of asbestos fiber of fixed porosity. The tester is equipped with a manometer, fitted with electrodes, to permit the automatic measurement of the time required to draw a fixed volume of air through the specimen, under a suction head which is inversely proportional to the volume of air drawn. The apparatus,[8] illustrated in Fig. 1Fig. 2, Fig. 7, Fig. 5, and Fig. 8, is described below.

13.1.1 *Permeability Cell* (Fig. 5), consisting of a rigid cylinder 40.7 mm + 0.025, – 0.000 (1.60237 in. + 0.00097, – 0.00000) inside diameter, of noncorroding metal. The top of the cell is at right angles to the principal axis of the cell. The bottom of the cell forms an air-tight connection, by means of a rubber O-ring, with the check valve holder which joins the cell to the manometer. A ledge 5 mm [0.2 in.] in width forms an integral part of the cell, 167 mm + 0.000, – 0.009, (6.57445 in. + 0.00000, – 0.00035), from the top of the cell, for support of the perforated metal disk. A pair of hooks must be added to retain the plunger as shown in Fig. 2(*b*) and 7. Vertical slots must be cut into the base to supplement the existing helical slots (Fig. 5). The latter are required with the standard apparatus while the former are preferable for use with the cell clamp shown in Fig. 4, Fig. 7, and Fig. 8.

13.1.2 *Plunger*—The plunger fits into the cell with a clearance of not more than 0.1 mm [0.004 in.]. The bottom of the plunger has sharp square edges and is at right angles to the principal axis. An air vent is provided on each side of the plunger. The top of the plunger is provided with a collar such that when the plunger is placed in the cell and the collar

[8] Model LDDA or Model 7207 (Asbestos Model) supplied by Chemisches Laboratorium fur Tonindustrie, (1) Berlin-Reinickendorf 1, Kopenhagener str. 60-74c., Germany, is suitable provided it is modified as described in 12.1.1 and 12.1.11.2. Distributors are Alpine American Corp., Michigan Drive, Natick, Mass. 01762, and J. W. Ellis Industries, 111 Queen St. East, Suite 302, Toronto, ON, Canada. 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.

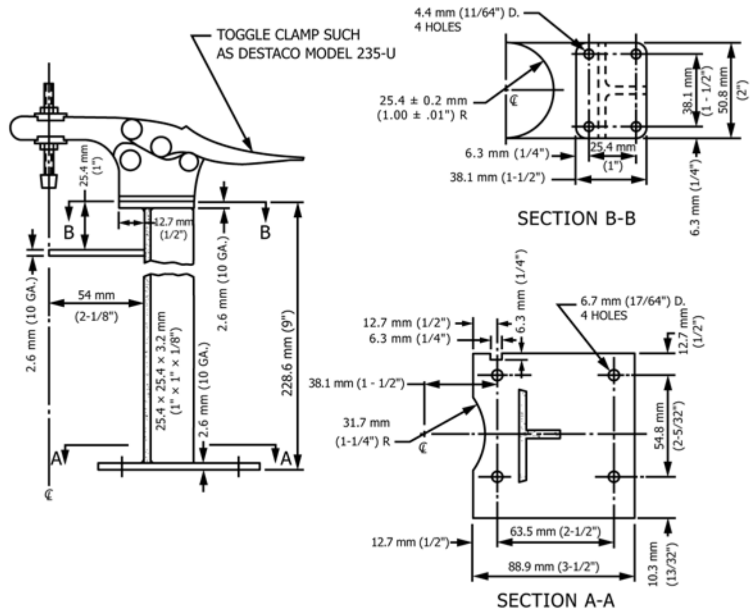


FIG. 8 Cell Holder

brought into contact with the top of the cell, the distance between the bottom of the plunger and the top of the perforated disk shall be 57.00 ± 0.60 mm [2.2441 ± 0.0237 in.]. The plunger supplied with the apparatus must be modified by fitting it with pins on either side of the collar to engage the cell hooks mentioned in 12.1.1, as shown in Fig. 2(*b*).

13.1.3 *Spacer,* constructed of noncorroding metal as shown in Fig. 2(*c*). This item is not supplied with the apparatus. The wire cloth corresponds to U.S. Sieve Series No. 30 described in Specification E11. The spacer fits inside the cell snugly. The thickness of the spacer, 6.71 ± 0.04 mm [0.2642 ± 0.0015 in.], is set to leave a thickness of bed for the asbestos specimen and filter papers of 50.29 ± 0.64 mm [2.0527 ± 0.262 in.].

13.1.4 *Filter Paper,* medium retentive, corresponding to Type 1, Grade B, as prescribed in Federal Specification for Paper, Filter, Analytical (NNN-P-1475B). The filter paper disks shall be circular, with smooth edges, and shall have the same diameter as the inside of the cell.

NOTE 4—Filter paper disks that are too small may leave part of the sample adhering to the inner wall of the cell above the top disk. When too large in diameter, the disks have a tendency to buckle and cause erratic results.

13.1.5 *Perforated Disk,* noncorroding metal 1.52 ± 0.04 mm [0.05984 ± 0.00157 in.] in thickness, perforated with 271 holes 1.0 mm [0.04 in.] in diameter equally distributed over the open area left by the inner ledge of the cell. The disk fits inside the cell snugly.

13.1.6 *Check Valve Holder,* connecting the cell to the manometer, and joining the manometer to a suction pump through a rubber sleeve type of check valve. This valve allows air to be evacuated from the manometer, by means of the suction pump, but prevents flow in the other direction.

13.1.7 *Suction Pump,* consisting of a simple piston in a cylinder. It serves to evacuate the air between the cell and the liquid surface in the manometer thus causing the liquid to rise in one branch, and to fall in the other to a point below the tip of the longest electrode. A suction head is thus created which subsequently draws air through the specimen.

13.1.8 *Manometer,* U-tube, constructed according to the design indicated in Fig. 7, using 20.7± 0.1-mm [0.815 ± 0.004-in.] outer diameter glass tubing with a wall thickness of 1.92 ± 0.12 mm [0.0756 ± 0.0047 in.]. The top of one arm forms an airtight connection with the check valve holder which joins the manometer to the cell. The top of the other arm supports three electrodes of different lengths. These are arranged so that when the surface of the liquid traverses the distance between the lower tips of the two shorter electrodes, the volume swept out by the liquid corresponds to the volume of air drawn through the specimen (not precisely equal since air is drawn under varying pressure conditions with consequent change in volume). This volume is approximately 17.80 cm^3 [1.086 $in.^3$]. The manometer is mounted so that the arm connected to the cell is vertical. This arm has a line etched around the tube at a height which corresponds to a volume of 100 mL [6.102 $in.^3$] of liquid in the U-tube.

13.1.9 *Manometer Liquid*—The manometer must be filled to the etch mark with a nonvolatile, nonhygroscopic liquid of low viscosity and sufficient electrical conductivity to energize the electrode circuits. The specific gravity of the liquid supplied with the apparatus is 1.086 ± 0.001.

13.1.10 *Timer*—The timer contains a mechanical clock movement with a sweep second hand. The time is started and stopped by means of a lever which is activated by an electric solenoid, governed by the electrode circuits.

13.1.11 *Accessories:*

13.1.11.1 *Tamper,* supplied with the apparatus, consisting of a rod 6 mm [0.25 in.] in diameter and 280 mm [11 in.] in length terminated at each end with a disk. One disk is 40 mm [1.5 in.] in diameter and perforated with four holes of 8 mm [0.3 in.] in diameter and four holes of 3 mm [0.125 in.] in diameter symmetrically disposed. This end of the tamper serves to pack the fiber in the cell. The other end is plain, 25 mm [1 in.] in diameter, and is used for pushing the plug of fiber out of the cell after testing.

13.1.11.2 *Cell Holder,* shown in Fig. 8, is an optional accessory not supplied with the apparatus, but strongly recommended.

13.1.11.3 *Porous Cellulose Filters,* 12 mm [0.5 in.] long and 12 mm [0.5 in.] in diameter, are supplied with the apparatus for insertion at the top of the check valve holder to prevent the entrance of contamination into the system.

13.1.11.4 *Funnel,* wide-mouth, for loading the cell.

13.2 *Calibrating Standards,* as described in 7.1

13.2.1 *Handle,* for inserting and extracting capillary tube holders in the permeability cell, as described in Fig. 2(*a*).

14. Preparation of Apparatus

14.1 Before using or calibrating the instrument, check the system for air leaks as follows:

14.1.1 Seal off the top of the permeability cell by removing the plunger, coating the edge of the cell with petroleum jelly, and sliding a piece of thick, flat glass over the opening. Clamp the cell firmly in position on the apparatus by using a suitable spacer (such as a rubber stopper) of the required thickness on top of the glass.

14.1.2 Apply vacuum to the manometer by means of the suction pump, by rotating the handwheel at the side of the apparatus. The air interface should be drawn as little as possible below the longest electrode. It may not be drawn below the straight part of the manometer leg.

14.1.3 Wait 5 min until the oil drains from the walls of the manometer, then observe the level of the liquid. If the level remains stationary, there are no leaks. If it moves, examine the tubing, check valve and joints, and correct any defects before proceeding further with the test.

14.1.4 Minute leaks might exist in a system, however, without having a significant effect upon the air permeability value. Changes in the manometer level of less than 2.5 mm [0.1 in.] in 10 min may be neglected. Refer to 18.5. Erratic readings can be caused by fines collecting in the rubber check valve. This valve must be cleansed regularly.

15. Procedure

15.1 Place the perforated disk at the bottom of the cell and cover it with a filter paper.

15.2 Divide the test specimen into four approximately equal parts. Pack the fiber into the cell one part at a time, keeping the bed level uniform, and compress after each addition using the tamping tool supplied with the apparatus. Take care not to compress the fiber beyond final plug length or required porosity of 70 %.

NOTE 5—Assume an average specific gravity of 2.55 for chrysotile asbestos. Other varieties with different specific gravities will result in different porosities. However, it is still possible to compare different samples of given species with equal densities on the same basis.

15.3 When all the fiber has been added, compress, and place a filter paper disk on top of the fiber bed.

15.4 Place the spacer, screen side down, upon the filter paper, insert the plunger into the cell, and compress until the collar is seated flush with the top of the cell.

15.5 Fasten the hooks on the cell to the plunger to prevent fiber springback and clamp the cell in position on the apparatus. Test the specimen under compression.

15.6 Turn the suction handwheel to the filling position to displace the liquid in the manometer. Then turn it to the measuring position and reset the clock to zero. This procedure starts the automatic process which will indicate on the clock the time required for the fixed volume of air to permeate through the specimen.

16. Calculation

16.1 Record the time readings to the nearest estimated 0.1 s. Take four readings on each specimen and calculate the average.

16.2 The expected maximum difference between any individual reading and the average is ±3.0 %. When the maximum difference is exceeded (Note 6), repeat the test by taking readings on a new test specimen.

NOTE 6—When the instrument has not been in use for some time the first reading may be erratic. In that case discard the first reading and replace it with an additional reading.

16.3 Results may be checked by Method A as described in 10.8 using the Dyckerhoff cell, or as described in 10.1 to 10.7 using the other cell. Refer to 3.2.2 and to Note 3.

17. Report

17.1 Fully identify the sample stating the origin and the designation.

17.2 Report the mean value of the average readings on two acceptable test specimens.

18. Precision and Bias

18.1 Reproducibility within ±3.0 % of the average can be obtained on homogeneous samples free from nonfibrous contaminants, with a given setting of the instrument.

18.2 The calibrating procedure, however, permits ±3.0 % deviation from the cumulative average value of the calibrating standard.

NOTE 7—Duplication of the atmospheric conditions used for calibration of the standards is recommended for greater precision. A statement of standardization conditions is included with the standards.

18.3 One source of error resides in the clock movement of older apparatus which ticks 152 times per minute instead of the required 600 times to permit readings to 0.1 s.

18.4 Another source of error is the formation of drops at the tips of the electrodes, which short-circuit the timer solenoid. The probable errors are 2 and 0.2 s respectively for high and low standards.

18.5 Minute air leaks mentioned in 14.1.4 become significant for readings above 600 s.

19. Keywords

19.1 air permeability; asbestos; Dyckerhoff; fiber; permeability; Rapid Surface Area; specific surface

APPENDIX

(Nonmandatory Information)

X1. MAINTENANCE OF CELL

X1.1 Check the dimensions which control the internal length and diameter of the cell regularly. The dimensions of the components should be such that the effective length occupied by the specimen is 58.903 ± 0.050 mm [2.319 ± 0.002 in.], and the nominal diameter is 38.964 ± 0.050 mm [1.534 ± 0.002 in.].

X1.2 The internal length may be corrected by removing metal very carefully as follows:

X1.2.1 To reduce internal length, remove metal from the end face of the cell.

X1.2.2 To increase the internal length, remove metal from the inner face of the end cap.

X1.3 If the dimensions of the internal length or diameter exceed tolerance limits and adjustments cannot be made, the complete cell should be returned to the supplier in exchange for a new cell.