Designation: D1667 – 17

Standard Specification for Flexible Cellular Materials—Poly (Vinyl Chloride) Foam (Closed-Cell)[1]

This standard is issued under the fixed designation D1667; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification covers flexible closed-cell or non-interconnecting cellular products, the elastomer content of which is predominantly poly(vinyl chloride) or copolymers thereof.

1.2 In the case of conflict between the provisions of this specification and those of detailed specifications or methods of test for a particular product, the latter shall take precedence.

1.3 Reference to the methods for testing closed-cell poly-(vinyl chloride) contained herein shall specifically state the particular test or tests desired and not refer to these methods of test as a whole.

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

1.5 The following precautionary statement pertains to the test method portions only of this specification: *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.*

NOTE 1—There is no known ISO equivalent to this standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D395 Test Methods for Rubber Property—Compression Set

D573 Test Method for Rubber—Deterioration in an Air Oven

D1056 Specification for Flexible Cellular Materials—Sponge or Expanded Rubber

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *closed cell*—an expanded structure consisting of a multitude of individual, non-connecting, gas-tight cells.

3.1.2 *flexible cellular material*—a cellular organic polymeric material which will not rupture when a specimen 200 by 25 by 25 mm (8 by 1 by 1 in.) is bent around at 25-mm (1-in.) diameter mandrel at a uniform rate of one lap in 5 s at a temperature between 18 and 29°C (65 and 85°F).

3.1.3 *surface skin*—the smooth surface on the material formed during manufacture by contact with the molds, cover plate, or air.

3.1.4 *V*—the ASTM symbol designating nonrigid vinyl cellular plastics.

3.1.5 *vinyl or PVC*—these terms refer to poly(vinyl chloride) or copolymers thereof.

4. Materials and Manufacture

4.1 Closed-cell vinyl is produced in sheet, strip, molded, or simple specific shapes.

5. Grades of Closed-Cell Vinyl or PVC-Symbol VE

5.1 Closed-cell vinyl shall be designated by two symbol letters VE, indicating V for vinyl and E for closed cell. The grade shall be designated by two digits, the first of which designates closed cell, and the second of which indicates the degree of firmness, the softer grades being identified with the lower numbers and the firmer grades with the higher numbers.

NOTE 2—*Examples*—VE-41 is a closed cell (expanded) vinyl of soft grade (see Table 1).

[1] This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.22 on Cellular Materials - Plastics and Elastomers.

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[2] 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.

***A Summary of Changes section appears at the end of this standard**

TABLE 1 Physical Requirements of Closed Cell Vinyl Products, Type VE

Basic Requirements		Requirements Added by Suffix Letters		
	Compression Deflection, 25 % Deflection	Suffix B	Suffix L Water Absorption, max	
Grade Number	kPa (psi)	Compression Set, 25 % Deflection, 22 h at Room Temperature, 24 h Recovery, % max	kg/m^2 cut surface	lb/ft^2 cut surface
VE-40	3.5 to 15 (0.5 to 2.17)	20	0.5	0.1
VE-41	15 to 35(2.17 to 5.07)	20	0.5	0.1
VE-42	35 to 65(5.07 to 9.42)	20	0.5	0.1
VE-43	65 to 90(9.42 to 13)	20	0.5	0.1
VE-44	90 to 120(13 to 17.4)	20	0.5	0.1
VE-45	120 to 170(17.4 to 24.6)	20	0.5	0.1

5.2 If suffix tests are required, suffix letters shall be added singly or in combination after any grade number to indicate additional requirements beyond those specified in Table 1 as basic requirements. The significance of the approved suffix letters is as follows:

B—Compression Set under Constant Deflection
C—Weather Resistance[A]
D—Load Deflection[A]
E—Oil Resistance[A]
F—Low Temperature—18°C (0°F)
G—Tear Resistance[A]
H1—Flex Resistance (Dynamic)[A]
J—Abrasion Resistance[A]
K2—Adhesion (Cemented Bond Made After Molding)[A]
L—Water Absorption Test Required with Values as Specified in Table 1
M—Flame Resistance[A]
P—Non-Staining[A]
R1—Rebound[A]
R2—Energy Absorption[A]
S—Volume Change after Heat Aging[A]
W—Density[A]
Z—Special Requirements[A]

[A] Test method and values to be arranged between the manufacturer and the purchaser.

6. Tolerances on Dimensions

6.1 Tolerances on dimensions of closed-cell vinyl products are given in Table 2.

TABLE 2 Tolerances on Dimensions of Closed Cell Vinyl Products

Thickness, mm (in.)	Tolerance, mm (in.)
3 to 15 (0.118 to 0.590)	±2 (0.079)
15 to 40 (0.590 to 1.574)	±2.5 (0.098)
Over 40 (over 1.574)	±3 (0.118)
Length and Width, mm (in.)	**Tolerance, mm (in.)**
Up to 150 (up to 6)	±6 (0.236)
150 to 300 (6 to 12)	±10 (0.393)
Over 300 (over 12)	±3 %

7. Workmanship, Finish, and Appearance

7.1 Closed cell vinyl furnished under this specification shall be manufactured from poly(vinyl chloride) or copolymers thereof, together with the added compounding ingredients of such nature and quality that the finished product complies with the specification requirements. In permitting a choice in use of materials by the manufacturer, it is not intended to imply that the different materials are equivalent in respect to all physical properties. Any special characteristics, other than those prescribed in this specification, which may be desired for specific applications shall be designated in the product specifications as they may influence the choice of the type of poly(vinyl chloride) or other ingredients used. All materials and workmanship shall be in accordance with good commercial practice and the resulting product shall be free of defects affecting serviceability.

7.2 Due to manufacturing conditions, material may have to be altered or repaired. This repaired or altered material will be acceptable under this specification provided the material used in such repairs or alterations shall be of the same composition and quality as the original product and provided such alterations do not affect the serviceability, size, and shape beyond the tolerances provided herein.

8. Color

8.1 Unless otherwise specified, the color of the material shall be optional with the manufacturer.

9. Sampling

9.1 When possible the completed manufactured product shall be used for the tests specified. Representative samples of the lot being examined shall be selected at random as required.

9.2 When it is necessary or advisable to obtain test specimens from the article, as in those cases where the entire sample is not required or adaptable for testing, the method of cutting and the exact position from which specimens are to be taken shall be specified. The apparent density and the state of fusion could vary in different parts of the finished product, particularly if the article is of complicated shape or of varying thickness. These features affect the physical properties of the specimens. The apparent density is affected by the number of cut surfaces as opposed to the number of skin-covered surfaces on the test specimen.

9.3 When the finished product does not lend itself to testing or to the taking of test specimens because of complicated shape, small size, metal or fabric inserts, adhesion to metal, or other reasons, suitable test slabs shall be prepared as agreed between the supplier and purchaser. When differences arise, due to the difficulty in obtaining suitable test specimens from the finished part, the supplier and the purchaser shall agree on acceptable deviations.

10. Physical Properties

10.1 The various grades of closed-cell vinyl shall conform to the requirements as to basic physical properties prescribed in Table 1, together with any additional requirements indicated.

11. Test Methods

11.1 Unless specifically stated otherwise, make all tests in accordance with the methods specified in Section 14.

12. Inspection and Rejection

12.1 All tests and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified.

12.2 The purchaser reserves the right to make the tests and inspection for acceptance or rejection of the material at the laboratory of his choice.

12.3 Any material that fails in one or more of the test requirements shall be retested. For this purpose, two additional tests shall be made for the requirement in which failure occurred. Failure of either of the tests shall be cause for final rejection.

12.4 Rejected material shall be disposed of as directed by the manufacturer.

13. Packaging and Package Marking

13.1 The material shall be properly and adequately packaged. Each package or container shall be legibly marked with the name of the material, name or trademark of the manufacturer, and any required purchaser's designations.

14. General Test Methods

14.1 The following tests shall be applicable in the physical testing of closed cell poly(vinyl chloride) or copolymers thereof:

14.1.1 *Compression Deflection*—Test method described in Sections 16 – 20.

14.1.2 *Compression Set Under Constant Deflection*—Test method described in Sections 21 – 25.

14.1.3 *Water Absorption*—Test method described in Sections 26 – 30.

NOTE 3—Additional test methods are listed in the appendix.

15. Measurement of Test Specimens

15.1 The length and width shall be measured with a steel scale or tape. Care shall be taken not to distort the material.

15.2 Thicknesses up to and including 25 mm (1 in.) shall be measured using a dial-type gauge having a maximum stem and foot mass of 25 g and a foot 32 mm (1.25 in.) in diameter, taking care not to compress the specimen. Thicknesses over 25 mm (1 in.) shall be measured using a sliding caliper gage or as specified in 15.1. When a sliding caliper gage is employed the gage setting shall be made with the gage out of contact with the closed cell vinyl. The specimen shall be passed through the previously set gage, and the proper setting shall be the one when the measured faces of the gage contact the surfaces of the article without compressing it.

15.3 The steel scale or tape used to measure length or width shall be graduated in divisions not over 1 mm (0.031 in.). The dial gage for measuring thickness shall be graduated in divisions not over 0.02 mm (0.001 in.). The calipers used for measuring thickness shall be graduated in divisions not over 0.1 mm (0.005 in.).

15.4 Results reported shall be the average of a minimum of three measurements.

COMPRESSION DEFLECTION TEST METHOD

16. Scope

16.1 This test consists of measuring the force necessary to produce a 25 % deflection on a 645.16-mm^2 (1-$in.^2$) test specimen.

17. Apparatus

17.1 The apparatus used for this test shall have a flat indentor foot, larger than the specimen being tested, connected to a force-measuring device, and mounted in such a manner that the specimen shall be deflected at a rate between 0.2 and 0.8 mm/s (0.5 and 2.0 in./min). The apparatus shall be arranged to support the specimen on a level, horizontal plate.

18. Test Specimens

18.1 The specimens shall be cylinders 28.67 ± 0.50 mm in diameter, which yields 645.16 ± 0.20 mm^2 (1 $in.^2$) in area with parallel top and bottom surfaces. They shall be cut so that opposite edges are parallel, either from the finished product in a manner agreed upon between the manufacturer and the purchaser, or from standard test slabs, or from commercial flat sheets. The thickness of the test specimens shall be measured and stated in the report. Maximum thickness shall be 25.4 mm (1.0 in.). The specimens shall be cut with either a revolving die or oscillating cutter. Use a soap solution if a lubricant is needed. If a lubricant is used, the specimen shall be thoroughly dried before proceeding with the testing. In some cases, it may be necessary to freeze the cellular vinyl to obtain parallel cut edges.

NOTE 4—Other specimen sizes can be used as agreed upon between user and supplier.

19. Procedure

19.1 Test closed-cell vinyl (grades VE-40 to VE-45) samples less than 6.0 mm (0.236 in.) in thickness by plying up to obtain a thickness as near 12.7 mm (½ in.) as possible. Deflect the specimen 25 % of its original height. Maintain the deflection at 25 % with automatic or manual control and record the force in newtons or pounds force 60 ± 1 s after the 25 % deflection is reached. The result obtained in this test is influenced by temperature, and tests that are to be compared shall be conducted under substantially the same temperature. In all cases, report the actual temperature during the test.

19.2 In case of dispute perform the test at a temperature of 23 ± 2°C (73.4 ± 3.6°F). Condition the specimen undeflected and undistorted at this temperature for at least 12 h before testing. Ordinarily only one test shall be made, but in case of dispute express the result as the average of three tests on three different specimens.

NOTE 5—Humidity does not affect the results.

20. Report

20.1 Report the unit force required, expressed in kPa or psi.

COMPRESSION SET UNDER CONSTANT DEFLECTION (SUFFIX B)

21. Scope

21.1 This test determines the compression set after constant deflection at room temperature 23 ± 2°C (73.4 ± 3.6°F).

22. Apparatus

22.1 The apparatus and procedure shall be the same as that prescribed in Method B of Test Methods D395 except as follows: The apparatus is a compression device of two parallel plates using at least four studs and nuts to accomplish compression. Normally, compression is 25 %, but any value to which both buyer and seller agree, may be used. The compression plates may be aluminum or any other smooth, clean material, which won't deflect under the force necessary to produce the desired deflection.

23. Test Specimen

23.1 The specimen shall be any convenient size with parallel top and bottom surfaces, that shall be at right angles to the side surfaces. The specimen shall be either round or rectangular. The minimum dimension across the top shall be at least equal to the thickness and at least 645.16 mm^2 (1 $in.^2$) in area. The minimum thickness shall be 12.7 mm (0.5 in.).

24. Procedure

24.1 Accurately determine the height of the specimen as described in Section 14, and record the measurement. Place the specimen between the plates of the clamping device, and deflect it 25 ± 1 % of its original height. Hold the specimen in this compressed condition 22 h ± 15 min at room temperature, then release the specimen from the clamping device and allow it to rest for 24 h ± 15 min at room temperature. Again, accurately determine the height of the specimen.

NOTE 6—Other deflection values can be used as agreed upon between user and supplier.

25. Calculation

25.1 Calculate the percentage compression set as follows:

$$\text{compression set, } \% = [(t_o - t_f)/(t_o - t_s)] \times 100 \quad (1)$$

where:

t_o = original thickness,
t_f = thickness at specified time after removal from the clamp, and
t_s = thickness of spacer bar.

WATER ABSORPTION (SUFFIX L)

26. Scope

26.1 The water absorption test is applicable to closed cell vinyl and is intended to show the non-interconnecting cell structure of the material.

27. Test Specimens

27.1 Use test specimens approximately 101.6 by 101.6 mm (4 by 4 in.) square and approximately 12.7 mm (0.5 in.) in thickness. Skin on one or both sides of the specimen is allowable. Only one test specimen is necessary for a valid test.

28. Apparatus

28.1 *Suggested equipment:*

28.1.1 10 ft PVC Column or any pressurized tank capable of obtaining 30 kPa (4.35 psi).

28.1.2 Retaining cage with weight for submersion of specimen.

28.1.3 Hose at bottom of pipe for drainage.

28.1.4 Scale.

28.1.5 Pressurized stream of air (30 psi max).

NOTE 7—Do not perform this test in a vacuum.

29. Procedure

29.1 Weigh the specimens and submerge under a 3 ± 0.152-m (10 ± 0.5-ft) head of water (equal to 30 ± 1.5 kPa or 4.35 ± 0.22 psi) at room temperature 18 to 29°C (65 to 90°F), for 48 h ± 15 min. Then place the specimens in a stream of air (30 psi max) for the minimum time required to remove visible water from the surface, and reweigh them.

30. Calculation

30.1 Calculate the results in terms of kilograms or pounds of water gain per square metre or square foot of surface without a skin or rind.

31. Report

31.1 *Report the following information:*

31.1.1 Thickness of specimen.

31.1.2 Type of apparatus used.

31.1.3 Original and final weight of the specimen.

31.1.4 Amount of water gain in kg or lb per square metre or square foot of surface without a skin or rind.

31.1.5 Time and temperature of the test.

32. Requirements

32.1 See Table 1.

NOTE 8—Water absorption requirements are optional unless Suffix L is specifically listed after the grade number.

33. Precision and Bias

33.1 Precision and bias for this specification are based on a round robin study performed in accordance with Practice E691, involving three materials tested by ten laboratories. For each material, all samples were prepared at one source, but the individual test specimens were prepared at the individual laboratories. The data listed in the following tables is based on the average of three determinations for each material. The number of laboratories for each test varied due to the inconsistency in test methods seen from the individual laboratory data returned. The data obtained and the number of participating laboratories for each test can be seen in Tables 3-11.

33.2 The consistency of the data supplied by the laboratories can be determined by reviewing the values of h and k statistics respectively in Table 4, Table 5, Table 7, Table 8, Table 10, and Table 11, where h is the between-laboratory consistency statistic and k is the within-laboratory consistency

TABLE 3 Precision Parameters for Water Absorption Test in Accordance with Sections 26–32

Material	Average	S_r	S_R	r	R
Material A	0.054694	0.008444	0.014557	0.023644	0.040759
Material B	0.064861	0.004079	0.017842	0.011421	0.049958
Material C	0.051833	0.012906	0.015235	0.036136	0.042657

TABLE 4 *h*-values for Water Absorption Analysis; 1.93 Critical Consistency with Other Laboratories

Laboratory	Material A	Material B	Material C
Lab #1	-0.11	0.48	0.74
Lab #2	-1.12	-0.70	-0.47
Lab #3	-0.63	-1.08	0.20
Lab #4	1.77	-0.20	0.05
Lab #5	0.37	-0.25	-1.68
Lab #6	-0.29	1.74	1.17

TABLE 5 *k*-values for Water Absorption Analysis; 1.98 Critical Laboratory Internal Consistency

Laboratory	Material A	Material B	Material C
Lab #1	1.81	1.42	0.00
Lab #2	0.38	0.75	0.45
Lab #3	1.27	0.98	0.34
Lab #4	0.90	1.21	0.78
Lab #5	0.25	0.17	2.24
Lab #6	0.31	0.99	0.27

TABLE 6 Precision Parameters for Compression Deflection Test

Material	Average	S_r	S_R	r	R
Material A	0.69507	0.02155	0.06664	0.06033	0.18658
Material B	2.92747	0.09613	0.42620	0.26915	1.19336
Material C	7.34957	0.20161	0.94625	0.56451	2.64950

TABLE 7 *h*-values for Compression Deflection Analysis; 2.29 Critical Consistency with Other Laboratories

Laboratory	Material A	Material B	Material C
Lab #1	1.63	1.40	1.15
Lab #2	-0.08	-0.56	-2.27
Lab #3	-1.63	0.08	0.31
Lab #4	1.22	1.88	1.08
Lab #5	-0.29	0.65	0.78
Lab #6	0.60	0.38	0.30
Lab #7	0.00	-1.17	-0.59
Lab #8	0.32	-0.48	-0.25
Lab #9	-1.06	-0.76	-0.25
Lab #10	-0.70	-0.66	-0.27

TABLE 8 *k*-values for Compression Deflection Analysis; 2.11 Critical Laboratory Internal Consistency

Laboratory	Material A	Material B	Material C
Lab #1	0.80	0.52	0.39
Lab #2	0.46	1.21	2.55
Lab #3	0.46	1.40	0.64
Lab #4	0.38	1.58	1.03
Lab #5	0.71	1.20	0.80
Lab #6	2.68	0.60	0.57
Lab #7	0.08	1.24	0.12
Lab #8	0.40	0.17	0.43
Lab #9	0.97	0.42	0.80
Lab #10	0.00	0.52	0.25

TABLE 9 Precision Parameters for Compression Set Test

Material	Average	S_r	S_R	r	R
Material A	5.0733	1.4457	2.8853	4.0479	8.0789
Material B	22.8667	1.5329	8.3982	4.2920	23.5150
Material C	13.8667	1.3742	3.4125	3.8477	9.5549

TABLE 10 *h*-values for Compression Set Analysis; 2.29 Critical Consistency with Other Laboratories

Laboratory	Material A	Material B	Material C
Lab #1	-0.99	-1.19	-0.98
Lab #2	0.10	0.90	-1.25
Lab #3	-1.09	-0.77	-0.21
Lab #4	0.28	1.88	2.21
Lab #5	0.78	-0.01	0.76
Lab #6	1.72	-0.60	-0.04
Lab #7	0.49	0.27	0.61
Lab #8	0.42	1.04	-0.39
Lab #9	-0.04	-0.73	-0.65
Lab #10	-1.66	-0.79	-0.05

TABLE 11 *k*-values for Compression Set Analysis; 2.11 Critical Laboratory Internal Consistency

Laboratory	Material A	Material B	Material C
Lab #1	1.16	0.28	0.51
Lab #2	2.03	0.73	0.87
Lab #3	1.04	0.66	0.32
Lab #4	0.48	1.78	2.26
Lab #5	0.08	0.46	0.95
Lab #6	1.29	1.40	0.53
Lab #7	0.81	1.47	0.42
Lab #8	0.31	0.96	0.22
Lab #9	0.90	0.69	1.51
Lab #10	0.00	0.26	0.33

statistic. The *h* and *k* tables give a picture of the overall variability of the test method as well as singling out results that should be investigated.

33.2.1 Those values of *h* and *k* in the tables that are marked in bold are values that exceeded the critical values listed for each test. An investigation to determine were the inconsistencies come from showed that small variations in results were due to inconsistently blotting water from test samples before performing measurements.

33.3 The number of laboratories, materials, and determinations in this study does meet the minimum requirements for determining precision prescribed in Practice E691. Precision, characterized by repeatability, S_r, r, and reproducibility, S_R, R can be seen in Table 3, Table 6, and Table 9.

34. Keywords

34.1 closed cell; flexible cellular material

APPENDIXES

(Nonmandatory Information)

X1. SUGGESTED TEST METHOD FOR VOLUME CHANGE AFTER HEAT AGING (SUFFIX S)

X1.1. Scope

X1.1.1 This test method describes the procedure for determining the volume change of closed cell vinyl after being aged for seven days at 60°C (140°F).

X1.2. Apparatus

X1.2.1 An oven as described in Section 6 of Test Method D573 is required.

X1.3 Specimens

X1.3.1 Test specimens shall consist of pieces 300 ± 20 by 300 ± 20 mm (12 ± 0.75 by 12 ± 0.75 in.) when the thickness of the material is 20 mm (0.75 in.) or less and 100 ± 12.7 by 100 ± 12.7 mm (4 ± 0.5 by 4 ± 0.5 in.) when the thickness of material is over 20 mm (0.75 in.). When the piece is an object of molded shape, the largest single piece so molded shall be used for this test.

NOTE X1.1—Shrinkage will vary with thickness.

X1.4. Procedure

X1.4.1 Determine the volume before and after the heat aging test by measuring the amount of water displaced by the material. This is done most easily on a piece this size by weighing the specimen first in air and then in water, using a cage or other arrangement which will be heavy enough to sink the specimen. The volume in cubic centimetres is equal to the mass of the specimen in air plus the mass of the cage in water minus the mass of both in water, all in grams. If more convenient take all masses in pounds and multiply the result by 27.7 to get the volume in cubic inches.

X1.4.2 Place the specimens in the oven with the temperature maintained at 60 ± 1°C (140 ± 2°F) for a period of 7 days ± 15 min. At the end of that period remove the specimens from the oven and allow them to recover for 5 h ± 15 min at 23 ± 1.0°C (73.4 ± 1.8°F). Then re-measure the volume.

X1.5. Calculation

X1.5.1 Calculate the percentage change in volume as follows:

$$\text{change in volume, } \% = \left[(V_1 - V_2)/V_1\right] \times 100 \qquad \text{(X1.1)}$$

where:

V_1 = original volume, and
V_2 = volume after oven aging.

X2. SUGGESTED TEST METHOD FOR LOW-TEMPERATURE TEST (SUFFIX F)

X2.1 See low temperature flex test in accordance with Specification D1056.

X3. SUGGESTED TEST METHOD FOR DENSITY (SUFFIX W)

X3.1 Scope

X3.1.1 This test method describes the procedure for determining the density by calculation from the mass and volume.

X3.2 Test Specimens

X3.2.1 Representative specimens of regular shape, not less than 16 mm^3 (1 $in.^3$) in volume, shall be cut from the sample to be tested.

X3.3 Procedure

X3.3.1 Weigh the specimen on a balance or scale graduated so as to permit weighings within ± 1 % of the mass to be measured.

X3.3.2 Determine the volume of the specimen. If the specimen is less than 10 mm (0.4 in.) in length or width, use a rule graduated to 0.2 mm (0.01 in.).

X3.4 Calculation

X3.4.1 Calculate the density as follows:

$$\text{density, kg/m}^3 = A/B \qquad \text{(X3.1)}$$

where:

A = mass of specimen, kg, and
B = volume of specimen, m^3.

NOTE X3.1—To convert this value to lb/ft^3 multiply by 0.0624.

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D1667 - 05(2011)) that may impact the use of this standard. (March 1, 2017)

(1) Revised Table 1 to correct psi conversions from kPa.
(2) Revised 16.1 to correct conversion of 1in.^{2} from 650 mm^2 to 645.16 mm^2.
(3) Revised 18.1 to add the correct diameter of specimen along with tolerances for diameter and area.
(4) Revised 19.1 to add tolerances for time.
(5) Revised 19.2 to adjust tolerance of temperature from ±1°C to ±2°C.
(6) Revised 21.1 to adjust tolerance of temperature from ±1°C to ±2°C.
(7) Revised 23.1 to fix conversion of 1 in.^{2} from 650 mm^2 to 645.16 mm^2. Fixed conversions of 0.500 in from 12.5 mm to 12.7 mm.
(8) Revised 24.1 to include tolerances from 25 % deflection, conditioning time and resting time.
(9) Revised 27.1 to fix conversion of 4 in. from 100 mm to 101.6 mm.
(10) Revised 29.1 to add tolerance for 3M head of water, pressure, and time.
(11) Revised Xl.4.2 to add tolerance for time.