Designation: D3453 – 12

Standard Specification for Flexible Cellular Materials—Urethane for Furniture and Automotive Cushioning, Bedding, and Similar Applications[1]

This standard is issued under the fixed designation D3453; 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 Department of Defense.

1. Scope*

1.1 This specification covers flexible cellular urethane materials intended for such uses as inserts for furniture cushions, mattresses, and similar applications.

1.2 This specification provides material and dimensional requirements and methods of tests for specific properties of load bearing, compression set, humid age resistance, pounding fatigue resistance, support factor and resilience.

1.3 This specification includes references to government regulations for burning characteristics of flexible cellular material used in specified applications.

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.*

NOTE 1—There is no equivalent ISO standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D3574 Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams

D3675 Test Method for Surface Flammability of Flexible Cellular Materials Using a Radiant Heat Energy Source

2.2 *Other Documents:*

16CFR1632 (Previously DoC FF4-72), Standard for the Flammability of Mattresses[3]

FMVSS 302 DoT Motor Vehicle Safety Standard[3]

DOT Federal Aviation Regulation (FAR), Part 25.853, Paragraph (b), and Appendix F[3]

Simplified Practice Recommendations R2-62 Bedding Products and Components (Mattresses, Springs, Bedsteads, and Cots)[4]

3. Classification

3.1 This specification covers eight grades of flexible cellular material that have been selected for use in accordance with load bearing and general physical properties, Table 1; four grades based on pounding-fatigue properties, Table 2; three grades based on cushioning performance properties, Table 3.

4. Basis of Purchase

4.1 Any product represented as complying with this specification shall meet all the requirements listed herein for its particular classification.

5. Burning Characteristics

5.1 Table 4 lists applicable government regulations on burning characteristics of material used in specified applications.

6. Dimensions

6.1 *For Use as Mattress Inserts:*

6.1.1 *Sizes*—The standard thickness and tolerance are specified in Table 5. These sizes have been adopted for mattress inserts to coordinate the insert with mattress ticking and other bed constructions. The other dimensions are specified in Table 7A of Simplified Practice Recommendations R2-62.

6.1.2 *For Use as Furniture Cushion Inserts*—The allowable tolerances on dimensions of furniture cushion inserts shall be as shown in Table 6.

[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.

Current edition approved Oct. 1, 2012. Published November 2012. Originally approved in 1976. Last previous edition approved in 2007 as D3453 - 07. DOI: 10.1520/D3453-12.

[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.

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

[4] Available from the Clearing House for Federal Scientific and Technical Information, 5285 Port Royal Rd., Springfield, VA 22151.

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

TABLE 1 Specific Physical Properties of Flexible Cellular Material

Grade Number		25 % Indentation Force Deflection (IFD) Values,[A] N (lbf)	Compression (comp) Set[B] After 90 % Deflection, % max	Moisture Resistance	
N	lbf			Compression Force Deflection Loss, % max	Compression Set[B] After Deflection, % max
245	55	245 ± 18 (55 ± 4)	15	20	20
196	44	196 ± 18 (44 ± 4)	15	20	20
151	34	151 ± 14 (34 ± 3)	15	20	20
120	27	120 ± 14 (27 ± 3)	15	20	20
93	21	93 ± 14 (21 ± 3)	15	20	20
67	15	67 ± 14 (15 ± 3)	20	20	25
40	9	40 ± 14 (9 ± 3)	25	—	30
22	5	22 ± 14 (5 ± 3)	30	—	35
Test method sections[C]		B1	D	J1,C	J1,D
Specimen size,[D] mm (in.)		380 × 380 × 100 (15 × 15 × 4)	50 × 50 × 25 (2 × 2 × 1)	50 × 50 × 25 (2 × 2 × 1)	50 × 50 × 25 (2 × 2 × 1)

[A] Tolerances have been established to provide for grade designations. Closer tolerances, when desirable for specific applications, shall be agreed upon between the purchaser and the seller.
[B] To be expressed as a percent of the original thickness.
[C] See Section 7 for an explanation of the test methods referenced.
[D] See 9.3 when indicated specimen sizes are not available.

TABLE 2 Pounding Fatigue Performance Grades

Grade	Description	Applications	40 % IFD[A] % Loss, max
AP	Heavy-duty use	transportation seating	20
BP	Normal-duty use	cushions, mattresses	30
CP	Light-duty use	arm rests, seat backs	35
DP	Unclassified	miscellaneous padding	40

[A] See Test Methods D3574, Test I_3, Procedure B (80 000 cycles).

TABLE 3 Cushioning Performance Grades[A]

Grade Number	Description	Support Factor[B]	Resilience[C]
NS	Normal Support	1.8 min	—
HS	High Support	2.3 min	—
HS-HR	High Support-High Resilience	2.4 min	55 % min

[A] Grades also subject to specific physical properties in Table 1.
[B] 65 % / 25 % IFD; See Test Methods D3574, Section 21 and Appendix X3.1.
[C] Ball Rebound; see Test Methods D3574, Sections 68–72.

7. Test Methods

7.1 The physical tests shall be in accordance with Test Methods D3574.

8. Physical Requirements

8.1 The material shall conform to the requirements for physical properties prescribed in Tables 1-3.

9. Inspection

9.1 Inspection of the material shall be agreed upon in writing by the purchaser and the seller as part of the purchase contract.

9.2 Testing for conformance to requirements shall be done in accordance with the appropriate sections of Test Methods D3574. The specific test methods in this reference to be used for each test shall be as listed in Tables 1-3, except as specified in 9.3. Burning tests in the reference are listed in Table 4.

9.3 If a specimen 380 by 380 by 100 mm (15 by 15 by 4 in.) cannot be obtained, an appropriate size, as well as its corresponding indentation force deflection (IFD) value, shall be agreed upon between the purchaser and the seller. In those cases where foams having thicknesses of 100 mm (4 in.) are not available, the following reduced IFD values are suggested:

Thickness	25 % IFD	65 % IFD	
75 mm (3 in.)	88 %	88 %	of 100 mm (4 in.) IFD value
50 mm (2 in.)	78 %	76 %	of 100 mm (4 in.) IFD value
25 mm (1 in.)	68 %	62 %	of 100 mm (4 in.) IFD value

In all cases, the IFD tolerances specified in Table 1 shall apply. For example, a 50-mm (2-in.) thick Grade 120-N (12 kg/27-lb) foam will have a 25 % IFD value of 94 ± 14 N (21.0± 3.0 lbf) = 80 to 108 N (18.0 to 24.0 lbf).

9.3.1 If an IFD specimen cannot be obtained, an approximation from the 50 % CFD in accordance with Test Methods D3574 to a 100-mm (4-in.) IFD can be made using the following equation:

$$\text{IFD} = \text{CFD} \times (A + B)$$

IFD Deflection	25 %	40 %	65 %
A	1.397	2.382	5.32
B	82.31	93.84	87.92

9.3.2 If a 25% CFD value in psi is needed it can be estimated by using the 25% IFD value (lb.) in the following expression:

$$25\%\ \text{CFD} = (25\%\ \text{IFD} + 5)/87$$

These conversions are useful for carpet cushion, packaging, and other specialty foams.

10. Retest and Rejection

10.1 If any failure occurs, the materials shall retested to establish conformity in accordance with agreement between the purchaser and the seller.

TABLE 4 Applicable Government Regulation for Specified Applications[A]

Types	Application	Regulation		
1	Automotive	49CFR571.302 (FMVSS 302) ASTM D5132 SAE J369 ISO 3795 16CFR1632 (FF 4–72) 16CFR1633	Government Documents	Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402
2	Mattress and Upholstered Furniture	CAL TB 106[B] CAL TB 116[B] CAL TB 117 CAL TB 121[B] CAL TB 129[B] CAL TB 133[B] CAL TB 603[B]	California	California Bureau of Home Furnishings and Thermal Insulation, 3485 Orange Grove Ave, North Highlands, CA 95660
		NFPA 260[B] NFPA 261[B]	National Fire Protection Association	1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269
		ASTM E1537[B] E1590[B] E1822[B]		
		BS 5852[B]	British Standards Institute	2 Park Street, London, England W1A 2B5
3	Aviation	FAR Part 25.853, Paragraph (b), and Appendix F FAA Oil Burner Test	Society of Automotive Engineers (SAE)	400 Commonwealth Dr., Warrendale, PA 15096-0001
4	Miscellaneous	ASTM D3675[C]	International Organization for Standardization (ISO)	1 rue de Varembé, Case postale 56, CH-1211, Geneva 20, Switzerland

[A] This standard is used to measure and describe the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of the materials, products or assemblies under actual fire conditions. Fire testing is inherently hazardous. Adequate safeguards for personnel and property shall be employed in conducting these tests.
[B] Composite test. Foam, fabric and other components often have a synergistic effect on each other.
[C] Various governmental bodies have issued regulations based on Test Method D3675. The regulations are not the same for all bodies issuing them. Here, the regulation of the government having jurisdiction should be consulted.

TABLE 5 Thickness and Tolerance for Mattress Inserts

Nominal Thickness		Plus		Minus	
mm	in.	mm	in.	mm	in.
100	4	4.8	3/16	1.6	1/16
125	5	4.8	3/16	1.6	1/16
150	6	4.8	3/16	3.2	1/8

11. Packaging, Marking, and Labeling

11.1 *Packaging*—The material shall be packed in standard commercial containers, so constructed as to ensure acceptance by common or other carriers for safe transportation at the lowest rate to the point of delivery, unless otherwise specified in the contract or order.

11.2 *Marking*—The shipping container shall be marked with the name, type, and quality of material in accordance with the contract or order under which the shipment is made. The shipping container shall also be marked with the name of the manufacturer and the contract or order number.

11.3 *Label*—In order for purchasers to identify products complying with all requirements of this voluntary specification, it is recommended that producers choosing to produce such products include a statement in conjunction with their name and address on labels, invoices, sales literature, and the like. The following statement is suggested:

11.3.1 "This product conforms to all the requirements for Grade , performance grade, established in ASTM Standard Specification D3453". Full responsibility for the conformance of this product with the standard is assumed by (name and address of producer or distributor).

12. Precision and Bias

12.1 See referenced methods for precision and bias information.

13. Keywords

13.1 automotive; bedding; flexible cellular; furniture; urethane

TABLE 6 Dimensional Tolerances for Furniture Cushion Inserts

Thickness					
Nominal		+		–	
mm	in.	mm	in.	mm	in.
25 to 75	1 to 3	3.2	1/8	1.6	1/16
Over 75 to 125	3 to 5	4.8	3/16	1.6	1/16
Over 125	over 5	4.8	3/16	3.2	1/8

Length and Width			
Nominal		±	
mm	in.	mm	in.
25 to 305, incl	1 to 12, incl	3.2	1/8
Over 305 to 610, incl	12 to 24, incl	6.4	1/4
Over 610 to 1220, incl	24 to 48, incl	9.6	3/8
Over 1220	over 48	12.7	1/2

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D3453 - 07) that may impact the use of this standard. (October 1, 2012)

(1) Permissive language review.
(2) Updated fire test caveat.
(3) Added conversion factors back into section 9.3.1 that inadvertently got removed in the Word doc provided.
(4) Added a new conversion for 25 % CFD from 25 % IFD in section 9.3.2.

Committee D20 has identified the location of selected changes to this standard since the last issue (D3453 - 01) that may impact the use of this standard. (September 1, 2007)

(1) Clarified ambiguous wording in 9.3.1 for approximating IFD from CFD values.
(2) Added more combustibility references to Table 4.