Designation: D 4819 – 96

Standard Specification for Flexible Cellular Materials Made From Polyolefin Plastics[1]

This standard is issued under the fixed designation D 4819; 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.

1. Scope

1.1 This specification applies to flexible closed-cell materials made from polyolefin plastics and blends of polyolefin plastics as defined in Section 3.

1.2 Extruded or molded shapes too small to permit the cutting of standard test specimens are difficult to classify or test by standard test methods and will usually require special testing procedures or the use of standard test sheets.

1.3 In case of conflict between the provisions of this specification and those of detailed specifications for a particular product, the latter shall take precedence. These detailed specifications for the flexible closed-cell polyolefin plastic foams should state the particular test or tests desired.

1.4 In cases involving referee decisions, SI units shall be used.

1.5 This specification does not contain test procedures or values for all the suffix letters listed in Table 1 and Table 2. Where the procedure is not described in this specification or special limits are desired, or both, the test procedures and values must be arranged between the purchaser and the supplier.

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

NOTE 1—There is no similar or equivalent ISO standard.

TABLE 1 Suffix Letter Designations

A	Heat resistance
B	Compression set under constant deflection
C	Ozone or weather resistance
D	Compression deflection
E	Oil resistance
F	Low temperature
G	Tear resistance
H	Flex resistance
I	Not assigned
J	Abrasion resistance
K	Adhesion capability
L	Water absorption
M	Flammability resistance
N	Impact resistance
O	Electrical properties
P	Staining resistance
Q	Not assigned
R_1	Resilience
R_2	Shock absorption
S	Thermal stability
T_1	Tensile strength
T_2	Ultimate elongation
U	Not assigned
V	Thermal conductivity
W	Density
X	Not assigned
Y	Not assigned
Z	Special requirements
AA	Buoyancy
BB	Compressive creep
CC	Dynamic cushioning
DD	Open cell
EE	Not assigned
FF	Water vapor transmission

2. Referenced Documents

2.1 *ASTM Standards:*

C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus[2]

D 412 Test Methods for Vulcanized Rubbers and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension[3]

D 624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers[3]

D 1596 Test Method for Dynamic Shock Cushioning Characteristics of Packaging Materials[4]

D 2863 Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)[5]

D 3575 Test Methods for Flexible Cellular Materials Made from Olefin Polymers[6]

E 96 Test Methods for Water Vapor Transmission of Materials[2]

F 355 Test Method for Shock Absorbing Properties of Playing Surface Systems and Materials[7]

2.2 *Motor Vehicle Safety Standard:*

[1] This specification is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.22 on Cellular Plastics.

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[2] *Annual Book of ASTM Standards*, Vol 04.06.

[3] *Annual Book of ASTM Standards*, Vol 09.01.

[4] *Annual Book of ASTM Standards*, Vol 15.09.

[5] *Annual Book of ASTM Standards*, Vol 08.02.

[6] *Annual Book of ASTM Standards*, Vol 09.02.

[7] *Annual Book of ASTM Standards*, Vol 15.07.

TABLE 2 Property Limits for Flexible Cellular Polyolefin Materials

Suffix Letter	Property	Test Method	Units	Maximum or Minimum	Suffix Numbers and Limiting Values								
					1	2	3	4	5	6	7	8	9
B	Compression set	D 3575	%	max	...	5	10	15	20	25	30	35	...
D	Compression deflection	D 3575	kPa (psi)		15	30	40	70	105	170	275	...	...
				min	2.0	4.0	6.0	10	15	25	40		
G	Tear strength	D 3575 or	N/M (lb/in.)		7.0	14	20	27	40	55	68	...	...
		D 624[A]		min	5.0	10	15	20	30	40	50		
L	Water absorption	D 3575	kg/m^2		...	0.20	0.30	0.40	0.50	1.00	...	...	...
			(lb/ft^2)	max		0.04	0.06	0.08	0.10	0.20			
M_1	Flammability-ease of ignition-LOI	D 3575 or D 2863[A]	% O_2	min	...	15	20	25	30	...	...	...	...
M_2	Flammability-burn rate	MVSS–302	mm/min		...	...	50	100	150	255	...	...	...
			(in./min)	max			2.0	4.0	6.0	10.0			
R_2	Shock absorption-Procedure A 25 mm (1 in.) thick samples	F 355	G's[B]	max	...	25	50	75	100	150	200	...	...
S	Thermal stability-dimensions[C]	D 3575	±%change	max	1	2	5	10	15	...	...	...	...
T_1	Tensile strength	D 3575 or D 412[A]	kPa (psi)		...	140	275	345	415	550	690	...	...
				min		20	40	50	60	80	100		
T_2	Ultimate elongation	D 3575 or D 412[A]	%	min	...	25	50	75	100	150	200	...	...
V	Thermal conductivity, 25 mm (1 in.) thick at 24°C (75°F), mean temperature 30°C (86°F), temperature differential	D 3575 Method B or C 518[A]	W/(mK)		...	0.040	0.046	0.052	0.058	0.063	...	...	...
			(BTU-in./(1·h·ft^2·°F)	max		0.28	0.32	0.36	0.40	0.44			
W	Density	D 3575	kg/m^3	nominal	25	30	50	65	80	95	130	160	...
			(lb/ft^3% , ±)	max/min	1.5	2.0	3.0	4.0	5.0	6.0	8.0	10.0	
					30/25	30/25	25/25	25/25	25/25	25/25	40/25	45/25	
AA	Buoyancy, 24 h exposure at 23°C (73°F), under 50 mm (2.0 in.) water head	D 3575 or UL1191[A]	kg/m^3		...	830	880	910	945	960	...	...	...
			(lb/ft^3)	min		52	55	57	59	60			
BB	Compressive creep, 7 kPa (1.0 psi) load at 23°C (73°F) for 1000 h	D 3575	%	max	...	2.0	4.0	6.0	10	15	...	...	...
CC_1	Dynamic cushioning, 50 mm (2.0 in.) thick, 7 kPa (1 psi) loading, 600 mm (23.6 in.) drop, 23°C (73°F)	D 3575 or D 1596[A]	G's[B]	max	...	...	30	40	50	60	80	...	...
CC_2	Dynamic cushioning, same conditions as *CC*, except for 14 kPa (2 psi) loading	D 3575 or D 1596[A]	G's[B]	max	...	...	30	40	50	60	80	...	...
CC_4	Dynamic cushioning, same conditions as CC_1 except for 28 kPa (4 psi) loading	D 3575 or D 1596[A]	G's[B]	max	...	...	30	40	50	60	80	...	...
FF	Water vapor transmission	E 96	ng/(Pa·s·m)		...	...	0.3	0.4	0.6	0.9	1.8	...	...
			(perm-in.)	max			0.2	0.3	0.4	0.6	1.2		

[A] Methods shown are equivalent.
[B] G = The dimensionless ratio of missile acceleration during impact to the acceleration of gravity (see Test Method F 355).
[C] Plus (+) sign indicates growth, minus (−) sign indicates shrinkage.

MVSS-302 Flammability of Vehicle Interior Materials—Passenger Cars, Multipurpose Passenger Vehicles, Trucks and Buses[8]

2.3 *UL Standard:*

UL1191 Standard for Components for Personal Flotation Devices[9]

[8] Available from Department of Transportation, Washington, DC.

[9] Available from Underwriter's Laboratories, Inc., 12 Laboratory Dr., PO Box 13995, Research Triangle Park, NC 27709-3995.

3. Terminology

3.1 *Definitions:*

3.1.1 *blend*—mixture of polyolefin plastic(s) with other polymer(s) in which at least 51 mass % is the polyolefin plastic(s).

3.1.2 *polyolefin plastics*—material based on polymers made by the polymerization of olefins or copolymerization of olefins with other polymers, the polyolefin being at least 51 mass %.

3.1.3 *resin*—solid, semi-solid, or pseudo-solid organic material that has an indefinite and often high molecular weight, exhibits a tendency to flow when subject to stress, usually has a softening or melting range, and usually fractures conchoidally.

4. Classification (Types, Suffix Letters, and Suffix Numbers)

4.1 *Types*—This specification covers two types of flexible, closed-cell polyolefin foams designated as follows:

4.1.1 *Type I*—Closed cell foams made with polyolefin plastics and either chemically or radiation crosslinked.

4.1.2 *Type II*—Closed cell foams made with polyolefin plastics that are non-crosslinked.

4.2 *Suffix Letters*—Suffix letters shall be added to the type designation (4.1) singly or in combination to indicate the necessary requirements.

4.2.1 The significance of the approved suffix letters is given in Table 1.

4.2.2 Frequently used suffix letters for polyolefin foams are given in Table 2. Where more than one test method exists for a given property, the suffix letters shall be followed immediately by a subscript number to designate the specific procedure.

4.3 *Suffix Numbers*—Each suffix letter shall be followed by a suffix number that indicates the property limit. Table 2 lists these suffix numbers and limiting values.

NOTE 2—Examples of the classification system are as follows:

Specification D 4819 Type I—B4D4M$_1$ 3T$_1$ 5T$_2$ 7W6Z$_1$ is a crosslinked foam with a maximum compression set of 15 %, a minimum compression deflection of 70 kPa (10 psi), an oxygen index of 20 % minimum, minimum tensile strength of 415 kPa (60 psi), minimum ultimate elongation of 200 %, a nominal density of 80 kg/m^3 (5.0 lb/ft^3), and a special requirement to be negotiated by the vendor and user.

Specification D 4819 Type II—D4T$_1$ 3T$_2$ 4 R$_2$ 5BB4Z$_1$ Z$_2$ is a non-crosslinked foam with a compression deflection of 70 kPa (10 psi) minimum, a minimum tensile strength of 275 kPa (40 psi), minimum ultimate elongation of 75 %, shock absorption of 100 G's maximum, compressive creep of 6 % maximum, and two special requirements.

5. Ordering Information

5.1 When ordering, the product shall be described by showing the type and suffix letters and number designations as described in Section 4.

5.2 Minimum recommended properties for either type of foam shall include requirements for Compression Deflection (Suffix *D*), Tensile Strength (Suffix T_1), and Ultimate Elongation (Suffix T_2).

5.3 The properties selected and values set shall be selected to ensure the required performance of the end product.

5.4 Special requirements shall be listed. Test procedures and limits shall be established by negotiation between the purchaser and the supplier. Each special requirement shall be listed as *Z* suffix letters followed by numerical subscripts.

6. Materials and Manufacture

6.1 Cellular polyolefin foams furnished under this specification shall be manufactured from any resin or blend of resins that are members of the polyolefin family together with added compounding materials of such a nature and quality that the finished product complies with this specification. In permitting choice in use of those materials by the producer, it is not intended to imply that the different resins are equivalent with respect to all physical properties. Special characteristics other than those prescribed in this specification that may be desired for specific applications shall be listed in the product specifications, as they may influence the choice of the type of resin or other materials used.

6.2 All materials and workmanship shall be in accordance with good commercial practice and the resulting cellular polyolefin shall be free from defects affecting serviceability.

7. Color

7.1 Unless otherwise specified, the color of cellular polyolefin foams shall be natural. The foam shall contain no colorants.

8. Physical Properties

8.1 The polyolefin foams shall conform to the requirements given in the classification (see Section 4) and described in Table 2 together with any special requirements.

9. Test Methods

9.1 Unless specifically stated otherwise, perform all tests in accordance with the methods specified in Test Methods D 3575.

9.2 Test methods and values for special requirements not listed in Table 2 shall be arranged between the purchaser and the supplier.

10. Tolerances on Dimensions

10.1 Tolerances on dimensions shall be as specified in Table 3, unless otherwise specified.

11. Inspection

11.1 All tests and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified. The manufacturer shall afford the inspector all reasonable facilities for tests and inspection.

11.2 The purchaser may make the test and inspection to govern acceptance or rejection of the material at his own laboratory or elsewhere. Such tests and inspection shall be made not later than 15 days after receipt of the material.

11.3 All samples for testing as required in Test Methods D 3575 shall be visually inspected to determine compliance with the material, workmanship, and color requirements before testing.

12. Rejection

12.1 Any material that fails in one or more of the test requirements may be retested. For this purpose, two additional

TABLE 3 Thickness Tolerances

NOTE 1— Tighter tolerances, if desired, should be arranged with the supplier.

NOTE 2—Some manufacturer's sales tolerances are tighter than those shown in Table 3.

NOTE 3—n/a: Not applicable. Products do not exist, at this time.

Thickness, mm (in.)	Tolerances,± , %	
	Type I	Type II
Sheets, Extruded:		
0.8–1.5 (0.031–0.059)	±20	±20
1.6–3.1 (0.062–0.122)	±15	±20
3.2–6.3 (0.125–0.248)	±10	±20
6.4–12.6 (0.250–0.496)	±10	±15
12.7 and thicker (0.500 and thicker)	±10	±15
Planks, Extruded:		
38–101 (1.50–3.98)	n/a	±10
102 and thicker (4.00 and thicker)	n/a	±7
Sheets, Skived:		
2.4–6.3 (0.094–0.248)	±20	n/a
6.4–37 (0.500–1.46)	±10	n/a
38 and thicker (1.50 and thicker)	±15	n/a

tests shall be made for the requirements in which failure occurred. Failure of either of the retests shall be cause for final rejection.

12.2 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 designation.

14. Keywords

14.1 closed cell; flexible cellular materials; polyolefin specification