Designation: D3851 – 07 (Reapproved 2012)

Standard Specification for Urethane Microcellular Shoe Soling Materials[1]

This standard is issued under the fixed designation D3851; 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 covers urethane microcellular materials for shoe soling applications. It provides physical property requirements and identifies test methods for determining those specific properties.

1.2 SI units are to be regarded as the preferred units of measurements for values. The inch-pound values in parentheses can be used if there is an agreement between the contractual parties.

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

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

D624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D1052 Test Method for Measuring Rubber Deterioration—Cut Growth Using Ross Flexing Apparatus

D1622 Test Method for Apparent Density of Rigid Cellular Plastics

D1938 Test Method for Tear-Propagation Resistance (Trouser Tear) of Plastic Film and Thin Sheeting by a Single-Tear Method

D2240 Test Method for Rubber Property—Durometer Hardness

D3489 Test Methods for Microcellular Urethane Materials

3. Classification

3.1 This specification covers three grades of microcellular urethane materials that may be selected for use according to abrasion resistance, cut-growth resistance, and other physical properties. The grades are classified as Grade 1, Grade 2, and Grade 3.

4. Ordering Information

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

5. Physical Requirements

5.1 The material shall conform to requirements for physical properties prescribed in Table 1.

6. Test Methods

6.1 The physical tests shall be in accordance with Test Method D3489.

7. Inspection

7.1 Inspection of the material shall be agreed upon in writing between the purchaser and the supplier as part of the purchase contract.

7.2 Testing for conformance to requirements shall be done in accordance with this specification and Test Methods D3489.

8. Retest and Rejection

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

9. Packaging, Marking, and Labeling

9.1 *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.

9.2 *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.

9.3 *Labeling*—In order that purchasers may identify products complying with all requirements of this specification, producers choosing to produce such products in conformance

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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 Property Requirements on Polyurethane Shoe Systems

Property	Grade			ASTM Method
	1	2	3	
Density	[A]	[A]	[A]	D792, D3489, or D1622
Tensile strength, min, MPa (psi)	4.9 (700)	3.5 (500)	2.8 (400)	D412
Ultimate elongation, min, %	300	275	250	D412
Tear, Die C, min, kN/m (lbf/in.)	22.0 (125)	22.0 (125)	17.5 (100)	D624
Tear, min, kN/m (lbf/in.)	11.5 (65)	7.0 (40)	4.4 (25)	D1938
Hardness, Shore A Durometer	[A]	[A]	[A]	D2240
Cut-growth resistance, minimum cycles at:				D1052
–20°F	30 000	10 000	10 000	
0°F	75 000	30 000	20 000	
75°F	150 000	75 000	50 000	
Taber abrasion (wear index), H-18 wheel, 1000 g, 1000 cycles	100	200	300	D3489

[A] As agreed upon between the purchaser and the seller.

with this voluntary specification may include a statement in conjunction with their name and address on labels, invoices, sales literature, and the like. The following statement is suggested.

9.3.1 "This product conforms to all the requirements for Grade ___ established in ASTM Standard Specification D3851. Full responsibility for conformance of this product with the standard is assumed by (name and address of converter or distributor).

10. Keywords

10.1 footwear; microcellular; polyurethane; shoe; shoe soling; sole; urethane

APPENDIX

(Nonmandatory Information)

X1. METHODS FOR DETERMINING MATERIAL SHRINKAGE

X1.1 Rationale

X1.1.1 Any material shrinkage has the potential to affect processing (such as ease of removal of parts from molds) and the finished parts dimensions. Minimum and maximum requirements for shrinkage shall be agreed on between the purchaser and the supplier. Two examples of procedures for measuring that material shrinkage are given below.

X1.2 Procedure A

X1.2.1 Measure the length of the cavity of the mold to the nearest 0.5 mm or 0.02 in. Make the measurement with the mold at room temperature.

X1.2.2 Mold at least three sound test parts from the material to be tested under such conditions of pressure, temperature, flow rates, time, etc., as the manufacturer and the purchaser may agree are suitable for the material.

X1.2.3 After removal from the mold, allow the parts to cool to room temperature before being measured. The period of storage for initial molding shrinkage shall be 2 ± 0.25 h. Measure the length of each part to the nearest 0.5 mm or 0.02 in. Measure the parts again not less than 20 nor more than 24 h to obtain the "24-h shrinkage," and again not less than 40 nor more than 48 h after molding, in order to determine the "48-h" or "normal" mold shrinkage.

X1.2.4 Calculate the percent shrinkage by subtracting the dimension of the specimen from the corresponding dimension of the mold cavity in which it was molded, multiply by 100, and divide the difference by the length of the mold cavity.

X1.2.5 Repeat the initial, 24-h, and 48-h shrinkage expressed in percent and each representing the mean of values obtained on three or more specimens.

X1.3 Procedure B

X1.3.1 After removal form the mold, allow the part and mold to cool to room temperature. The period of cooling shall be 2 ± 0.25 h.

X1.3.2 Measure the length of the cavity of the mold to the nearest 0.02 mm or 0.001 in.

X1.3.3 Measure the length of the part to the nearest 0.02 mm or 0.001 in.

X1.3.4 *Material Shrinkage*—Calculate the percent change as follows:

$$\%\ change\ in\ length = \frac{L_m - L_p}{L_m} \times 100 \qquad (X1.1)$$

where:

L_m = length of mold at room temperature, and
L_p = length of molded part at room temperature.