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Designation: D 5672 – 03

Standard Test Method for Testing Flexible Cellular Materials Measurement of Indentation Force Deflection Using a 25-mm [1-in.] Deflection Technique[1]

This standard is issued under the fixed designation D 5672; 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 test method covers a screening type quality control test used to determine if flexible polyurethane foam cushions are within the specified grade range for firmness.

1.2 This test method is limited to foams with thicknesses that are 75 mm [3 in.] or greater.

1.3 This test method is based on the fact that the traditional industry standard thickness for Indentation Force Deflection (IFD) is 100 mm [4 in.], and the traditional percent deflection for IFD acceptance and product planning is 25 %. With respect then to these traditional industry conventions, a 25 % deflection on a 100-mm [4-in.] cushion would be 25 mm [1 in.]. Thus, deflecting proper thickness cushions 25 mm [1 in.] will determine if the flexible polyurethane foam is within the specified grade range for 25 % IFD.

1.4 Cushion thicknesses less than 75 mm [3 in.] shall not be tested for IFD using this test method.

1.5 This test method is intended to provide a quick and simple method to screen flexible polyurethane foams for determination of its firmness grade.

1.6 *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—ISO 2439 is a similar test, but there are technical differences.

2. Referenced Documents

2.1 *ASTM Standards:*

D 3574 Methods of Testing Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams[2]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[3]

2.2 Method for IFD, Chapter 4.0, "Flexible Polyurethane Foam Standards and Guidelines," Joint Industry Foam Standards and Guidelines Committee[4]

3. Terminology

3.1 This test method is based on Test Methods D 3574, Test B_1. Refer to Test Methods D 3574 for terminology used in this test method.

4. Significance and Use

4.1 The 25-mm [1-in.] deflection IFD method is recommended for production screening and quality control on full size cushions only.

4.2 Applicable cushion thicknesses to be tested by this test method are only those listed in this test method. Further research and development are required before this test method will be applicable to other cushion thicknesses.

4.3 This test method is designed to give a value approximating the 25 % IFD on a 100-mm [4-in.] thick piece of foam when the actual specimen thickness tested is within the ranges listed in the test method. In case of disagreement, the referee method is the IFD procedure in Test Methods D 3574, Test B_1. The user of this test method shall establish the correlation between this test method and the referee method.

5. Apparatus

5.1 The apparatus used for determining IFD in Test Methods D 3574, Test B_1 is used for this test method.

6. Conditioning

6.1 The conditioning conditions described in Test Methods D 3574 are best used when using this test method; however, since this method is a screening type test method, precise conditioning is not always practical.

6.2 IFD is very sensitive to temperature and humidity conditions, therefore testing samples that have been exposed to extreme conditions of humidity and temperature shall be avoided. Simply placing the specimens to be tested into an air-conditioned room in the summer or a heated room in the

[1] This test method 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] *Annual Book of ASTM Standards*, Vol 09.02.

[3] *Annual Book of ASTM Standards*, Vol 14.02.

[4] Available from AFMA, P.O. Box HP-7, High Point, NC 27261.

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

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winter and allowing them to equilibrate for at least 4 h with the cooled or heated room air will alleviate some of the problems associated with extreme weather conditions.

7. Procedure

7.1 *For test specimens 75 mm [3 in.] to 100 mm [4 in.] in thickness*:

7.1.1 Length and width of the test specimens shall be a minimum 380 mm by 380 mm [15 in. by 15 in.]. Using the indentor foot, measure the original thickness of the foam specimen using the 4.5-N [1-lb] preload procedure in Test Methods D 3574, Test B_1. Then preflex the test specimen 75 % of its original thickness two times. Before removing the test specimen from under the indentor foot and while the indentor foot still maintains the 4.5 N [1 lb] preload, draw the circumference of the indentor foot on top of the test specimen using a felt tip marker. When circumscribing the indentor foot on the test specimen, be certain that the test specimen is not moved laterally in any direction from the exact location where it was preflexed with the indentor foot. The circumscribed circle will be used for exact relocation of the indentor foot after the required waiting period. After preflexing, a waiting period of 6 ± 1 min is to be observed before performing the 25-mm [1-in.] deflection IFD.

7.1.2 The preflex indentation speed, the indentor foot, and the final indentation speed are the same as specified in Methods D 3574, Test B_1.

7.1.3 After the 6 ± 1 min. waiting period, measure the test specimen thickness by using the 4.5-N [1-lb] preload procedure in Test Methods D 3574, Test B_1. Immediately indent the 200 mm [8 in.] diameter presser foot into the foam exactly 25 mm [1 in.]. After 60 ± 3 s read the 25 mm [1 in.] deflection IFD from the force gage in N [lb].

7.2 For test specimens 100 mm [4 in.] to 165 mm [6.5 in.] in thickness:

7.2.1 On 100 mm [4 in.] to 165 mm [6.5 in.] thickness test specimens, the amount of deflection during preflexing shall be 75 mm [3 in.]. Carry out all other parts of the test as described in Section 6 and in Test Methods D 3574, Test B_1.

7.3 It has been demonstrated that adherence to all details specified or referenced herein, are necessary to obtain good correlation between this test method and the Test Methods D 3574, Test B_1 IFD method. Small deviations in test procedures and conditions can produce large variances in test results in this and other tests on flexible polyurethane foams.

8. Precision and Bias

8.1 Precision for this test method are based on round robin studies conducted by members of the American Furniture Manufacturers Association (AFMA) in accordance with Practice E 691. For the study, five commercial foams were selected ranging in density from 1.1 pcf up to 3.5 pcf with IFD values between 53N [12 lb] and 160N [35 lb] at 25 % deflection. The number of labs that participated was five. Each laboratory obtained five test results for each material. Precision, characterized by repeatability (S_r and r) and reproducibility (S_R and $_R$), have been determined as shown below.

One Inch IFD, N (Five Laboratories)					
Material	Avg.	S_r^A	S_R^B	r^C	R^D
1	124.9	6.8	13.4	19.1	37.4
2	111.9	6.2	13.3	17.3	37.1
3	77.9	6.8	13.4	19.1	37.6
4	135.3	5.4	8.1	15.0	22.7
5	138.3	9.6	11.9	26.8	33.2

[A] S_r = within-laboratory standard deviation for the indicated material. It is obtained by pooling the within laboratory standard deviations of the test results from all of the participating laboratories.
[B] S_R = between-laboratory reproducibility, expressed as standard deviation.
[C] r = within-laboratory critical interval between two results = 2.8 × S_r.
[D] R = between laboratories critical interval between two results = 2.8 × S_R.

8.2 *Bias*—There are no recognized standards by which to estimate bias for this test method.

9. Keywords

9.1 flexible cellular; foam hardness; indentation test; polyurethane

SUMMARY OF CHANGES

This section identifies the location of selected changes to this test method. For the convenience of the user, Committee D20 has highlighted those changes that may impact the use of this test method. This section may also include descriptions of the changes or reasons for the changes, or both.

D 5672 - 03:
(*1*) ISO equivalency statement was added.
(*2*) Minimum sample size was reduced.
(*3*) Precision and Bias statements were added.
(*4*) Non-mandatory language was removed.

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ASTM D5672-03
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