Designation: C 421 – ~~95~~00

Standard Test Method for Tumbling Friability of Preformed Block-Type Thermal Insulation[1]

This standard is issued under the fixed designation C 421; 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 determination of the mass loss of preformed block-type thermal insulation as a result of a combination of abrasion and impact produced by a laboratory tumbling mechanism.

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

1.3 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*

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[1] This test method is under the jurisdiction of ASTM Committee C-16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.32 on Mechanical Properties.

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C 167 Test Methods for Thickness and Density of Blanket or Batt Thermal Insulations[2]
C 168 Terminology Relating to Thermal Insulating Materials[2]
C 303 Test Method for Density of Preformed Block-Type Thermal Insulation[2]

3. Terminology

3.1 *Definitions*—Definitions pertaining to thermal insulating materials are defined in Terminology C 168.

4. Significance and Use

4.1 Several test methods for measuring mass loss by abrasion and impact of preformed block-type thermal insulation have been used to some extent in the past. It is felt that no single test method completely covers all factors involving such forces for different kinds of materials, but this test method is intended to provide a procedure that will give reproducible results. It may be used for comparing the mass loss by tumbling before and after a specific treatment of the insulation, as agreed upon by the purchaser and the manufacturer.

5. Apparatus

5.1 *Box*—A cubical box of oak wood, having inside dimensions of 7½ by 7¾ by 7¾ in. (190 by 197 by 197 mm), mounted rigidly at the center of one 7¾ by 7¾ in. (197 by 197 mm) end, so that the axis normal to a face of the box is that of a rotatable horizontal shaft. One side of the box shall be hinged as a door and shall be gasketed to be dust-tight. The box shaft shall be motor driven at a constant speed of 60 ± 2 r/min.

5.2 *Cubes*—Twenty-four room-dry, solid oak, ¾ ± 1/32-in. (19 ± 0.8-mm) cubes shall be placed in the box with the test specimens. The specific gravity of the oak cubes shall be approximately 0.65; white oak meets this requirement.

NOTE 1—Number each group of wood cubes 1 through 24. At the end of every 600-revolution test, remove one "used" cube (follow the number sequence and remove the oldest cube) and replace with a correspondingly numbered "new" cube. In this manner, cube wear is eliminated as an uncontrolled variable in the test method. When the corners of the wood cubes have been worn so that the radius of curvature is greater than 1/16 in. (1.6 mm) or the cubes have become altered so as not to be comparable with new cubes, they shall be discarded and new ones used. A conventional machinist's radius gage may be used for checking the edge wear.

6. Test Specimens

6.1 Cut the insulation with a fine-tooth saw (similar to a 16-tooth band saw) into 1 ± 1/16-in. (25.4 ± 1.6-mm) cubes.

6.2 Test twelve cubes at a time cut from one piece of insulation. When flat insulation has special surfaces due to treatment or molding, cut each cube to include such special surfaces as one face, except that the edges and corners of the insulation shall not be used.

6.3 Dry and condition specimens prior to test, following applicable specifications for the material. If the material is adversely affected by oven temperatures, then condition specimens for not less than 40 h at 73.4± 1.8°F (23 ± 1°C), and 50 ± 5 % relative humidity before testing. In the absence of definitive drying specifications, dry specimens in an oven at 215 to 250°F (102 to 121°C) to constant mass, and hold in a desiccator to cool to room temperature before testing. Where circumstances or requirements preclude compliance with these conditioning procedures, exceptions agreed upon by the purchaser and the manufacturer may be made, but they shall be specifically listed in the test report.

7. Procedure

7.1 Conduct the test in the Standard Laboratory Atmosphere at 73.4 ± 1.8°F (23 ± 1°C) and 50 ± 5 % relative humidity.

NOTE 2—Other specimen conditioning procedures or test conditions may be selected to simulate actual-use conditions, upon agreement between the purchaser and the manufacturer.

7.2 Weigh the twelve conditioned test specimens on a balance to within ± 1 %.

7.3 Place the twelve specimens together with the 24 oak cubes in the clean test box and secure the lid tightly.

7.4 Rotate the box at 60 ± 2 r/min for 600 ± 3 revolutions.

7.5 Immediately after the test period, carefully empty the contents of the box onto a 3/8-in. (9.5-mm) mesh screen and tap gently to remove dust and small particles. Carefully remove the twelve largest pieces of insulation from the screen and weigh promptly.

8. Calculation

8.1 Calculate the percent mass loss to two significant figures using Eq 1:

$$\text{Mass loss, \%} = [(M_1 - M_2)/M_1] \times 100 \quad (1)$$

where:

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

M_1 = original mass, and
M_2 = final mass.

9. Report

9.1 The report shall include the following:

9.1.1 Complete description of the material tested, including type, source, and density, in accordance with Test Methods C 167 or C 303, and special surfaces if any,

9.1.2 Conditioning or drying procedures followed and special conditions employed in the test, if any,

9.1.3 Date of test,

9.1.4 Percent mass loss, and

9.1.5 Comments on the mode and extent of abrasion, erosion, crumbling, cracking, etc.

TABLE 1 Precision

Material		Mass Loss (%)	Repeatability		Reproducibility	
			± 2.0 Sr	± 2.0 Sr (%)	± 2.0 Sr	± 2.0 Sr[A] (%)
Rigid cellular	A	0.11	0.34	309	0.40	364
plastic	B	1.00	0.65	65.0	0.83	83.0
(Specimens = 3,	C	5.3	1.6	30.9	4.2	79.3
Laboratories = 6)	D	31.4	2.6	8.2	8.5	27.1
	E	48.9	4.5	9.1	11.3	23.2
	F	49.6	5.3	10.7	10.8	21.8
Calcium silicate (Specimen = 6, Laboratories = 4)	...	9.3	1.3	14.0	1.1	11.8
Perlite (Specimens = 3, Laboratories = 5)	...	54.4	4.2	7.6	9.5	17.5

[A]Sr=repeatability standard deviation
SR=reproducibility standard deviation

10. Precision and Bias [3]

10.1 *Precision*—The precision of this test method is given in Table 1.

10.1.1 *Repeatability*— The difference between successive results obtained by the same operator with the same apparatus under constant operating conditions on identical test materials would exceed the values given for repeatability in Table 1 only in one case in twenty.

10.1.2 *Reproducibility*— The difference between two single and independent results obtained by different operators working in different laboratories on identical material would exceed the values given for reproducibility in Table 1 only in one case in twenty.

10.2 *Bias*—No information can be presented on the bias of the procedure in this test method because no material having an accepted reference value is available.

11. Keywords

11.1 mass loss; thermal insulating materials—block/board; tumbling friability

[3] Supporting data have been filed at ASTM Headquarters. Request Research Report RR:C16-1006.