



# Standard Specification for Structural Insulating Board, Calcium Silicate<sup>1</sup>

This standard is issued under the fixed designation C 656; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification covers structural insulating board for general thermal insulating, fire-resistive, and marine bulkhead applications. The rigid, preformed structural insulating board is for use at temperatures up to 1700°F (927°C). For specific applications, the actual temperature limit shall be agreed upon between the manufacturer and the purchaser.

1.2 The structural insulating board maintains its structural integrity after immersion in water.

1.3 Rapid cycling over a wide temperature range is not recommended. Such use may result in surface cracking.

1.4 The values stated in inch-pound units are to be regarded as the standard. The SI equivalents of inch-pound units are given in parentheses.

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.*

1.6 When the installation or use of thermal insulation materials, accessories and systems, may pose safety or health problems, the manufacturer shall provide the user appropriate current information regarding any known problems associated with the recommended use of the company's products, and shall also recommend protective measures to be employed in their safe utilization. The user shall establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.

## 2. Referenced Documents

### 2.1 ASTM Standards:

C 165 Test Method for Measuring Compressive Properties of Thermal Insulations<sup>2</sup>

C 168 Terminology Relating to Thermal Insulating Materials<sup>2</sup>

C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of

the Guarded-Hot-Plate Apparatus<sup>2</sup>

C 203 Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation<sup>2</sup>

C 303 Test Method for Density of Preformed Block Type Thermal Insulation<sup>2</sup>

C 356 Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat<sup>2</sup>

C 390 Criteria for Sampling and Acceptance of Preformed Thermal Insulation Lots<sup>2</sup>

C 411 Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation<sup>2</sup>

C 447 Practice for Estimating the Maximum Use Temperature of Thermal Insulations<sup>2</sup>

C 518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus<sup>2</sup>

C 1058 Practice for Temperatures for Evaluating and Reporting Thermal Properties of Thermal Insulation<sup>2</sup>

D 1037 Test Methods for Evaluating the Properties of Wood-Base Fiber and Particle Panel Materials<sup>3</sup>

E 136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C<sup>4</sup>

## 3. Terminology

3.1 *Definitions*—The definitions in Terminology C 168 shall apply to the terms used in this specification.

## 4. Classification

4.1 The structural insulating boards shall be of the following types:

4.1.1 *Type I*—Maximum use temperature 1400°F (760°C).

4.1.2 *Type II*—Maximum use temperature 1700°F (927°C).

4.2 The structural insulating boards shall be of the following grades:

4.2.1 *Grade 1*—Typical density 36 lb/ft<sup>3</sup> (577 kg/m<sup>3</sup>).

4.2.2 *Grade 2*—Typical density 46 lb/ft<sup>3</sup> (737 kg/m<sup>3</sup>).

4.2.3 *Grade 3*—Typical density 60 lb/ft<sup>3</sup> (961 kg/m<sup>3</sup>).

4.2.4 *Grade 4*—Typical density 14 lb/ft<sup>3</sup> (224 kg/m<sup>3</sup>).

4.2.5 *Grade 5*—Typical density 18 lb/ft<sup>3</sup> (288 kg/m<sup>3</sup>).

4.2.6 *Grade 6*—Typical density 28 lb/ft<sup>3</sup> (449 kg/m<sup>3</sup>).

4.2.7 *Grade 7*—Typical density 40 lb/ft<sup>3</sup> (641 kg/m<sup>3</sup>).

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.06.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 04.10.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 04.07.

4.2.8 *Grade 8*—Typical density 60 lb/ft<sup>3</sup> (961 kg/m<sup>3</sup>).

**5. Ordering Information**

5.1 The type, grade, and dimensions shall be specified by the purchaser.

5.2 Inspection of the material may be specified by the purchaser.

5.3 When a certification or test report, or both, are required, it shall be specified by the purchaser.

**6. Materials and Manufacture**

6.1 Calcium silicate structural insulating board shall be composed of hydrated calcium silicate with natural or man-made fibers or fillers, or a combination thereof. Asbestos shall not be used as an ingredient or component of the product.

**7. Other Requirements**

7.1 Calcium silicate structural insulating board shall conform to the physical and mechanical requirements specified in Table 1.

**8. Dimensions and Permissible Variations**

8.1 Calcium silicate structural insulating board shall be available in the following dimensions:

Lengths	Widths	Thicknesses
96 in. (2438 mm)	48 in. (1219 mm)	½ in. (13 mm) <sup>A</sup>
48 in. (1219 mm)	48 in. (1219 mm)	¾ in. (19 mm)
48 in. (1219 mm)	24 in. (610 mm)	⅞ in. (22 mm) <sup>A</sup>
		1 in. (25 mm)
		1½ in. (38 mm)
		2 in. (51 mm)
		2½ in. (64 mm) <sup>A</sup>
		3 in. (76 mm) <sup>A</sup>

<sup>A</sup> Optional sizes.

8.2 Dimensions shall be within the following tolerances:

Length	Width	Thickness
+ 1 in. (25 mm)	+ 1 in. (25 mm)	± ¼ in. (1.5 mm)
- ½ in. (3 mm)	- ½ in. (3 mm)	

**9. Workmanship, Finish, and Appearance**

9.1 Calcium silicate structural insulating boards shall not

have visible defects, such as major cracks, lumps, or excessive departure from planeness, which adversely affect service qualities.

**10. Qualification Requirements**

10.1 Unless otherwise specified, the following requirements shall be employed for the purpose of initial material or product qualification.

- 10.1.1 Compressive strength,
- 10.1.2 Screw holding strength,
- 10.1.3 Linear shrinkage and temperate of use,
- 10.1.4 Apparent thermal conductivity, and
- 10.1.5 Combustion characteristics.

**11. Sampling**

11.1 Calcium silicate structural insulating boards shall be sampled in accordance with Criteria C 390. Specific provisions for sampling shall be agreed upon between the purchaser and the supplier.

**12. Test Methods**

12.1 *Dimensions and Density*—Use Test Method C 303, except that specimens shall be full-size sheets for determination of length and width and at least 12-in. (300-mm) square for determination of thickness and density.

12.2 *Flexural Strength*—Use Test Methods C 203 on a 1-in. (25-mm) thick specimen.

12.3 *Compressive Strength*—Use Test Methods C 165. Specimen thickness shall be 1½ in. (38 mm). Compress specimen to 10 % deformation and calculate on maximum load value.

12.4 *Screw Holding Strength*—Use Test Methods D 1037, Direct Screw Withdrawal Test. Test at least three specimens, 3½-in. (89-mm) square, and 1 in. (25 mm) or more in thickness after drying to constant weight from 215°F (102°C) to 250°F (121°C). Drill a hole at least 1 in. (25 mm) deep, normal to the surface at the center of each specimen, with a No. 29 drill. Install a No. 8, Type A, self-tapping screw at least ⅞ in. (22.2 mm) in length such that 3⅜ in. (18.8 mm) of the screw penetrates the board.

**TABLE 1 Physical and Mechanical Requirements**

	Type I				Type II			
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
Temperature of use, max, °F (°C)	1400 (760)	1400 (760)	1400 (760)	1700 (927)	1700 (927)	1700 (927)	1700 (927)	1700 (927)
Density, typical, lb/ft <sup>3</sup> (kg/m <sup>3</sup> )	36 (577)	46 (737)	60 (961)	14 (224)	18 (288)	28 (449)	40 (641)	55 (881)
Flexural strength, min, psi (kPa)	350 (2413)	550 (3792)	900 (6206)	100 (690)	200 (1379)	350 (2413)	800 (5516)	1200 (8274)
Compressive strength, min, psi (kPa)	900 (6206)	1000 (6895)	2000 (13 790)	200 (1379)	300 (2069)	600 (4137)	2000 (13 790)	4000 (27 580)
Screw-holding strength, min, lb (N)	80 (356)	120 (534)	150 (667)	NA	NA	20 (89)	150 (667)	200 (890)
Linear shrinkage, 24 h at max use temp, max.%	2.0	2.0	3.0	2.0	2.0	2.0	2.0	2.0
Apparent thermal conductivity, max, Btu-in./h-ft <sup>2</sup> °F (mW/m-K):								
Test Conditions	Approximate ΔT							
Mean Temperature	Recommended							
200°F (93°C)	0.71 (102)	0.92 (133)	...	0.42 (61)	0.54 (78)	0.61 (88)	0.73 (105)	...
400°F (204°C)	0.74 (107)	0.89 (128)	1.26 (182)	0.52 (75)	0.61 (88)	0.66 (95)	0.75 (108)	0.97 (140)
600°F (316°C)	0.80 (115)	0.87 (125)	1.28 (185)	0.67 (97)	0.67 (97)	0.73 (105)	0.78 (113)	0.99 (143)
800°F (427°C)	0.88 (127)	0.90 (130)	1.29 (186)	0.87 (125)	0.73 (105)	0.80 (115)	0.84 (121)	1.05 (151)
Combustion characteristics, max.:								
Temperature rise, ° F (°C)	90 (50)	90 (50)	90 (50)	54 (30)	54 (30)	54 (30)	54 (30)	54 (30)
Flame duration, s	30	30	30	30	30	30	30	30
Weight loss, %	50	50	50	50	50	50	50	50

12.5 *Apparent Thermal Conductivity*—Use Test Methods C 177 or C 518. Test Method C 518 shall not be used at temperatures other than those in the range of calibration.

12.5.1 Temperature of test shall be in accordance with Practice C 1058.

12.6 *Combustion Characteristics*—Use Test Method E 136.

12.7 *Maximum Use Temperatures*—Use Practice C 447, which references Test Method C 411. Linear shrinkage (length or width, or both) should not exceed 2 % at maximum use temperature. See Test Method C 356.

### 13. Inspection

13.1 Unless otherwise specified, the following requirements shall be employed for purposes of acceptance sampling of lots or shipments of qualified insulation:

13.1.1 Density,

13.1.2 Flexural strength,

13.1.3 Dimensions, and

13.1.4 Workmanship, finish, and appearance.

13.2 Inspection of the material shall be agreed upon between the purchaser and the supplier.

### 14. Rejection and Rehearing

14.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be promptly reported in writing to the manufacturer or seller. In case of dissatisfaction with the results of the tests, the manu-

facturer or seller may make a claim for a rehearing with the purchaser.

### 15. Certification

15.1 When specified in the purchase order or contract, the manufacturer's or seller's certification shall be furnished to the purchaser stating that samples representing each lot have been manufactured, tested, and inspected in accordance with this specification and the requirements have been met. When specified in the purchase order or contract, a report of the test results shall be furnished.

### 16. Packaging and Package Marking

16.1 *Packaging*—Unless otherwise specified, the manufacturer's standard packaging system shall be used.

16.2 *Marking*:

16.2.1 Unless otherwise specified, each package shall be marked with the manufacturer's name, the product name, quantity, nominal dimensions, and manufacturer's lot or date-code identification.

16.2.2 When specified in the purchase order or contract, each container shall be marked with the appropriate ASTM C656 type and grade, or other special designations.

### 17. Keywords

17.1 calcium silicate; fire-resistive; marine; structural insulation; thermal insulation

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