



Standard Specification for Rigid Foam for Use in Structural Sandwich Panel Cores¹

This standard is issued under the fixed designation E 1730; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This specification covers rigid, closed cell, polyurethane and polyisocyanurate thermal insulation for sandwich panels used in shelter construction for exposure to ambient temperatures of -25° to 160°F (-32° to 71°C). Painted surfaces of shelters in actual field use reach temperatures of 200°F (93°C). The materials in this specification must be capable of withstanding processing, (laminating) temperatures of 110°C (230°F).

1.2 The values stated in either inch-pound or SI units are to be regarded separately as the standard. The values given in parentheses are for information only.

1.3 The following precautionary caveat pertains only to the test method portion, Section 12, of this specification: *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:

- C 165 Test Method for Measuring Compressive Properties of Thermal Insulations²
- C 168 Terminology Relating to Thermal Insulating Materials²
- C 177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus²
- C 273 Test Method for Shear Properties in Flatwise Plane of Flat Sandwich Constructions or Sandwich Cores³
- C 366 Test Methods for Measurement of Thickness of Sandwich Cores³
- C 390 Criteria for Sampling and Acceptance of Preformed Thermal Insulation Lots²
- C 518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus²

¹ This specification is under the jurisdiction of ASTM Committee E-6 on Performance of Buildings and is under the direct responsibility of Subcommittee E06.53 on Materials and Processes for Durable Rigidwall Relocatable Structures. Current edition approved Oct. 10, 1999. Published November 1999. Originally published as E 1730-95. Last previous edition E 1730-95.

² Annual Book of ASTM Standards, Vol 04.06.

³ Annual Book of ASTM Standards, Vol 15.03.

- C 550 Practice for Measuring Trueness and Squareness of Rigid Block Thermal Insulation²
- D 883 Terminology Relating to Plastics⁴
- D 1621 Test Method for Compressive Properties of Rigid Cellular Plastics⁴
- D 1622 Test Method for Apparent Density of Rigid Cellular Plastics⁴
- D 1623 Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics⁴
- D 2126 Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging⁴
- D 2856 Test Method for Open Cell Content of Rigid Cellular Plastics by the Air Pycnometer⁵
- E 864 Practice for Surface Preparation of Aluminum Alloys to Be Adhesively Bonded in Honeycomb Shelter Panels⁶
- F 501 Test Method for Aerospace Materials Response to Flame with Vertical Test Specimen (for Aerospace Vehicles Standard Conditions)⁷
- 2.2 Code of Federal Regulations Aeronautics and Space: 14 CFR 25.853 (Federal Air Regulation 25.853) Compartment Interior (Amend. 25-72)⁸
- 2.3 Federal Standard: QQ-A-25011 Aluminum Alloy 6061-T6 Plate and Sheet⁹ QQ-A-260/11 Aluminum Alloy 6081, Plate and Sheet⁹
- 2.4 Military Standards: MIL STD 105 Sampling Procedures and Tables for Inspection by Attributes⁹

3. Terminology

3.1 *Definitions*—The terms used in this specification are defined in Terminologies C 168 and D 883.

4. Classification

4.1 The unfaced foam thermal insulation boards covered by this specification are classified as follows:

- 4.1.1 *Type 1*—Nominal density: 32 kg/m^3 (2.0 lb/ft^3).
- 4.1.2 *Type 2*—Nominal density: 48 kg/m^3 (3.0 lb/ft^3).
- 4.1.3 *Type 3*—Nominal density: 64 kg/m^3 (4.0 lb/ft^3).

⁴ Annual Book of ASTM Standards, Vol 08.01.

⁵ Annual Book of ASTM Standards, Vol 08.02.

⁶ Annual Book of ASTM Standards, Vol 04.11.

⁷ Discontinued: see 1998 Annual Book of ASTM Standards, Vol 04.07.

⁸ Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

⁹ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

4.1.4 *Type 4*—Nominal density: 192 kg/m³ (12.0 lb/ft³).

5. Ordering Information

5.1 Orders for materials purchased under this specification shall include the following:

- 5.1.1 Designation of this specification,
- 5.1.2 Product name and type, or both,
- 5.1.3 Dimensions and tolerances,
- 5.1.4 Impact resistance test specimen preparation,
- 5.1.5 Material marking requirements, and
- 5.1.6 Packaging requirements.

6. Foam

6.1 The morphology of the insulation shall consist of a multitude of individual cells of uniform size and dimension, essentially closed off from each other, homogeneous throughout, free of voids, accumulations of unexpanded material, foreign inclusions, or seams (see Table 1).

7. Dimensions and Tolerances

7.1 The dimensions, squareness, and tolerances shall be specified by the purchaser.

8. Qualification

8.1 When required by the purchaser, materials supplied under this specification must be tested for and meet the properties listed in Table 2. Having a qualified product does not obviate the supplier from continued, on-going product compliance with all requirements to this specification.

8.2 In addition to meeting the requirements of the tests stipulated in Table 2 as manufactured, the compressive, tensile, and shear properties must also meet these requirements after having been preconditioned for 4 h at 110°C (230°F), and allowed to equilibrate in accordance with 11.2.

8.3 Unless otherwise specified by the purchaser, qualified materials remain qualified as long as there are no changes in product formulation, critical raw materials, that is, isocyanates and polyols, basic methods of manufacture, or plant location.

9. Acceptance

9.1 *Lot Size for Acceptance Testing*—For the purpose of acceptance testing a lot is defined as a single, identifiable, production run using raw materials from a single batch.

9.2 *Acceptance Testing (Physical Properties)*—A representative sample shall be selected from each foam lot and tested for the following physical properties:

TABLE 1 Classification of Characteristics

Characteristic	Major		Method of Inspection
	Major	Minor	
Length, width, and thickness	X	...	9.4.3
Edge squareness	X	...	9.4.3
Holes through board exceeding 40 mm ² for each 92900 mm ² (0.0625 in. ² for each square foot) of area	X	...	9.4.2
Crushed foam	X	...	9.4.2
Voids larger than 40 mm (0.0625 in. ²)	X	...	9.4.2
Unexpanded material	...	X	9.4.2
Foreign inclusions	...	X	9.4.2
Contaminants	...	X	9.4.2
Seams	X	...	9.4.5

Property	Requirement	Method
Density	Table 2	12.1
Compressive strength	Table 2	12.3
Shear strength	Table 2	12.5
Flame resistance	Table 2	12.8

9.3 Sampling for Acceptance (Examination):

9.3.1 Samples for quality conformance examination shall be selected in accordance with Inspection Level II of MIL STD 105.

9.3.2 When the conditions for reduced inspection specified in MIL-STD-105 have been complied with, a reduced sampling in lieu of full sampling shall be instituted. Sampling for reduced inspection shall be in accordance with Criteria C 390 (Inspection Level S-2 of MIL STD 105).

9.4 Examination:

9.4.1 Samples selected in accordance with 9.3 shall be examined for characteristics listed in Table 1.

9.4.2 Visual examination shall consist of scanning for surface characteristics.

9.4.3 Dimensional measurements shall be made with calipers, rules, and tape rules as appropriate to the specified tolerances. In cases of dispute or when specifically invoked by the purchaser, the methodology and procedures of Method C 336 or Practice C 550 shall be utilized.

9.4.4 The Acceptable Quality Level (AQL) for major characteristics shall be 1.0 % and for minor characteristics shall be 2.5 %.

9.4.5 Seams (see Table 1) are defined as: a plane of undermixed material, or a fold which developed within the rising foam mass that reduces the tensile strength of the foam. When viewed normal to a cut sheet, a seam appears as a line on the foam surface. This condition must be differentiated from simple discoloration (arising from the same causes but not as pronounced) that have no appreciable effect on foam strength. This condition shall be evaluated by taking a sample, (not to exceed 51 mm (2 in.) thick from the sheet and bending it over a 305 mm (12 in.) cylinder to failure. If the failure plane follows the discontinuity then the discontinuity shall be considered a seam.

10. Physical Property Requirements

10.1 The rigid, cellular polyurethane or polyisocyanurate foam shall have limiting property values as shown in Table 2.

11. Test Preconditioning

11.1 A period of at least 72 h must elapse from the time of foam manufacture until the cutting of any test specimens.

11.2 Unless otherwise specified, by the purchaser, the test specimens shall be conditioned at 24 ± 2°C (75 ± 9°F) and at relative humidity of less than 60 % for at least 12 h prior to testing.

12. Test Methods

12.1 *Density*—Determine the density in accordance with Test Method D 1622.

12.2 *Thermal Conductivity*—Determine the thermal conductivity in accordance with Test Method C 177 or Test Method C 518 at mean temperatures of 5°, 24°, and 52°C (41°, 75°, 120°F) after conditioning for 7 ± 1 days at 24 ± 2°C (75