



Designation: C591 – 21

Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation¹

This standard is issued under the fixed designation C591; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers the types, physical properties, and dimensions of unfaced, preformed rigid cellular polyisocyanurate plastic material intended for use as thermal insulation on surfaces from -297°F (-183°C) to 300°F (149°C). For specific applications, the actual temperature limits shall be agreed upon by the manufacturer and purchaser.

1.2 This specification only covers “polyurethane modified polyisocyanurate” thermal insulation which is commonly referred to as “polyisocyanurate” thermal insulation. This standard does not encompass all polyurethane modified materials. Polyurethane modified polyisocyanurate and other polyurethane materials are similar, but the materials will perform differently under some service conditions.

1.3 This standard is designed as a material specification, not a design document. Physical property requirements vary by application and temperature. At temperatures below -70°F (-51°C) the physical properties of the polyisocyanurate insulation at the service temperature are of particular importance. Below -70°F (-51°C) the manufacturer and the purchaser must agree on what additional cold temperature performance properties are required to determine if the material can function adequately for the particular application.

1.4 This standard addresses requirements of unfaced preformed rigid cellular polyisocyanurate thermal insulation manufactured using blowing agents with an ozone depletion potential of 0 (ODP 0).

1.5 Except 6.2 and 8.2 – 8.4, which are related to the size and shape of fabricated parts, and 16.1, which is related to the storage of fabricated parts, the requirements in this standard specification apply to the polyisocyanurate insulation in the form of buns supplied by the insulation manufacturer.

¹ This specification is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.22 on Organic and Nonhomogeneous Inorganic Thermal Insulations.

Current edition approved April 15, 2021. Published May 2021. Originally approved in 1966. Last previous edition approved in 2020 as C591 – 20. DOI: 10.1520/C0591-21.

1.6 When adopted by an authority having jurisdiction, codes that address fire properties in many applications regulate the use of the thermal insulation materials covered by this specification. Fire properties are controlled by job, project, or other specifications where codes or government regulations do not apply.

1.7 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.8 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.9 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- C165 Test Method for Measuring Compressive Properties of Thermal Insulations
- C168 Terminology Relating to Thermal Insulation
- C177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
- C272/C272M Test Method for Water Absorption of Core Materials for Sandwich Constructions
- C303 Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation
- C335/C335M Test Method for Steady-State Heat Transfer Properties of Pipe Insulation

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.

- C390 Practice for Sampling and Acceptance of Thermal Insulation Lots
- C411 Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
- C518 Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- C550 Test Method for Measuring Trueness and Squareness of Rigid Block and Board Thermal Insulation
- C585 Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing
- C871 Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions
- C1045 Practice for Calculating Thermal Transmission Properties Under Steady-State Conditions
- C1058/C1058M Practice for Selecting Temperatures for Evaluating and Reporting Thermal Properties of Thermal Insulation
- C1114 Test Method for Steady-State Thermal Transmission Properties by Means of the Thin-Heater Apparatus
- C1303/C1303M Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation
- C1363 Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
- C1763 Test Method for Water Absorption by Immersion of Thermal Insulation Materials
- D883 Terminology Relating to Plastics
- D1621 Test Method for Compressive Properties of Rigid Cellular Plastics
- D1622/D1622M Test Method for Apparent Density of Rigid Cellular Plastics
- D2126 Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
- D2856 Test Method for Open-Cell Content of Rigid Cellular Plastics by the Air Pycnometer (Withdrawn 2006)³
- D6226 Test Method for Open Cell Content of Rigid Cellular Plastics
- E84 Test Method for Surface Burning Characteristics of Building Materials
- E96/E96M Test Methods for Water Vapor Transmission of Materials

3. Terminology

3.1 For descriptions of terms used in this specification, refer to Terminologies C168 and D883.

3.2 The term polyisocyanurate does not encompass all polyurethane containing materials (see 1.2).

3.3 The term “core specimen” refers to representative samples cut in accordance with the sampling procedure listed within each property test method.

3.4 Definitions of Terms Specific to This Standard:

3.4.1 *aged, v*—in relation to thermal conductivity testing, the act of delaying thermal conductivity testing for a specified time period after the final polymerization.

3.4.1.1 *Discussion*—Unfaced preformed rigid cellular polyisocyanurate thermal insulation samples are aged because the thermal conductivity of this material increases with time, primarily due to changes in the composition of the gas contained within the closed cells. The rate of this thermal conductivity increase diminishes with time so an aging time prior to testing is selected to reasonably represent the long-term performance of the material. The aging time for thermal conductivity test specimens of material covered by this standard is typically 180 days.

3.4.2 *conditioned, v*—the act of putting specimens in specified temperature and humidity conditions immediately prior to testing to allow the specimens to reach temperature and moisture content equilibrium.

3.4.2.1 *Discussion*—Samples are conditioned for a fairly short time period (typically 12 to 24 h) during which the test lab holds the sample at standard lab conditions (see 11.3) immediately prior to testing. If specimens are aged (see 3.4.1) for thermal conductivity testing at the same conditions specified for conditioning and kept at these conditions until the time of testing, then a separate conditioning period at the end of the aging period is not necessary.

3.4.3 *final polymerization, n*—the final chemical reaction and cooling that occurs immediately following primary manufacturing of unfaced preformed rigid cellular polyisocyanurate thermal insulation materials created using a simultaneous blowing and exothermic polymerization process.

3.4.3.1 *Discussion*—Unfaced preformed rigid cellular polyisocyanurate thermal insulation materials created using a simultaneous blowing and exothermic polymerization process are formed into a shape such as a bun during manufacture. This shape reaches its final form and size during primary manufacturing and is at a temperature substantially above ambient. This shape continues to undergo final polymerization and cooling for a time period ranging from a few hours to several days. This period of final polymerization and cooling is part of the manufacturing process and samples are not taken for testing or quality control until the end of this period is reached.

3.4.4 *insulation fabricator, n*—a company that machines, cuts, grinds, or otherwise transforms the unfaced polyisocyanurate bun insulation received from an insulation manufacturer into various shapes such as boards, blocks, pipe shells, tank segments, and elbows/fittings.

3.4.4.1 *Discussion*—It is possible for a company to function as both an insulation fabricator and an insulation manufacturer. In this standard specification the insulation fabricator is also referred to simply as the fabricator.

3.4.5 *insulation manufacturer, n*—a company engaged in primary manufacturing of unfaced polyisocyanurate foam.

3.4.5.1 *Discussion*—It is possible for a company to function as both an insulation manufacturer and an insulation fabricator. In this standard specification the insulation manufacturer is also referred to simply as the manufacturer.

3.4.6 *ozone depletion potential (ODP), n*—a relative index indicating the extent to which a chemical product causes ozone depletion.

3.4.6.1 *Discussion*—The reference level of 1 is the potential

³ The last approved version of this historical standard is referenced on www.astm.org.