



Standard Specification for Selection and Application of Thermal Insulation Systems on Liquefied Natural Gas (LNG) Type C Tanks¹

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1. Scope

1.1 This specification covers selection and application requirements for the design of a thermal insulation system used on cryogenic liquefied natural gas (LNG) Type C tanks that can store LNG at a higher pressure than Type A or Type B tanks.

1.2 Methods and materials for installation, including jacketing and vapor retarders, are also detailed.

1.3 This specification shall be applied to LNG fueled and cargo vessel applications as regulated by either the International Code of Safety for Ships Using Gases or Other Low Flashpoint Fuels (IGF Code) or International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code).

1.4 This specification provides requirements for the properties of thermal insulation and other materials used in LNG Type C tanks as described in IGC Code Chapter 4.19.3 and IGF Code Section 6.4.13.3.

1.5 LNG Type C tanks are described in IGC Code and IGF Code.

1.6 This specification addresses suitable properties of resistance to fire and flame spread for LNG Type C tanks or portions of the tank are located on or above the exposed deck as well in hold spaces that are not maintained permanently inerted (that is, an atmosphere with less than 5 % oxygen).

1.7 The LNG tank operating temperature range addressed by this specification is from a temperature of -259°F (-162°C) $+0/-9^{\circ}\text{F}$ ($+0/-5^{\circ}\text{C}$) to ambient temperatures no greater than 113°F (45°C).

1.8 This specification does not address the thermal insulation on vacuum jacketed (that is, insulation systems that operate at below ambient pressure) insulated LNG Type C tanks.

1.9 The design of removable/reusable insulation systems is not addressed in this specification.

1.10 Structural design and physical strength of insulation systems are not addressed in this specification. However, the securement of jacketing systems is addressed.

1.11 Insulation system density is not a design criterion considered in this specification.

1.12 Tank-mounted insulated pipe is outside the scope of this specification.

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

1.14 *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.*

1.15 *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

[C136 Test Method for Sieve Analysis of Fine and Coarse Aggregates](#)

[C165 Test Method for Measuring Compressive Properties of Thermal Insulations](#)

[C167 Test Methods for Thickness and Density of Blanket or Batt 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 Test Method for Water Absorption of Core Materials](#)

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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- C303** Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation
- C591** Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
- C680** Practice for Estimate of the Heat Gain or Loss and the Surface Temperatures of Insulated Flat, Cylindrical, and Spherical Systems by Use of Computer Programs
- C835** Test Method for Total Hemispherical Emittance of Surfaces up to 1400°C
- C1136** Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
- C1729** Specification for Aluminum Jacketing for Insulation
- C1767** Specification for Stainless Steel Jacketing for Insulation
- C1809** Practice for Preparation of Specimens and Reporting of Results for Permeance Testing of Pressure Sensitive Adhesive Sealed Joints in Insulation Vapor Retarders
- D696** Test Method for Coefficient of Linear Thermal Expansion of Plastics Between –30°C and +30°C with a Vitreous Silica Dilatometer
- D1621** Test Method for Compressive Properties of Rigid Cellular Plastics
- D1622** Test Method for Apparent Density of Rigid Cellular Plastics
- D2126** Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
- D6226** Test Method for Open Cell Content of Rigid Cellular Plastics
- E84** Test Method for Surface Burning Characteristics of Building Materials
- E96** Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
- E136** Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 °C
- E228** Test Method for Linear Thermal Expansion of Solid Materials With a Push-Rod Dilatometer
- E831** Test Method for Linear Thermal Expansion of Solid Materials by Thermomechanical Analysis
- F3319** Specification for Selection and Application of Field-Installed Cryogenic Pipe and Equipment Insulation Systems on Liquefied Natural Gas (LNG)-Fueled Ships

2.2 Other Standards:

- 46 CFR Part 38** Subpart 38.05-2 Design and Construction of Cargo Tanks³
- 46 CFR Part 164** Subpart 164.109 Non-Combustible Materials (SOLAS)³
- IMO FTP Code** Fire Test Procedures Code IMO Resolution MSC 307 (88), Annex 1 Part 1 and Part 5 and Annex 2⁴
- IMO SOLAS 1974** International Convention for the Safety of Life at Sea, as amended through 2014, Chapter II-2 Regulations 5 and 6⁴

- IGC Code** International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk⁴
- IGF Code** International Code of Safety for Ships using Gases or Other Low-Flashpoint Fuels⁴
- ISO 8497** Determination of Steady-State Thermal Transmission Properties of Thermal Insulation for Circular Pipe⁵
- MSC 1-Circ 1558** Unified Interpretations of The IGF Code⁶
- DIN 4102-1** Fire Behavior of Building Materials and Elements for Classification of Building Materials Requirements and Testing⁷

3. Terminology

3.1 *Definitions*—For definitions of terms relating to insulating materials used in this specification, refer to Terminology C168.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *rubber membrane vapor retarder*; *n*—relatively thick, flexible material acting as a vapor retarder, the primary component of which is a rubber or rubberized material such as rubberized asphalt, nitrile rubber, or butyl rubber, combined with one or more secondary components such as aluminum foil, plastic film, and mesh or nonwoven reinforcement.

4. Insulation and Jacket Materials

4.1 Insulation and jacket/lagging manufacturers shall publish/describe material specifications that are intended for use on LNG Type C tanks at the temperature range requirements.

4.2 All materials and material properties shall be verified for applicability for use at cryogenic temperatures.

NOTE 1—The heat transmission studies for these tanks and issues related to stress corrosion cracking of austenitic stainless steel includes a maximum ambient still air temperature of 113 °F (45 °C) and this design condition is adopted in this specification for these tanks.

5. General Requirements

5.1 All safety requirements as applicable to ships such as those from the relevant flag administration, the IMO SOLAS 1974, the IGC Code, and the IGF Code are applicable to the insulation materials and systems described in this specification.

5.2 Insulation systems will comply with one of the following flammability requirements:

5.2.1 Be noncombustible by virtue of complying with the criteria of one of the following three: (1) Test Method E136, (2) Part 1 of the IMO FTP Code, or (3) 46 CFR 164.109 (see Table 1 I A).

NOTE 2—Thermal insulation that does not meet recognized standards for fire resistance may be used in hold spaces that are not kept permanently inerted provided its surfaces are covered with material with low-flame-spread characteristics and that forms an efficient approved vapor seal.

³ Available from the U.S. Government Printing Office, Superintendent of Documents, 732 N. Capital St NW, Washington, DC 20402-0001, www.access.gpo.gov.

⁴ Available from the International Maritime Organization, 4 Albert Embankment, London, United Kingdom, SE1 7SR, http://www.imo.org.

⁵ Available from the American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.

⁶ Available from the Iranian Classification Society, NO.5, Shabnam. Alley, Qaem Maqam-e-Farahani St., Haft-e-Tir. Sqr., Tehran, IR, ics.org.ir.

⁷ Available from Deutsches Institut für Normung e.V.(DIN), Am DIN-Platz, Burggrafenstrasse 6, 10787 Berlin, Germany, http://www.din.de.