



CGA-341—2023 SPECIFICATION FOR INSULATED CARGO TANK FOR NONFLAMMABLE CRYOGENIC LIQUIDS

EIGHTH EDITION

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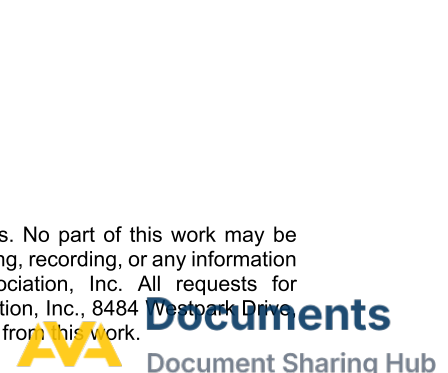
Bulk Distribution Equipment & Standards Committee

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1 Introduction and scope

This standard contains specifications for a cargo tank with very efficient insulation and relatively low heat leak to the lading. This cargo tank resembles an oversized thermos bottle because the liquid container is supported in an approximately concentric manner within the outer jacket, with insulation contained in the annular space. Thus, the outer jacket is often the primary structural member anchored to the truck bed or the tandem and upper coupler (fifth wheel) assemblies.

This cargo tank specification contains the suggested minimum guidelines for insulated, non-DOT specification cargo tanks intended for transporting nonflammable cryogenic liquids such as argon, helium, nitrogen, and oxygen at pressures less than 25.3 psi (174 kPa) in the highway mode in the United States.^{1,2} These cargo tanks are allowed by paragraph 173.320 of the U.S. Department of Transportation (DOT) Title 49 of the U.S. *Code of Federal Regulations* (49 CFR) [2].

In Canada, the *Transportation of Dangerous Goods Regulations (TDG Regulations)* of Transport Canada (TC) apply [3]. These regulations require that cargo tanks be constructed, used, and maintained in accordance with CSA B620, *Highway tanks and TC portable tanks for the transportation of dangerous goods* and CSA B622, *Selection and use of highway tanks, TC portable tanks, and ton containers for the transportation of dangerous goods, Class 2* [4, 5].

2 Definitions

For the purpose of this publication, the following definitions apply.

2.1 Publication terminology

2.1.1 Shall

Indicates that the procedure is mandatory. It is used wherever the criterion for conformance to specific recommendations allows no deviation.

2.1.2 Should

Indicates that a procedure is recommended.

2.1.3 May

Indicates that the procedure is optional.

2.1.4 Will

Used only to indicate the future, not a degree of requirement.

2.1.5 Can

Indicates a possibility or ability.

2.2 Technical definitions

2.2.1 ASME Code

Edition and addenda of Section VIII, Division 1, "Pressure Vessels," of the ASME *Boiler & Pressure Vessel Code* of the American Society of Mechanical Engineers in effect at the date of tank manufacture [6].

2.2.2 Cargo tank

Assembled liquid container (including insulation, support system, and outer jacket) that either is permanently attached to or forms a part of a road vehicle or is not permanently attached to a road vehicle but by reason of its size, construction, or attachment to a road vehicle is loaded or unloaded without being removed from the road vehicle.

¹ psi, bar, and kPa shall indicate gauge pressure unless otherwise noted as (psia; bar, abs; and kPa, abs) for absolute pressure or (psid; bar, dif; and kPa, dif) for differential pressure. All kPa values are rounded off per CGA P-11, *Guideline for Metric Practice in the Compressed Gas Industry* [1].

² References are shown by bracketed numbers and are listed in order of appearance in the reference section.

2.2.3 Cryogenic liquid

Liquefied gas having a boiling point lower than -130°F at 14.7 psia (-90°C at 101 kPa, abs).

2.2.4 Design pressure

Maximum gauge pressure at the top of the liquid container in its operating position.

NOTE—As used in this specification, design pressure is identical to the term maximum allowable working pressure (MAWP) as used in the ASME Code [6].

2.2.5 Design service temperature

Minimum allowable temperature for which a liquid container is suitable.

NOTE—Design service temperature is identical to the minimum allowable temperature for which the liquid container is suitable as defined in paragraph UG-116 of the ASME Code [6].

2.2.6 Design weight of lading

Maximum weight of lading to be carried in the cargo tank.

NOTE—Design weight of lading is used in the design calculations for the liquid container, inner support system, outer jacket, anchorage, etc.

NOTE—Products of differing densities can be carried in the cargo tank as long as the design weight of lading is not exceeded.

2.2.7 Insulation

Material of low thermal conductivity that surrounds the liquid container and reduces the flow of heat to the liquid container.

NOTE—The insulation may or may not be evacuated.

2.2.8 Lading

Cryogenic liquid being transported in the liquid container.

2.2.9 Liquid container

Inner tank (pressure vessel) that actually contacts and holds the lading.

2.2.10 Outer jacket

Outer metal jacket around the insulation.

NOTE—The outer jacket protects the insulation from moisture. It is often the primary structural member that serves as the frame of the cargo tank or is anchored to the frame of a truck.

2.2.11 Pressure relief device (PRD)

Device intended to relieve excessive pressure in a container, e.g., a liquid container or outer jacket, under certain conditions of exposure.

2.2.12 Ultimate strength

Maximum stress a material can resist before failure.

NOTE—Ultimate strength incorporates an accounting of tensile, compressive, and shear stress into one word. Ultimate strengths are usually stated in terms of the kind of stress producing the failure. Minimum ultimate means the minimum value of a range of ultimate strengths as determined by measurements.

3 General requirements**3.1 Design pressure and design service temperature**

The design pressure shall not be less than 25.3 psi (174 kPa). To determine the minimum permissible thickness of the different parts of the liquid container, the static head of the lading shall be added to the design pressure. If evacuated insulation is used, the liquid container shall be designed for a pressure of 14.7 psia (101 kPa, abs) more than the design pressure plus the static head of the lading.

The design service temperature shall be -320°F (-196°C). For liquid helium, the design service temperature shall be -452°F (-269°C).

Because vehicular stability is critical to the safe operation of cargo tanks, the design should keep the center of gravity as low as practical.

3.2 Regulations

The cargo tank and its lading are subject to the following applicable regulations:

- In the United States, 49 CFR [2]; and
- In Canada, the *TDG Regulations* of TC as well as the pressure vessels acts and regulations of the provinces in which the cargo tank is used [3].

3.3 Liquid container

3.3.1

The liquid (pressure) container shall be of welded construction that is designed, constructed, and stamped in accordance with and fulfilling the requirements of the ASME Code [6].

3.3.2

Maximum stress values in the shell at the inner support system shall be in accordance with UG-23 and UG-54 of the ASME Code [6]. However, the allowable stress value for the combination of general primary membrane stress and local primary membrane stress shall not exceed 1.25 times the maximum allowable stress value as prescribed by the ASME Code at a temperature of 100°F (38°C) [6].

NOTE—See ASME Code, Section VIII, Division 2, Part 5, Paragraph 5.12 for definitions [6].

The weight of the liquid container itself, the design weight of lading, and the weight of articles supported by the liquid container shall be considered using the forces described in 3.4.1.

3.3.3

Design details that permit the collection and retention of cleaning materials or contaminants should be avoided. Designs that permit the flushing of all surfaces by the normal sloshing of the cryogenic liquid are preferred.

3.3.4

For liquid containers greater than 15 ft (4.6 m) in length, a permanently attached transverse baffle should be included. For liquid containers longer than 30 ft (9.1 m), multiple baffles should be included and spaced no greater than 15 ft (4.6 m) apart. The baffles should be permanently attached to the inside of the container and designed to minimize liquid sloshing. Each baffle shall be designed for a minimum longitudinal loading of $3/4$ g times the per compartment design weight of lading. The allowable stress shall be equal to $1/4$ of the room temperature ultimate strength.

NOTE— $3/4$ g is based on $1-1/2$ g loading times $1/2$ the compartment weight of lading, which is the maximum baffle loading condition.

3.4 Inner support system

3.4.1

The liquid container shall be supported within the outer jacket by members designed to withstand the following minimum static loadings times the weight of the liquid container and attachments when filled to the design weight of lading:

- vertical downward of 2.0;