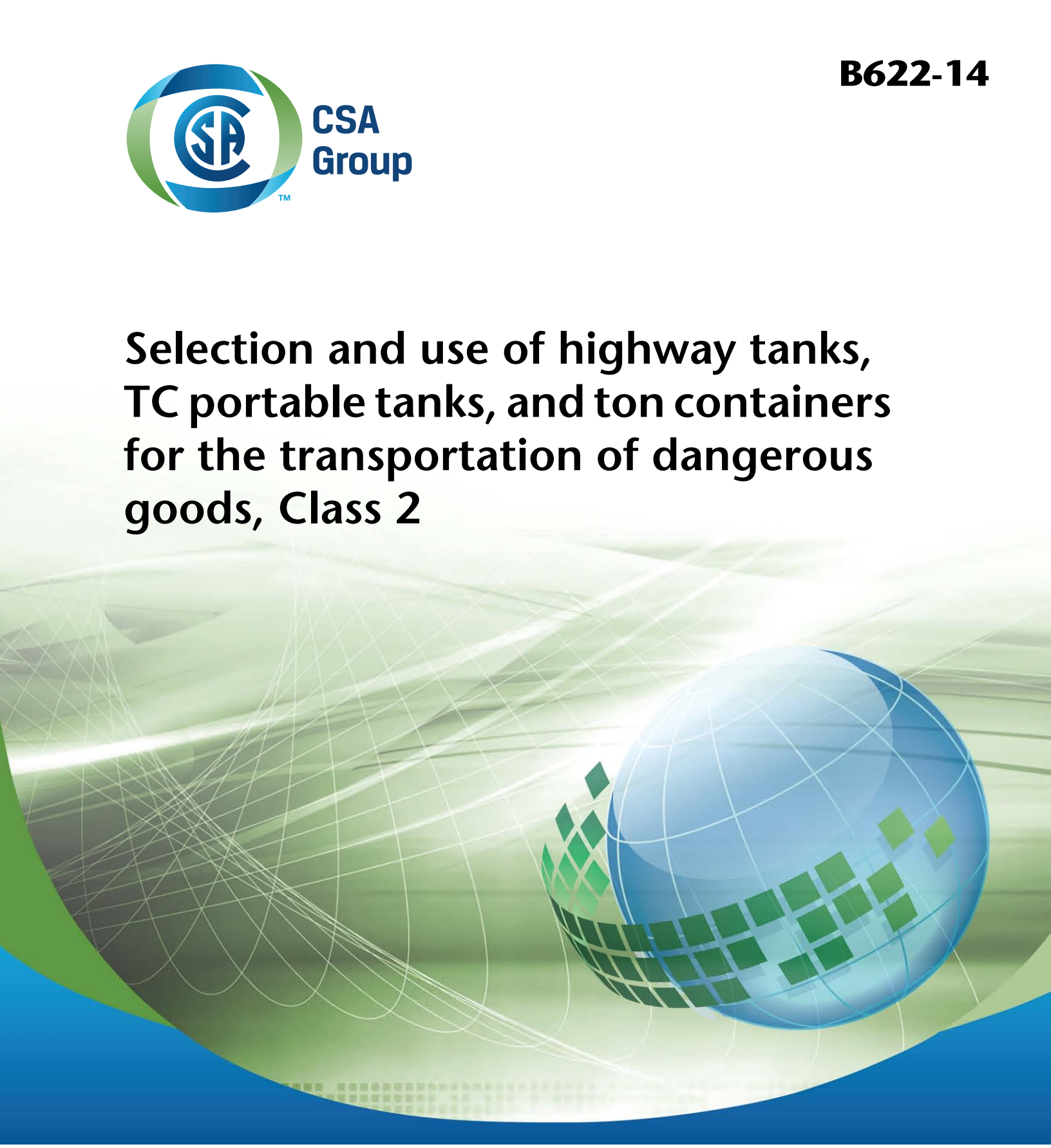
B622-14

Selection and use of highway tanks, TC portable tanks, and ton containers for the transportation of dangerous goods, Class 2



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B622-14

Selection and use of highway tanks, TC portable tanks, and ton containers for the transportation of dangerous goods, Class 2

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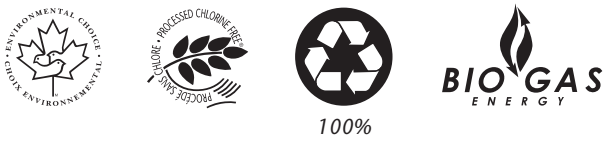

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The Technical Committee thanks Kevin Green of Transport Canada (retired) for his contributions to the development of this Standard.

Preface

This is the fifth edition of CSA B622, *Selection and use of highway tanks, TC portable tanks, and ton containers for the transportation of dangerous goods, Class 2*. It supersedes the previous editions published in 2009, 2003, 1998, and 1987, under the title *Selection and use of highway tanks, multi-unit tank car tanks, and portable tanks for the transportation of dangerous goods, Class 2*.

This Standard is one of a series of Standards prepared for use in conjunction with the *Transportation of Dangerous Goods Regulations*. It should be noted that this Standard, by itself, does not have the force of law unless it is officially adopted by a regulatory authority. Since the Standard may be adopted into regulations with certain exceptions or additional requirements, it is recommended that the regulations of the relevant jurisdiction be consulted in order to establish the extent to which this Standard has been adopted. Where an industry practice differs from the requirements of this Standard, an application for a permit for equivalent level of safety may be requested from the regulatory authority.

This Standard was prepared by the CSA Technical Committee on Highway Tanks and TC Portable Tanks for the Transportation of Dangerous Goods, made up of members having responsibilities and expertise as manufacturers and users, or representing related areas, including testing and inspection of tanks, materials production, and regulatory interests. It was believed that such a Standard, developed by consensus, would be practical, current with respect to technology and industry practices, useful, and acceptable to all interested parties.

This Standard was prepared giving due consideration to current industry practices in North America, the *US Code of Federal Regulations*, Title 49, and the United Nations publication *Recommendations on the Transport of Dangerous Goods: Model Regulations*. This Standard takes into account recent proven experience and the current technical advances made in the field. This Standard does not deviate fundamentally from the current industry practices in North America; most changes made involve clarification, corrections, and reorganization. CSA B620-14, *Highway tanks and TC portable tanks for the transportation of dangerous goods*, is the reference document for design, construction, testing, and inspection requirements.

This Standard was prepared by the Technical Committee on Highway Tanks and TC Portable Tanks for Transportation of Dangerous Goods, under the jurisdiction of the Strategic Steering Committee on Mechanical Industrial Equipment Safety, and it has been formally approved by the Technical Committee.

Notes:

(1) *Use of the singular does not exclude the plural (and vice versa) when the sense allows.*

(2) *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*

(3) *This Standard was developed by consensus, which is defined by* CSA Policy governing standardization — Code of good practice for standardization *as "substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity". It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this Standard.*

(4) *To submit a request for interpretation of this Standard, please send the following information to* ***inquiries@csagroup.org*** *and include "Request for interpretation" in the subject line:*
(a) define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;
(b) provide an explanation of circumstances surrounding the actual field condition; and
(c) where possible, phrase the request in such a way that a specific "yes" or "no" answer will address the issue.
Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization *and are available on the* Current Standards Activities *page at* ***standardsactivities.csa.ca****.*

(5) *This Standard is subject to review five years from the date of publication. Suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to* ***inquiries@csagroup.org*** *and include "Proposal for change" in the subject line:*
(a) Standard designation (number);
(b) relevant clause, table, and/or figure number;
(c) wording of the proposed change; and
(d) rationale for the change.

B622-14
Selection and use of highway tanks, TC portable tanks, and ton containers for the transportation of dangerous goods, Class 2

1 Scope

1.1
This Standard details the requirements for the selection and use, handling, filling, and unloading of highway tanks, TC portable tanks, and ton containers used as means of containment for the transportation of dangerous goods of Class 2.

1.2
This Standard sets out certain minimum requirements for the selection of the appropriate means of containment for the transportation of dangerous goods. This Standard does not, however, prescribe selection of the materials of construction of the means of containment to ensure chemical compatibility with the dangerous goods. Consequently, it is essential to exercise competent technical and engineering judgment in conjunction with this Standard.

1.3
Where any requirement of this Standard differs from the *Transportation of Dangerous Goods (TDG) Regulations*, the requirements of the *TDG Regulations* apply.

1.4
This Standard does not apply to tubes for the transportation of gases. Requirements for these tubes are provided in CSA B340.

1.5
In CSA Standards, "shall" is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; "should" is used to express a recommendation or that which is advised but not required; "may" is used to express an option or that which is permissible within the limits of the standard; and "can" is used to express possibility or capability.

Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material.

Notes to tables and figures are considered part of the table or figure and may be written as requirements.

Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

1.6
The values given in SI (metric) units are the standard. The values given in parentheses are for information only. Units for pressure refer to gauge pressure unless otherwise noted.

2 Reference publications

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below. Where there is an inconsistency between this Standard and a referenced publication other than the T*ransportation of Dangerous Goods (TDG) Act* or *Regulations*, the requirements of this Standard shall prevail. Application of a referenced publication shall be made only with careful consideration of this Standard's reference to that particular publication.

CSA Group

CAN/CGA-8.1-M86 (R2011)
Elastomeric composite hose and hose couplings for conducting propane and natural gas

CAN1-8.3-77 (R2011)
Thermoplastic hose and hose couplings for conducting propane and natural gas

B51-09
Boiler, pressure vessel, and pressure piping code

B340-08
Selection and use of cylinders, spheres, tubes, and other containers for the transportation of dangerous goods, Class 2

B620-1987 (superseded)
Highway tanks and portable tanks for the transportation of dangerous goods

CAN/CSA-B620-98 (superseded)
Highway tanks and portable tanks for the transportation of dangerous goods

B620-03 (superseded)
Highway tanks and portable tanks for the transportation of dangerous goods

B620-09 (superseded)
Highway tanks and TC portable tanks for the transportation of dangerous goods

B620-14
Highway tanks and TC portable tanks for the transportation of dangerous goods

ASME (American Society of Mechanical Engineers)

B31.3-2012
Process Piping

Boiler and Pressure Vessel Code, Section II, Part D, and Section VIII, Division 1, UG101(m) (excluding addenda), 1998

Boiler and Pressure Vessel Code [excluding Section II, Part D, and Section VIII, Division 1, UG101(m)], 2013

ASTM International (American Society for Testing and Materials)

A20/A20M-11
Standard Specification for General Requirements for Steel Plates for Pressure Vessels

A300-58 (Discontinued 1975)
Specification for Steel Plates for Pressure Vessels for Service at Low Temperatures

A516/A516M-10
Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

A612/A612M-12
Standard Specification for Pressure Vessel Plates, Carbon Steel, High Strength, for Moderate- and Lower-Temperature Service

B580-79 (2009)
Standard Specification for Anodic Oxide Coatings on Aluminum

D1838-12a
Standard Test Method for Copper Strip Corrosion by Liquefied Petroleum (LP) Gases

CGA (Compressed Gas Association)
CGA-341-2002
Specification for Insulated Cargo Tank Specification for Nonflammable Cryogenic Liquids

G-2.2-1985 (reaffirmed 1997)
Guideline Method for Determining Minimum of 0.2% Water in Anhydrous Ammonia

G-4.1-2009
Cleaning Equipment for Oxygen Service

S-1.2-2009
Pressure Relief Device Standards — Part 2 — Portable Containers for Compressed Gases

V-6-2008
Standard Bulk Refrigerator Liquid Transfer Connections

CGSB (Canadian General Standards Board)
CAN/CGSB-3.13-M88
Liquefied Petroleum Gas (Butanes)

CAN/CGSB-3.14-2013
Propane for fuel purposes

CAN/CGSB-43.147-2005
Construction, Modification, Qualification, Maintenance, and Selection and Use of Means of Containment for the Handling, Offering for Transport, or Transporting of Dangerous Goods by Rail

Chlorine Institute
Drawings 101-4, 101-6, 103-3, 103-4, 104-4, 104-5, 106-3, 106-5, 137-1, 137-2, H-50155, and H-51970

Government of Canada
Transportation of Dangerous Goods Act, S.C. 1992, c. 34, and the *Transportation of Dangerous Goods Regulations,* as amended from time to time

Government of USA
US Code of Federal Regulations, Title 49, Parts 107 to 180, as amended from time to time (referenced as 49 CFR)

NFPA (National Fire Protection Association)
10-2013
Standard for Portable Fire Extinguishers

United Nations
Recommendations on the Transport of Dangerous Goods — Model Regulations, 15th rev. ed. (2007)

3 Definitions

The definitions provided in CSA B620-14, the *Transportation of Dangerous Goods Regulations*, and the *Transportation of Dangerous Goods Act*, 1992, apply in this Standard.

4 Selection of means of containment

4.1 General requirements

In addition to any Specific Requirements given in Clause 6 for the particular dangerous goods to be transported, the means of containment shall comply with the requirements of Clauses 5.2, 5.3, and 5.4. Where a TC specification tank is required by this Standard, the tank shall comply with the applicable requirements of CSA B620-14, unless otherwise specified.

4.2 CSA B620-1987, CAN/CSA-B620-98, B620-03, and CSA B629-09 specifications

Where Clause 6 of this Standard requires the use of a tank of a specification included in CSA B620-14, a tank of the same specification that was constructed and certified in accordance with CSA B620-1987 prior to 15 August 2002, constructed and certified in accordance with CAN/CSA-B620-98 prior to 21 September 2005, constructed and certified in accordance with CSA B620-03 prior to the enforcement date of CSA B620-09 or constructed and certified in accordance with CSA B620-09 prior to the enforcement date of CSA B620-14 in the *TDG Regulations* may be used instead. Where Clause 6 of this standard requires or permits the use of a TC 51, Transport Canada's *TDG Regulations* require that the tank shall have been manufactured and certified prior to the enforcement date of this Standard in the *TDG Regulations*. The ground clearance requirements of CSA B620-1987 shall not apply if the ground clearance requirements of Clause 5.2.7 of CAN/CSA-B620-98, Clause 5.2.8 of CSA B620-03, Clause 5.2.8 of CSA B620-09 or Clause 5.2.8 of CSA B620-14 are satisfied.

4.3 Ton containers

Ton containers shall be selected and used for the transportation of dangerous goods by road in accordance with the requirements of CAN/CGSB-43.147.

4.4 Equivalent and substitute specifications

4.4.1

Where Clause 6 of this Standard requires the use of a tank of a specification included in CSA B620-14,

(a) a tank constructed and certified in accordance with 49 CFR and listed in column 3 of Table 1 may be used instead of the tank in column 2 of the same item number, but the Specific Requirements of Clause 6 for the tank in column 2 shall nonetheless be met; and

(b) a tank listed in column 4 of Table 1 may be used instead of the tank listed in column 2 of the same item number if

  (i) the tank in column 4 complies with the Specific Requirements given in Clause 6 for the tank in column 2; and

  (ii) the tank was constructed and certified in accordance with

    (1) the requirements of 49 CFR in force on the date of its certification;

    (2) the terms of CGA 341 in existence on the date of its certification and an edition of the ASME *Code* not later than that referenced in this Standard for tanks manufactured prior to 1 January 2003; or

    (3) the regulations for the transportation of dangerous goods by rail in Canada in force on the date of its certification.

4.4.2

Where the use of an equivalent or substitute specification is permitted as specified in Clause 4.4.1 and as shown in Table 1, the ground clearance requirements of the equivalent or substitute specification shall not

apply if the ground clearance requirements of Clause 5.2.7 of CAN/CSA-B620-98, Clause 5.2.8 of CSA B620-03, Clause 5.2.8 of CSA B620-09 or Clause 5.2.8 of CSA B620-14 are satisfied.

4.4.3

Specification MC 330 tanks, as shown in column 4 of Table 1, that are used to transport flammable gas or anhydrous ammonia shall be provided with emergency discharge control equipment in accordance with Clause 5.3 Section 178.337-11(c) of CSA B620-1987, Clause 5.2.2.1 of CSA B620-03, Clause 5.2.2.1 of CSA B620-09, or Clause 5.2.2.1 of CSA B620-14.

Table 1
Equivalent and substitute specifications
(See Clause 4.4.1 to 4.4.3, 5.1, and 5.2.2.)

Column 1	Column 2	Column 3	Column 4
Item number	CSA B620 specification	49 CFR DOT or MC equivalent specification	CTC, CGA, or MC substitute specification
1	TC 331	MC 331	MC 330
2	TC 338	MC 338	—
3	TC 341	—	CGA 341*
4	TC 51†	DOT 51‡	CTC 51§

**A CGA 341 tank shall be acceptable only if it was manufactured and certified prior to 1 January 2003.*
†A TC 51 shall be acceptable only if manufactured and certified prior to the enforcement date of this Standard in the TDG Regulations.
‡A DOT 51 shall be acceptable only if manufactured and certified prior to 1 Jan 2003.
§A CTC 51 shall be acceptable only if manufactured and certified prior to 1 July 1995.

5 Loading and unloading requirements

5.1 General requirements

A means of containment shall not be used unless the following conditions are fulfilled:

(a) it has been selected in accordance with Clause 4 and 6 of this Standard;
(b) any repair or modification has been performed as required for its specification;
(c) it is free of any visible defect that could affect its integrity during loading, unloading, or transportation;
(d) where a fire hazard exists, precautions have been taken to prevent a difference in electrical potential between conductive surfaces and to ensure safe dissipation of static electricity through bonding or grounding, or both, as appropriate;
(e) hoses and couplings are inspected to ensure that they are mechanically fit, compatible with the lading, and will function properly. A hose assembly shall not be used to load or unload dangerous goods if it is determined to have any of the conditions identified in Clause 7.2.10 of CSA B620-14, or if the markings are not in accordance with that clause. Despite the requirement of Clause 7.2.10.4(a) of CSA B620-14, a hose may continue to be used if the reinforcement is exposed as long as there is no evidence of wear, deterioration, or other damage in the exposed reinforcement;
(f) hoses and hose fittings installed on TC 331 and TC 51 tanks, and their equivalent or substitute tanks listed in Table 1, shall have a minimum working pressure of 2400 kPa (350 psi), and hoses and hose fittings in liquefied petroleum gas service shall comply with CSA CAN/CGA-8.1 or CSA CAN1-8.3;

(g) while parked for loading or unloading,
  (i) a fail-safe brake interlock system is used that will apply the parking brake while the loading and unloading hoses are connected; or
  (ii) chock blocks at the rear wheels;
(h) no later than 1 Jan 2015, highway tanks and vehicles transporting portable tanks containing dangerous goods of Class 2.1 shall be equipped with one or more dry chemical fire extinguishers accessible from the ground, with a combined total effective rating of not less than 40BC. Each fire extinguisher shall be recharged immediately after each use and shall be inspected and marked annually in accordance with NFPA 10;
(i) no later than 1 Jan 2016, diesel engines on highway tanks and portable tanks containing dangerous goods of Class 2.1 and being used during loading or off loading shall be equipped with an automatic engine air intake shut-off device that will prevent engine runaway in case of exposure to flammable vapours. The device shall activate automatically if engine runaway is detected and remain activated until manually reset; and
(j) hose assemblies used in refrigerated liquefied gas service shall be manufactured and documented as conforming to CSA B51 or ASME B31.3 and marked "CSA B51" or "ASME B31.3" by the hose assembly manufacturer.

Note: *It is recommended that all filling and unloading hose connections conform to the requirements of CGA V-6 where the dangerous goods to be loaded or unloaded are specified in that publication.*

5.2 Pre-loading requirements

5.2.1 Means of containment

In addition to the requirements in Clause 5.1, a means of containment shall not be loaded with dangerous goods unless the following conditions are fulfilled:
(a) it has been inspected, tested, retested, and is marked
  (i) if it conforms to a TC specification, in accordance with
    (1) Clause 7 of CSA B620-14 where the inspection or test is performed in Canada; and
    (2) either Clause 7 of CSA B620-14 or Part 180 of 49 CFR for the corresponding MC or DOT specification listed in column 3 of Table 1 of this Standard, where the inspection or test is performed in the US, provided the types of inspections and tests and intervals prescribed in Clause 7 of CSA B620-14 are satisfied; and
  (ii) if it is an equivalent or substitute tank listed in Table 1
    (1) as required in CSA B620 for its corresponding TC specification where the inspection or test is performed in Canada; or
    (2) as required in Part 180 of 49 CFR for its MC or DOT specification, or as required in CSA B620 for its corresponding TC specification, provided the types of inspections and tests and intervals prescribed in Clause 7 of CSA B620-14 are satisfied, where the inspection or test is performed in the US;
(b) if, since the last time it was loaded or unloaded, a component such as piping, valves, or fittings has been restored or replaced, and that component has been tested for leaks at the maximum normal operating pressure of the tank;
(c) it does not contain any compressed or liquefied gas, residues, or foreign materials that could react with the intended lading or otherwise create a hazard; and
(d) those parts that contact the intended lading will not be subject to deterioration by or react with the lading or cause the lading to decompose, and thereby create a hazard.

5.2.2 MAWP

The MAWP of the highway or portable tank to be loaded shall be greater than or equal to
(a) the MAWP specified in Clause 6 for the particular dangerous goods; or
(b) for TC 331 or TC 51 tanks, and their equivalent or substitute tanks listed in Table 1, the vapour pressure of the dangerous goods at
  (i) 46 °C (115°F) if the tank volumetric capacity is greater than 4500 L (1200 US gal; 990 Imp. gal); or

(ii) 55 °C (131°F) if the tank volumetric capacity is 4500 L (1200 US gal; 990 Imp. gal) or less.

5.2.3 Enclosed space

When portable tanks are transported in an enclosed space such as a van or container, suitable measures shall be taken to vent the enclosed space to atmosphere.

5.2.4 Maximum filling ratio

The filling ratio of a tank shall not exceed

(a) the filling ratio specified in Clause 6 for the particular dangerous goods; or

(b) for TC 331 or TC 51 tanks, and their equivalent or substitute tanks listed in Table 1, a filling ratio that prevents the tank from becoming 98% liquid-full should the temperature of the contents rise to
   (i) 40 °C (104°F) for insulated tanks; or
   (ii) 46 °C (115°F) for uninsulated tanks.

Note: *Unless otherwise specified, filling ratio is defined as the ratio, expressed as a percentage, of the mass of the gas in the tank at* 15 °C *(59°F) to the mass of water that the tank will hold where the water density is* 1000 kg/m^3 *(8.33 lb/US gal, 10 lb/Imp. gal).*

5.2.5 Tank protection

A portable tank shall be completely contained within the length of the vehicle into or on which it is loaded or to which it is attached. A tank shall not be mounted below the vehicle body or deck. The following protection shall be provided either by the vehicle or the portable tank:

(a) a rear-end protection that can deflect at least 15 cm (6 in) horizontally forward without any contact with any part containing lading when subjected to an impact of twice the combined weight of the full tank and the vehicle to which it is attached; and

(b) suitable damage protection to protect all valves, safety devices, and other accessories from damage by collision, jackknifing, or overturning.

5.2.6 Highway and portable tanks in compressed liquefied gas service

For TC 331, MC 330, MC 331, TC 51, CTC 51, and DOT 51 tanks designed to transport liquefied compressed gases, except tanks designed to transport Class 2.2 gases with no subsidiary class and portable tanks that are removed from the vehicle for loading and unloading, the following requirements shall apply:

(a) No person shall load a TC 331 or TC 51 tank unless the tank is equipped with an appropriate emergency discharge control as specified in Clauses 5.3.2.5 and 6.2.9.3 of CAN/CSA-B620-98, CSA B620-03, CSA B620-09, or Clause 5.3.2.5 of CSA B620-14.

(b) No person shall load a TC 331 or TC 51 tank manufactured after 1 January 2016, unless the tank is equipped with an appropriate emergency discharge control as specified in Clause 5.3.2.5 of CSA B620-14.

(c) An MC 330 or MC 331 tank shall comply with the emergency discharge control requirements in this clause as though it were a TC 331 tank.

(d) A CTC 51 or DOT 51 tank shall comply with the emergency discharge requirements of this clause as though it were a TC 51 tank.

(e) Each operator of a highway or portable tank transporting compressed liquefied gas shall carry, on or within the cargo tank motor vehicle, written emergency discharge control procedures for all delivery operations.

(f) The procedures shall describe the tank's emergency discharge control features and operation.

(g) A facility registered to perform inspections and tests on TC 331 tanks may install the emergency discharge control as required by Item (b), (c), or (d), provided that modification to valves and piping is not required.

(h) The design for the emergency discharge control shall be certified by a design engineer. The certification shall consider any specifications of the original component manufacturer and shall detail the operation of the means to shut off the flow of product, including the parameters (e.g., temperature, pressure, product types) within which the shut-off means is designed to operate. All

components of the discharge system that are integral to the design shall be included in the certification. A copy of the design certification shall be provided to the owner of the tank on which the emergency discharge control equipment is installed.

(i) Unless equipment is installed or removed as part of regular operation (e.g., a hose), the emergency discharge control shall be installed under the supervision of a tank inspector. The tank inspector shall certify that the equipment is installed and tested, where it is possible to do so without damage to equipment, in accordance with the design engineer's certification. The registered facility performing the installation and testing shall provide the certification in accordance with Clauses 5.1.7 and 8.2.1 of CSA B620-14 to the owner of the tank on which the emergency discharge control equipment is installed.

(j) The off-truck emergency shutdown system shall be tested monthly in accordance with Clause 7.2.9 of CSA B620-14.

5.3 Requirements during filling

5.3.1 Safety requirements during filling

5.3.1.1

During loading of a means of containment the operator responsible for the transfer shall have been trained in product hazards and emergency procedures, and shall remain alert, within easy access of the flow shutdown control, and to the extent possible, with the hose and tank in clear view except for brief periods to operate controls or to check the receiving container, except where

(a) the dangerous goods are air, refrigerated liquid; argon, refrigerated liquid; helium, refrigerated liquid; krypton, refrigerated liquid; neon, refrigerated liquid; nitrogen, refrigerated liquid; oxygen, refrigerated liquid; or xenon, refrigerated liquid;

(b) the vapour pressure of the dangerous goods is less than or equal to 175 kPa, gauge (25.3 psi);

(c) the tank and filling system have controls to
   (i) prevent overfilling or unsafe release; and
   (ii) protect the tank, its appurtenances, and the filling system; and

(d) the contents are checked after filling to ensure compliance with the filling limits of this Standard.

5.3.1.2

Where the loading system is capable of producing pressures in excess of the MAWP of the tank, the loading system shall be continually monitored or shall be modified to ensure that the tank pressure never exceeds 120% of the MAWP or, in the case of helium, refrigerated liquid; argon, refrigerated liquid; neon, refrigerated liquid; nitrogen, refrigerated liquid; krypton, refrigerated liquid; xenon, refrigerated liquid; and air, refrigerated liquid, 150% of the MAWP.

5.3.2 Filling by volume

5.3.2.1

Filling by volume shall conform to one of the following requirements, as applicable:

(a) If a tank is equipped with an adjustable liquid level device (rotary, slip-tube, or float gauge), the amount of lading shall be determined by using an easily readable thermometer in a thermometer well, in combination with the liquid level device, and corrected for the lading at 15 °C (59°F).

(b) For carbon dioxide, refrigerated liquid, and nitrous oxide, refrigerated liquid, the amount of lading shall be determined by using the equilibrium pressure in the supply tank, in combination with the liquid level device.

5.3.2.2

When loading tanks that have a maximum liquid level indicator, such as a fixed-length dip-tube, the indicator shall be arranged to function before or when the maximum filling ratio is reached.

5.3.3 Filling with refrigerated liquefied gas

5.3.3.1

When refrigerated liquefied gases are being loaded, the lading shall not

(a) be colder than the tank design service temperature;
(b) weigh more than
    (i) an amount that results in
        (1) a pressure in excess of the pressure-relief valve setting; or
        (2) the maximum filling ratio; and
    (ii) the design weight of lading on the metal identification plate; and
(c) fill the tank with liquid to more than 98% of its volumetric capacity below the pressure-relief valve or pressure-control valve inlet, except with helium, refrigerated liquid.

5.3.3.2

The filling rate shall not exceed the liquid flow capacity of the primary pressure-relief system rated at

(a) 150% of the tank's MAWP for Class 2.2 dangerous goods other than oxygen; or
(b) 120% of the tank's MAWP for Class 2.1 dangerous goods and oxygen.

5.4 Requirements after filling

The following requirements shall apply:

(a) Immediately after filling, all valves up to and including the outermost valve and other openings in the means of containment shall be closed and secured except emergency self-closing valves on TC 338 and TC 341 tanks and those that would interfere with the normal functioning of any safety relief device or pressure-regulating devices. This requirement shall not apply to means of containment in non-flammable refrigerated liquefied gas service provided that all service connections are closed.
(b) After the tank is filled and the loading lines are disconnected, every valve and pressure-relief device shall be inspected for leakage.
(c) After a tank is filled with a flammable refrigerated liquefied gas, the temperature of the lading shall be low enough to ensure that the lading will not vent to the atmosphere in less than the marked rated holding time for the lading on the metal identification plate.
(d) Prior to transport, the means of containment shall be secured to the transport vehicle in a manner that will endure the normal conditions of transportation.
(e) On TC 341 and TC 338 tanks equipped with pressure-building coils, the pressure-building circuit shall be emptied of liquid prior to transport, and for Class 2.1 gases the manual block valve referred to in Clause 5.2.2.8(g) of CSA B620-14 shall be closed and the circuit depressurized.

5.5 Pre-unloading requirements

5.5.1 General

In addition to the requirements in Clause 5.1, prior to unloading a means of containment, the following conditions shall be fulfilled:

(a) unloading connections shall be inspected to ensure that the lading will be discharged into the proper receiving line;
(b) precautions shall be taken to isolate from each other substances that can react violently together, if such substances are to be unloaded simultaneously at the same location;
(c) the space available in the receiving means of containment shall be verified to ensure that it is sufficient to accommodate the quantity of goods to be unloaded;
(d) the operator, when remotely opening the internal safety control valve (ISC), shall have an unobstructed view of the tank, delivery hose, and container being filled, to the maximum extent practicable;
(e) if the periodic inspection or test interval expires after the tank was last loaded, the tank may be transported to its unloading destination and unloaded;

(f) no person shall unload a TC 331 or TC 51 tank unless the tank is equipped with an appropriate emergency discharge control as specified in Clauses 5.3.2.5 and 6.2.9.3 of CAN/CSA-B620-98, CSA B620-03, CSA B620-09, or Clause 5.3.2.5 of CSA B620-14.
(g) no person shall unload a TC 331 or TC 51 tank manufactured after 1 January 2016, unless the tank is equipped with an appropriate emergency discharge control as specified in Clause 5.3.2.5 of CSA B620-14.

5.5.2 Daily test of off-truck emergency shutdown system

On highway and portable tanks equipped with an off-truck emergency shutdown system as defined in any edition of CSA B620 or in 49 CFR, an operator shall successfully test the activation within 18 h prior to the first delivery of each day. When the remote means are wireless transmitters/receivers, the person conducting the test shall be at least 46 m (150 ft) from the tank and should have the tank in his or her line of sight.

Following this daily test , a report outlining the results shall be prepared by the person performing the off-truck emergency shutdown system test, and shall be retained for at least one month by the operator or the tank owner. The report need not comply with Clause 7.3 of CSA B620-14 but shall identify the name and address of the owner and the person performing the test, a reference traceable to the tank serial number, the date of the test, the nature of the test, and the result of the test.

5.6 Unloading requirements

During the unloading of a means of containment,

(a) the operator responsible for the transfer shall have been trained in product hazards and emergency procedures, and shall remain alert, within easy access of the tank flow shutdown control, and to the extent possible, with the hose and tank in clear view except for brief periods to operate controls or to check the receiving container;
(b) if equipped with an off-truck emergency shutdown system as defined in Clause 3.2 of CSA B620-14, the operator shall be in possession of the control at all times the tank valve is open, within 150 ft of the tank and 25 ft of the hose;
(c) the loading and unloading limits for the delivering and receiving means of containment shall not be exceeded, including the rate of filling, the gross vehicle weight, the maximum product load, and the MAWP and vacuum limits; and
(d) the quantity of dangerous goods unloaded shall be controlled.

5.7 Post-unloading requirements

The following requirements shall apply:

(a) Immediately after the means of containment has been unloaded,
    (i) all hatches, valves up to and including the outermost valve, and other openings in the means of containment shall be closed and secured except the emergency self-closing valves on TC 338 and TC 341 tanks. This requirement shall not apply to means of containment in non-flammable refrigerated liquid service provided that all service connections are closed; and
    (ii) the exterior surfaces shall be clean and free of residue or spills of dangerous goods.
(b) The closing and securement of valves and openings in Item (a) (i) shall not interfere with the normal functioning of any safety relief devices or pressure-regulating devices.

The requirements in Item (a) shall not apply if the means of containment is cleaned and purged immediately after unloading.

6 List of dangerous goods, Class 2, and Specific Requirements

6.1 Classification, prohibition, and exemption under the *TDG Act* and *Regulations*

Clause 6 provides requirements for the handling, offering for transport, and transportation of dangerous goods in large containers that are neither prohibited from transportation nor exempted by the *TDG Regulations*.

Notes:

(1) *Dangerous goods are classified in Part 2 of the* TDG Regulations. *The appropriate shipping name and the corresponding particulars (description, UN number, class, division, and packing group, as applicable) are assigned by Schedule 1 of the* TDG Regulations.

(2) *Certain dangerous goods are exempted by the* TDG Regulations*, and others are prohibited from transport by Schedule 3 of the* TDG Regulations.

6.2 Requirements for specific dangerous goods

The dangerous goods listed in column 1 of Table 2 shall be handled, offered for transport, or transported in tanks in accordance with the Specific Requirements of Clause 6.3 that are listed in column 4 for highway tanks and column 5 for portable tanks.

Table 2
Specific tank requirements for dangerous goods, Class 2
(See Clause 6.2 and 6.3.)

Column 1	Column 2	Column 3	Column 4	Column 5
Description and shipping name	UN number	Classification	Specific Requirements for highway tanks	Specific Requirements for portable tanks
Goods of Class 2.1 not listed below	—	**2.1**	**1, 15, 49, 71**	**4, 15, 49, 71**
1-chloro-1,1-difluoroethane, or refrigerant gas R142b	2517	2.1	1, 9, 13, 48	4, 9, 13, 48
Butadienes, stabilized	1010	2.1	1, 25, 46	4, 25, 46
Butane	1011	2.1	1, 22, 25, 26, 46, 76	4, 22, 24, 25, 26, 46
Butylene	1012	2.1	1, 22, 25, 26	4, 22, 24, 25, 26
1,1-Difluoroethane, or refrigerant gas R152a	1030	2.1	1, 9, 17, 48	4, 9, 17, 48
Dimethyl ether	1033	2.1	1, 15, 29, 48	4, 15, 29, 48
Dimethylamine, anhydrous	1032	2.1 (8)	1, 15, 28, 48	4, 15, 28, 48
Ethane, refrigerated liquid	1961	2.1	3, 46, 62	—
Ethyl methyl ether	1039	2.1	1, 9, 49	4, 9, 49
Ethylene, refrigerated liquid	1038	2.1	2, 63, 64, 68	—
Hydrogen, refrigerated liquid	1966	2.1	2, 63, 64, 68	—
Isobutane	1969	2.1	1, 22, 25, 26	4, 22, 24, 25, 26

(Continued)

Table 2 (Continued)

Column 1	Column 2	Column 3	Column 4	Column 5
Description and shipping name	**UN number**	**Classification**	**Specific Requirements for highway tanks**	**Specific Requirements for portable tanks**
Isobutylene	1055	2.1	1, 22, 25, 26	4, 22, 24, 25, 26
Methane, refrigerated liquid, or natural gas, refrigerated liquid (with high methane content)	1972	2.1	2, 63, 64, 68	—
Methyl acetylene and propadiene mixtures, stabilized	1060	2.1	1, 11, 27, 46	4, 11, 27, 46
Methyl chloride or refrigerant gas R40	1063	2.1	1, 18, 47	4, 18, 47
Methyl chloride and methylene chloride mixture	1912	2.1	1, 15, 49	4, 15, 49
Methylamine, anhydrous	1061	2.1	1, 32, 48, 51	4, 32, 48, 51
Petroleum gases, liquefied, N.O.S.*	1075	2.1	1, 22, 25, 26, 45, 46, 76	4, 22, 24, 25, 26, 45, 46
Propane	1978	2.1	1, 22, 25, 26, 45, 46, 76	4, 22, 24, 25, 26, 45, 46
Propylene	1077	2.1	1, 22, 25, 26, 46	4, 22, 24, 25, 26, 46
1,1,1-Trifluoroethane, or refrigerant gas R143a	2035	2.1	1, 9, 49	4, 9, 49
Trimethylamine, anhydrous	1083	2.1	1, 9, 43, 48	4, 9, 43, 48
Vinyl chloride, stabilized	1086	2.1	1, 11, 15, 20, 48	—
Vinyl fluoride, stabilized	1080	2.1	1, 9, 21,48	—
Vinyl methyl ether, stabilized	1087	2.1	1, 11, 41	—
Goods of Class 2.2 not listed below	**—**	**2.2**	**1, 15, 70**	**4, 15, 70**
1,1,1,2 Tetrafluoroethane, or refrigerant gas R134a	3159	2.2	1, 9, 48	4, 9, 48
Air, refrigerated liquid, non-pressurized	1003	2.2 (5.1)	66, 67, 69	75
Ammonia solutions, relative density (specific gravity) less than 0.880 at 15 °C (59°F) in water, with more than 35% but not more than 50% ammonia	2073	2.2	1, 10, 15, 46, 76	4, 4, 15, 46
Argon, refrigerated liquid	1953	2.2	66, 67, 69	75
Bromotrifluoromethane, or refrigerant gas R13B1	1009	2.2	1, 12	4, 12
Carbon dioxide, refrigerated liquid	2187	2.2	3, 46, 60, 61	4, 46, 60, 61
Chlorodifluorobromomethane, or refrigerant gas R12B1	1974	2.2	1, 9, 48	4, 9, 48

(Continued)

Table 2 (Continued)

Column 1	Column 2	Column 3	Column 4	Column 5
Description and shipping name	**UN number**	**Classification**	**Specific Requirements for highway tanks**	**Specific Requirements for portable tanks**
Chlorodifluoromethane, or refrigerant gas R22	1018	2.2	1, 9, 14, 48	4, 9, 14, 48
Chlorodifluoromethane and chloropentafluoroethane mixture with fixed boiling point, with approximately 49% chlorodifluoromethane, or refrigerant gas R502	1973	2.2	1, 9	4, 9
Chloropentafluoroethane, or refrigerant gas R115	1020	2.2	1, 15, 48	4, 15, 48
1-chloro-1,2,2,2-tetrafluoroethane, or refrigerant gas R124	1021	2.2	1, 9, 48	4, 15, 48
1-chloro-2,2,2-trifluoroethane, or refrigerant gas R133a	1983	2.2	1, 9, 48	4, 9, 48
Chlorotrifluoromethane, or refrigerant gas R13	1022	2.2	1, 9	4, 9
Chlorotrifluoromethane and trifluoromethane azeotropic mixture with approximately 60% chlorotrifluoromethane, or refrigerant gas R503	2599	2.2	1, 9, 48	4, 9, 48
Dichlorodifluoromethane, or refrigerant gas R12	1028	2.2	1, 9, 16, 48	4, 9, 16, 48
Dichlorodifluoromethane and difluoroethane azeotropic mixture with approximately 74% dichlorodifluoromethane, or refrigerant gas R500	2602	2.2	1, 9, 45, 48	4, 9, 45, 48
Dichlorofluoromethane, or refrigerant gas R21	1029	2.2	1, 9, 48	4, 9, 48
1,2-Dichloro-1,1,2,2- tetrafluoroethane, or refrigerant gas R114	1958	2.2	1, 9, 48	4, 9, 48
Helium, refrigerated liquid	1963	2.2	66, 67, 69	75
Hexafluoroethane, compressed, or refrigerant gas R116, compressed	2193	2.2	1, 9, 48	4, 9, 48
Hexafluoropropylene, or refrigerant gas R1216	1858	2.2	1, 30, 48	4, 30, 48
Krypton, refrigerated liquid	1970	2.2	66, 67, 69	75
Neon, refrigerated liquid	1913	2.2	66, 67, 69	75
Nitrogen, refrigerated liquid	1977	2.2	66, 67, 69	75

(Continued)

Table 2 (Concluded)

Column 1	Column 2	Column 3	Column 4	Column 5
Description and shipping name	**UN number**	**Classification**	**Specific Requirements for highway tanks**	**Specific Requirements for portable tanks**
Nitrous oxide, refrigerated liquid	2201	2.2 (5.1)	1, 46, 60, 65	4, 46, 60, 65
Octafluorocyclobutane, or refrigerant gas RC318	1976	2.2	1, 9, 48	4, 9, 48
Octafluoropropane, or refrigerant gas R218	2424	2.2	1, 9, 48	4, 9, 48
Oxygen, refrigerated liquid	1073	2.2 (5.1)	65, 66, 67, 69	65, 75
Refrigerant gases, N.O.S.*	1078	2.2	1, 9, 48	4, 9, 48
Tetrafluoromethane, compressed, or refrigerant gas R14, compressed	1982	2.2	1, 9, 48	4, 9, 48
Trifluoromethane, or refrigerant gas R23	1984	2.2	1, 9, 48, 49	4, 9, 48, 49
Xenon, refrigerated liquid	2591	2.2	66, 67, 69	75
Goods of Class 2.3 not listed below	—	**2.3**	**74**	**74**
Ammonia, anhydrous	1005	2.3 (8)	1, 10, 33, 46, 54, 56, 76	4, 10, 33, 46, 55, 56, 73
Ammonia solutions, relative density (specific gravity) less than 0.880 at 15 °C (59°F) in water, with more than 50% ammonia	3318	2.3 (8)	1, 10, 33, 46, 54, 56, 76	4, 10, 33, 46, 55, 56, 73
Chlorine	1017	2.3 (8)	1, 48, 58	4, 48, 53
Ethylene oxide, or ethylene oxide with nitrogen up to a total pressure of 1 MPa (10 bar) at 50 °C	1040	2.3 (2.1)	1, 44	4, 44
Hydrogen chloride, refrigerated liquid	2186	2.3 (8)	3, 15, 48, 62	—
Methyl bromide	1062	2.3	1, 15, 33, 42, 52, 53	4, 15, 33, 42, 52, 53
Methyl mercaptan	1064	2.3 (2.1)	1, 33, 34, 46, 50, 53	4, 33, 34, 46, 50, 53
Sulphur dioxide, liquefied	1079	2.3	1, 33, 40, 42, 47, 53	4, 33, 40, 42, 47, 53

**N.O.S. — not otherwise specified.*

6.3 Specific Requirements

The following is a list of the Specific Requirements referred to in Table 2. Where "may" is used in these requirements, it indicates that an alternative specification is permitted. The alternative permitted shall be as specified in Table 2 and this clause.

1. Highway tanks shall be TC 331.
2. Highway tanks shall be TC 338.
3. Highway tanks shall be TC 331 or TC 338.

4. Portable tanks shall be TC 51.
5. *Deleted*
6. *Deleted*
7. *Deleted*
8. *Deleted*
9. TC 51 and TC 331 tanks shall be filled by weight.
10. Tanks shall be constructed so that no part normally in contact with ammonia liquid or vapour is made of aluminum, copper, silver, zinc, or their alloys.
11. Valves or safety devices shall not be fabricated of materials that will cause the formation of acetylides.
12. TC 51 and TC 331 tanks shall
    (a) have a minimum MAWP of 2520 kPa, gauge (365 psi); and
    (b) be filled by weight to a filling ratio that is less than or equal to 133.
13. The filling ratio shall be less than or equal to 100.
14. TC 51 and TC 331 tanks shall
    (a) have a MAWP greater than or equal to 1725 kPa, gauge (250 psi); and
    (b) have a filling ratio less than or equal to 105.
15. Tanks shall be filled by weight.
16. The filling ratio shall be less than or equal to 119, and TC 331 and TC 51 tanks shall have a MAWP greater than or equal to 1035 kPa, gauge (150 psi).
17. The filling ratio shall be less than or equal to 79, and TC 331 and TC 51 tanks shall have a MAWP greater than or equal to 1035 kPa, gauge (150 psi).
18. The following requirement shall apply:
    (a) TC 51 and TC 331 tanks shall
        (i) have a MAWP greater than or equal to 1035 kPa, gauge (150 psi);
        (ii) if filled by weight, have a filling ratio equal to or less than 84; and
        (iii) if filled by volume, have a filling ratio equal to or less than 88.5.
    (b) TC 51 tanks may be equipped with fusible plugs if
        (i) the volumetric capacity is greater than 900 L (240 US gal; 200 Imp. gal);
        (ii) filled by weight to a filling ratio equal to or less than 84;
        (iii) the tank's MAWP is greater than or equal to 1550 kPa, gauge (225 psi);
        (iv) the fusible plugs are in accordance with CGA S-1.2 and open at 120% of the MAWP or less; and
        (v) for tanks over 760 mm (30 in) in length, each end is equipped with fusible plugs that provide enough venting capacity for the whole tank.
19. *Deleted*
20. Tanks shall
    (a) have a MAWP greater than or equal to 1035 kPa, gauge (150 psi); and
    (b) have a filling ratio less than or equal to 84.
21. TC 331 tanks shall
    (a) have a MAWP greater than or equal to 1725 kPa, gauge (250 psi);
    (b) be insulated and comply with the low-temperature requirements of the ASME *Code* under which they were built, for an insulated tank with a service temperature of –73 °C (–100°F) or less;
    (c) be equipped with an outer jacket of steel;
    (d) be filled to a filling ratio less than or equal to 66; and
    (e) be filled with product at a low enough temperature that at ambient conditions
        (i) if the expected time between loading and delivery is 24 h or less, the tank will vent after more than twice that time; or
        (ii) if the expected time between loading and delivery is greater than 24 h, the tank will vent more than 24 h after that time.
22. Gases with a higher corrosiveness than Classification 1 of ASTM D1838 shall be loaded only in tanks marked "NQT" at or near the tank's metal identification plate(s).
23. *Deleted*

24. Tanks constructed in accordance with CSA B51, Part 1, but not meeting the requirements of specification TC 51 may be offered for transportation, if they are emptied to the greatest extent possible and in no case shall they contain more liquefied gas than 5% of their volumetric capacity.
25. Depending on the specific gravity of the liquid portion of the gas at 15 °C (59°F) listed in column 1 of Table 3, the filling ratio of tanks filled shall not exceed
    (a) that listed in column 2 for tanks of 4540 L (1200 US gal; 1000 Imp. gal) or less; or
    (b) that listed in column 3 for tanks greater than 4540 L (1200 US gal; 1000 Imp. gal).
    Tanks filled by volume using a fixed-length dip-tube as the primary gauging device shall be filled using a filling ratio less than 97% of that specified in Item (a) or (b), as applicable.

Table 3
Filling ratios for liquefied petroleum gases
(See Specific Requirement 25.)

Column 1	Column 2	Column 3
Maximum permitted filling ratio	**Tank volumetric capacity**	
Specific gravity of the liquid material at 15 °C (59°F)	**4540 L (1200 US gal; 1000 Imp. gal) or less**	**Over 4540 L (1200 US gal; 1000 Imp. gal)**
0.473–0.480	38	41
0.481–0.488	39	42
0.489–0.495	40	43
0.496–0.503	41	44
0.504–0.510	42	45
0.511–0.519	43	46
0.520–0.527	44	47
0.528–0.536	45	48
0.537–0.544	46	49
0.545–0.552	47	50
0.553–0.560	48	51
0.561–0.568	49	52
0.569–0.576	50	53
0.577–0.584	51	54
0.585–0.592	52	55
0.593–0.600	53	56
0.601–0.608	54	57
0.609–0.617	55	58
0.618–0.626	56	59
0.627 and over	57	60

26. Gases shall be odorized in accordance with the requirements of either CAN/CGSB-3.13 or CAN/CGSB-3.14.

27. TC 51 and TC 331 tanks shall
    (a) have a MAWP greater than or equal to 1380 kPa, gauge (200 psi);
    (b) if filled by weight, be filled to a filling ratio less than or equal to 53; and
    (c) if filled by volume, be filled to a filling ratio less than or equal to 90.
28. TC 51 and TC 331 tanks shall
    (a) have a minimum MAWP of 1035 kPa, gauge (150 psi); and
    (b) be filled to a filling ratio less than or equal to 59.
29. TC 51 and TC 331 tanks shall
    (a) have a minimum MAWP of 1380 kPa, gauge (200 psi); and
    (b) be filled to a filling ratio less than or equal to 59.
30. Tanks shall
    (a) have a minimum MAWP of 1725 kPa, gauge (250 psi); and
    (b) be filled by weight to a filling ratio less than or equal to 110.
31. Tanks shall be filled by weight to a filling ratio less than or equal to 110.
32. Tanks shall be filled by weight to a filling ratio less than or equal to 60.
33. To determine the maximum filling ratio in accordance with Clause 5.2.4, "98%" in Clause 5.2.4(b) shall be replaced by "95%".
34. TC 51 and TC 331 tanks shall
    (a) if filled by weight, be filled to a filling ratio less than or equal to 80; and
    (b) if filled by volume, be filled to a filling ratio less than or equal to 90.
35. *Deleted*
36. *Deleted*
37. *Deleted*
38. *Deleted*
39. *Deleted*
40. The following requirements shall apply:
    (a) TC 331 and TC 51 tanks shall
        (i) be filled to a filling ratio less than or equal to
            (1) 125, if filled by weight; and
            (2) 87.5, if filled by volume;
        (ii) be furnished with a corrosion allowance of 20% of the shell thickness or 2.5 mm (0.10 in); and
        (iii) have a MAWP greater than or equal to
            (1) 1035 kPa, gauge (150 psi), if smaller than or equal to 4540 L (1200 US gal; 1000 Imp. gal); or
            (2) 865 kPa, gauge (125 psi), if larger than 4540 L (1200 US gal; 1000 Imp. gal).
    (b) TC 51 tanks may be equipped with fusible plugs if
        (i) the volumetric capacity is greater than 910 L (240 US gal; 200 Imp. gal);
        (ii) the tank's MAWP is greater than or equal to 1550 kPa, gauge (225 psi);
        (iii) the fusible plugs are in accordance with CGA S-1.2 and open at 120% of the MAWP or less; and
        (iv) for a tank that is over 760 mm (30 in) in length, each end is equipped with fusible plugs that provide enough venting capacity for the whole tank.
    (c) TC 51 tanks with a maximum volume of 910 L (240 US gal; 200 Imp. gal) volumetric capacity may also be used. They shall be equipped with fusible plugs, shall be filled by mass, and shall have a minimum design pressure of 1550 kPa, gauge (225 psi).
41. Tanks shall be filled to a filling ratio less than or equal to 68.
42. TC 331 and TC 51 tanks shall be
    (a) constructed of stainless steel with head and shell thickness greater than or equal to 6.35 mm (0.25 in) and the thickness required to sustain the MAWP; or
    (b) non-stainless steel with a minimum thickness obtained from one of the following formulas:
    Formula for metric units:

$$e_1 = (12.74e_0) / (Rm_1A_1)^{1/3}$$

Formula for non-metric units:

$$e_1 = (144.74e_0) / (Rm_1A_1)^{1/3}$$

where

e_1 = thickness of non-stainless steel used equivalent to e_0, in millimetres or inches, as applicable

e_0 = required thickness, in millimetres or inches, as applicable, of stainless steel with minimal tensile strength of 517 MPa (75 000 psi) and elongation greater than or equal to 40%

Rm_1 = specified minimum tensile strength of the steel used, in MPa or psi as applicable

A_1 = specified minimum percentage elongation of the steel multiplied by 100 (e.g., 20% times 100 equals 20). Elongation values shall be determined from a 50 mm (2 in) test specimen.

43. TC 331 and TC 51 tanks shall
    (a) have a MAWP greater than or equal to 1035 kPa, gauge (150 psi); and
    (b) be filled by weight to a filling ratio less than or equal to 57.
44. TC 331 and TC 51 tanks shall be
    (a) padded with dry nitrogen or other dry inert gas
        (i) taking into account the solubility of the gas in ethylene oxide to ensure that the vapour phase of the ethylene oxide is non-flammable at 41 °C (106°F) or less; and
        (ii) that is free of impurities that can cause the ethylene oxide to rearrange chemically or to polymerize, decompose, or undergo other violent chemical reaction;
    (b) insulated with mineral wool or glass fibre resulting in thermal conductance at 15 °C (59°F) of not more than 1.5333 kJ/h•m^2/°C (0.075 Btu/h•ft^2/°F);
    (c) covered with a steel jacket of 2.66 mm (12 gauge) or more to prevent moisture from coming in contact with the insulation;
    (d) equipped with pressure-relief devices set to discharge at 517 kPa, gauge (75 psi);
    (e) filled to a filling ratio that prevents the tank from becoming liquid-full at 85 °C (185°F) and that takes into account the partial pressure of the padding gas;
    (f) constructed so that no part normally in contact with ethylene oxide liquid or vapour is made of copper, silver, mercury, magnesium, or their alloys;
    (g) equipped with packings and gaskets
        (i) of material other than neoprene, natural rubber, and asbestos; and
        (ii) that do not react spontaneously with, or lower the auto-ignition temperature of, ethylene oxide; and
    (h) of a volumetric capacity less than or equal to 1135 L (300 US gal; 250 Imp. gal).
45. TC 331 and TC 51 tanks shall have a MAWP greater than or equal to 1725 kPa, gauge (250 psi).
46. Tanks filled by volume shall be equipped with one of the following as the primary gauging device:
    (a) rotary tube;
    (b) fixed-length dip-tube; or
    (c) adjustable slip-tubes.
47. When filling by volume, only fixed-length dip-tube gauging devices shall be permitted.
48. Contents-gauging devices shall not be permitted.
49. TC 331 and TC 51 tanks shall have a MAWP greater than or equal to the vapour pressure of the dangerous goods, plus the lesser of 1% of the vapour pressure and 175 kPa, gauge (25.3 psi), at
    (a) 46 °C (115°F) if the tank volumetric capacity exceeds 4500 L (1200 US gal; 990 Imp. gal); and
    (b) 55 °C (131°F) if the tank volumetric capacity is 4500 L (1200 US gal; 990 Imp. gal) or less.
50. TC 331 and TC 51 tanks shall be
    (a) constructed of stainless steel with head and shell thickness greater than or equal to 7.62 mm (0.30 in) and the thickness required to sustain the MAWP; or
    (b) non-stainless steel with a minimum thickness obtained from one of the following formulas:
    Formula for metric units:

$$e_1 = (12.74e_0) / (Rm_1A_1)^{1/3}$$

Formula for non-metric units:

$$e_1 = (144.74e_0) / (Rm_1A_1)^{1/3}$$

where

e_1 = thickness of non-stainless steel used equivalent to e_0 , in millimetres or inches, as applicable

e_0 = required thickness, in millimetres or inches, as applicable, of stainless steel with minimal tensile strength of 517 MPa (75 000 psi) and elongation greater than or equal to 40%

Rm_1 = specified minimum tensile strength of the steel used, in MPa or psi as applicable

A_1 = specified minimum percentage elongation of the steel multiplied by 100 (e.g., 20% times 100 equals 20). Elongation values shall be determined from a 50 mm (2 in) test specimen.

51. The MAWP shall be greater than or equal to 1.1 times the vapour pressure of the lading at 46 °C (115°F).
52. The MAWP shall be greater than or equal to 1.3 times the vapour pressure of the lading at 46 °C (115°F).
53. TC 331 and TC 51 tanks shall be insulated so that the overall thermal conductance at 15.5 °C (60°F) is not more than 1.5333 kJ/h•m^2/°C (0.075 Btu/h•ft^2/°F).
54. As long as the Specific Requirements 10, 33, 46, and 56 (a) (ii) and (b) are fulfilled, a tank that meets the requirements of the edition of the ASME *Code* under which it was built, and is marked accordingly, may be used if
    (a) it has a MAWP greater than or equal to 1725 kPa, gauge (250 psi);
    (b) it is painted white or aluminum;
    (c) it is periodically inspected and tested in accordance with the requirements for TC 331 tanks in Clause 7 of CSA B620-14;
    (d) it was manufactured and used to transport anhydrous ammonia prior to 1 July 1996;
    (e) it complies with the requirements in Clause 5.2.6 for TC 331 tanks;
    (f) any repairs made after the enforcement date of this Standard have been made in compliance with the requirements for TC 331 tanks in Clause 7.5 of CSA B620-14; and
    (g) it complies with the requirements of the following clauses of CSA B620-09:
        (i) Clause 5.1.3 for securement;
        (ii) Clauses 5.1.5.2 to 5.1.5.4 for rear-end protection;
        (iii) Clause 5.2.2.1 for discharge control devices; and
        (iv) Clause 5.2.2.10.1 for excess flow protection.
55. A tank commonly known as a nurse tank or applicator tank, operated exclusively for agricultural purposes, shall not have to meet the specification requirements for a TC 51 tank or the rear-end protection requirements of Clause 5.2.5(a) if it was manufactured prior to the enforcement date of this standard and
    (a) it is periodically inspected and tested in accordance with the requirements for TC 51 tanks in Clause 7 of CSA B620-14, except that the external visual inspection shall be conducted annually and the pressure test shall be conducted every 3 years;
    (b) it has a MAWP greater than or equal to 1725 kPa, gauge (250 psi), and meets the requirements of the ASME *Code* under which it was built and is marked accordingly;
    (c) it is equipped with safety relief valves meeting the requirements of CGA S-1.2;
    (d) it is painted white or aluminum;
    (e) it has a volumetric capacity of 11 365 L (3000 US gal; 2500 Imp. gal) or less;
    (f) it is loaded to a filling ratio no greater than 56;
    (g) it is securely mounted on a farm wagon or a farm implement; and
    (h) any repairs made after the enforcement date of this Standard have been made in compliance with the requirements for TC 51 tanks in Clause 7.5 of CSA B620-14.
56. The following requirements shall apply:
    (a) TC 331 and TC 51 tanks shall
        (i) have a MAWP greater than or equal to 1827 kPa, gauge (265 psi);

(ii) be filled to a filling ratio equal to or less than
  (1) 56, if filled by weight;
  (2) 82, if filled by volume; or
  (3) 87.5, if filled by volume where
    (A) the tank is uninsulated;
    (B) the temperature of the anhydrous ammonia is not lower than –1 °C (30°F); and
    (C) the filling of such a tank is stopped at the first indication of frost or ice formation on the outside surface of the tank and is not resumed until such frost or ice has disappeared; and

(iii) be constructed of steel that is
  (1) not quenched and tempered (NQT); or
  (2) quenched and tempered (QT) if
    (A) the anhydrous ammonia has a water content greater than or equal to 0.2% by weight; and
    (B) the requirements of Item (b) are complied with.

(b) For tanks of quenched and tempered (QT) steel,
  (i) the documentation required by Part 3 of the *TDG Regulations* shall indicate that the anhydrous ammonia contains at least 0.2% water by weight; or
  (ii) the amount of water in the anhydrous ammonia shall be verified or increased to be in accordance with the following requirements:
    (1) the analysis of water content shall be in accordance with CGA G-2.2 and conducted on a sample
      (A) taken every 7 days from the storage tank used to fill the highway tanks, or whenever new product is added to the storage tank;
      (B) taken from the loading lines or highway tanks (the sample shall be taken from one load out of 10 or taken once every 24 h); and
      (C) if water is added during the loading, taken from the loading line downstream of the point of water injection;
    (2) if any water is added, steam condensate, deionized, or distilled water shall be used; and
    (3) records of analysis shall be retained for two years.

57. Deleted

58. The following requirements shall apply:
(a) TC 331 tanks shall
  (i) have a MAWP greater than or equal to 1550 kPa, gauge (225 psi);
  (ii) be filled by weight to a filling ratio equal to or less than 125;
  (iii) be insulated
    (1) such that the overall thermal conductance at 15 °C (59°F) is less than or equal to 1.65 kJ/h•m^2/°C (0.08 Btu/h•ft^2/°F); and
    (2) on TC 331 tanks, with
      (A) at least 100 mm (4 in) of corkboard or self-extinguishing polyurethane foam; or
      (B) 5 cm (2 in) of ceramic fibre/fibreglass of minimum density of at least 311 kg/m^3 (4 lb/ft^3) covered by 5 cm (2 in) of fibre;
  (iv) be furnished with a corrosion allowance of 20% of the shell thickness or 2.5 mm (0.10 in), and have a minimum wall thickness including corrosion allowance of 7.62 mm (0.30 in) for stainless steel or 15.88 mm (0.625 in) for carbon steel;
  (v) have plates, manway nozzle, and anchorage constructed of the following materials:
    (1) if manufactured on or before 31 December 1974, Class 1, Grade A, flange or firebox quality steel
      (A) conforming to ASTM A300; and
      (B) that has been Charpy keyhole notch impact tested at –45.5 °C (–50°F) in both longitudinal and transverse directions to the rolling; or
    (2) if manufactured on or after 1 January 1975, steel
      (A) conforming to ASTM A612, Grade B, or A516, Grade 65 or 70; and
      (B) that has been Charpy V-notch tested in accordance with ASTM A20;

(vi) be equipped with a single nozzle that shall be located on the top of the tank and shall
  (1) be protected by a dome cover plate or manhole cover that conforms to
    (A) Drawing 103-3, dated 23 January 1958, or Drawing 103-4, dated 1 September 1971, of the Chlorine Institute, if the tank was manufactured on or before 31 December 1974; or
    (B) Drawing 103-4, dated 1 September 1971, of the Chlorine Institute, if the tank was manufactured on or after 1 January 1975; and
  (2) be equipped with a housing and manway cover that conforms to
    (A) Drawing 137-1, dated 7 November 1962, or Drawing 137-2, dated 1 September 1971, of the Chlorine Institute, if the tank was manufactured on or before 31 December 1974; or
    (B) Drawing 137-2, dated 1 September 1971, of the Chlorine Institute, if the tank was manufactured on or after 1 January 1975;

(vii) be equipped with an excess flow valve under each angle valve; these valves shall conform to the following:
  (1) on tanks manufactured on or before 31 December 1974
    (A) for angle valves, Drawing 104-4, dated 5 May 1958, or Drawing 104-5, dated 1 September 1972, of the Chlorine Institute;
    (B) for liquid excess flow valves, Drawing 101-4, dated 16 May 1969, or Drawing 101-6, dated 1 September 1973, of the Chlorine Institute; and
    (C) for vapour excess flow valves, Drawing 106-3, dated 16 May 1969, or Drawing 106-5, dated 1 September 1973, of the Chlorine Institute; and
  (2) on tanks manufactured on or after 1 January 1975
    (A) for angle valves, Drawing 104-5, dated 1 September 1972, of the Chlorine Institute;
    (B) for liquid excess flow valves, Drawing 101-6, dated 1 September 1973, of the Chlorine Institute; and
    (C) for vapour excess flow valves, Drawing 106-5, dated 1 September 1973, of the Chlorine Institute;

(viii) be equipped with a safety relief valve of Chlorine Institute Type 1-1/2 JQ225, conforming to Drawing H-51970, dated 7 October 1968, or Drawing H-50155, Revision A, dated 18 April 1969;

(ix) be equipped with a cap or plug attached to each angle valve that shall securely close the angle valve opening, except during loading or unloading; and

(x) be equipped with angle valves that have been tested prior to initial installation and, once installed, tested according to the schedule of the tank's periodic retesting with dry air or inert gas at 1550 kPa, gauge (225 psi) or more.

(b) TC 51 tanks shall
  (i) have a MAWP greater than or equal to 1550 kPa, gauge (225 psi);
  (ii) be filled by weight to a filling ratio equal to or less than 125; and
  (iii) be insulated such that the overall thermal conductance at 15 °C (59°F) is less than or equal to 1.65 kJ/h•m^2/°C (0.08 Btu/h•ft^2/°F).

59. Deleted

60. TC 331, TC 11, and TC 51 tanks shall
  (a) have a MAWP greater than or equal to
    (i) 1380 kPa, gauge (200 psi); or
    (ii) if constructed in conformity with the low-temperature requirements of the ASME *Code* under which they were built,
      (1) 690 kPa, gauge (100 psi); and
      (2) the control pressure;
  (b) be filled to a filling ratio less than or equal to 95;
  (c) be equipped with a
    (i) pressure-control valve;
    (ii) pressure gauge; and

(iii) shut-off valve between the pressure gauge and the tank that shall remain closed except during loading and unloading;

(d) be insulated such that the overall thermal conductance is not more than 1.65 kJ/h•m^2/°C (0.08 Btu/h•ft^2/°F) at 15 °C (59°F); and

(e) for nitrous oxide, be insulated in accordance with Clause 5.3.2.4.2 of CSA B620-14.

61. TC 331 and TC 51 tanks may be equipped with non-reclosing safety relief devices with set-to-discharge pressures between 1.5 and 2 times the MAWP.

62. TC 331 and TC 338 tanks shall

(a) be equipped with an outer jacket made of steel or stainless steel;

(b) be insulated and comply with the low-temperature requirements of the ASME *Code* under which they were built, for an insulated tank with a service temperature of less than or equal to

(i) –73 °C (–100°F); or

(ii) the boiling point of the lading at 1 atmosphere of pressure;

(c) be filled with product at a low enough temperature that at ambient conditions

(i) if the expected time between loading and delivery is 24 h or less, the tank will vent after more than twice that time; or

(ii) if the expected time between loading and delivery is greater than 24 h, the tank will vent more than 24 h after that time;

(d) for ethane, refrigerated liquid, have a MAWP equal to or greater than 690 kPa, gauge (100 psi); and

(e) be filled to a filling ratio less than or equal to

(i) for hydrogen chloride

(1) 103, if the MAWP is between 690 and 2070 kPa, gauge (100 and 300 psi);

(2) 91, if the MAWP is greater than 2070 but less than 3105 kPa, gauge (300 but less than 450 psi); or

(3) 86.7, if the MAWP is greater than or equal to 3105 kPa, gauge (450 psi); and

(ii) a filling ratio that results in an outage of at least 2% under the inlet of the pressure-relief valve or the pressure-control valve.

63. TC 338 tanks shall

(a) after every trip where the actual holding time, adjusted to 29 °C (85°F), is less than 90% of the marked rated holding time (MRHT) marked on the plate, be re-marked with a lower MRHT, unless the tank is restored to the marked MRHT; and

(b) not be refilled until the metal identification plate is re-marked or the tank is restored to the marked MRHT.

64. The following requirements shall apply:

(a) TC 338 tanks shall be marked on the right side of the tank, near the front, in characters at least 5 cm (2 in) high, with

(i) "One Way Travel Time = ___hrs" or "OWTT = ___hrs", with the number of hours as calculated in Item (ii); and

(ii) the number of hours (n) determined in accordance with the following:

(1) if the MRHT is greater than 72 h, then n = (MRHT – 48 h); or

(2) if the MRHT is less than or equal to 72 h, then n = (MRHT– 24 h)/2.

(b) Where the tank is partially unloaded, the marking shall include "One Way Travel Time = " or "OWTT = ", and

(i) the OWTT determined in accordance with Item (a)(ii) followed by "hrs";

(ii) the pressure in kPa after the unloading, followed by "kPa to", followed by the filling ratio after the unloading, followed by the words "per cent filling density"; and

(iii) the set-to-discharge pressure of the pressure-control valve or pressure-relief valve, followed by "kPa at", followed by the filling ratio after the unloading, followed by the words "per cent filling density".

(c) Multiple OWTT markings for different pressure ranges shall be permitted.

65. Highway tanks and portable tanks shall be cleaned according to CGA G-4.1 prior to their first use in transporting either oxygen, refrigerated liquid, or nitrous oxide, refrigerated liquid, and any time thereafter when the lading has been contaminated.

66. Except as permitted in Specific Requirement 69, highway tanks shall be TC 338.
67. TC 338 tanks shall
    (a) have a design service temperature of
        (i) –196 °C (–320°F) or less; and
        (ii) for helium, refrigerated liquid, –269 °C (–452°F) or less;
    (b) depending on the pressure-control valve setting listed in column 2 of Table 4, be filled to a filling ratio less than or equal to
        (i) that listed in column 3 for argon, column 4 for helium, column 5 for nitrogen, column 6 for oxygen, and column 7 for air, of the same item number listed in column 1; and
        (ii) except for helium, refrigerated liquid, a filling ratio that results in an outage of at least 2% under the inlet of the pressure-relief valve or the pressure-control valve; and
    (c) if used to transport oxygen
        (i) not be equipped with any part made of aluminum that can contact the lading unless the aluminum is anodized in accordance with ASTM B580;
        (ii) be equipped with a manhole; and
        (iii) be equipped with an outer jacket made of steel.

Table 4
Maximum filling ratios* for argon, helium, nitrogen, oxygen, and air, refrigerated liquids

(See Specific Requirement 67.)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Item	Pressure-control valve setting, kPa, gauge (psi)	Argon, refrigerated liquid, UN1951, at design service temperature –196 °C (–320°F)	Helium, refrigerated liquid, UN1963, at design service temperature –269 °C (– 452°F)	Nitrogen, refrigerated liquid, UN1977, at design service temperature –196 °C (–320°F)	Oxygen, refrigerated liquid, UN1073, at design service temperature –196 °C (–320°F)	Air, refrigerated liquid, UN1003
1	180 (26)	—	12.5	—	—	—
2	207 (30)	129	12.5	74	105	80.3
3	276 (40)	—	12.5	—	—	79.2
4	345 (50)	—	12.5	—	—	78
5	380 (55)	125	12.5	71	102	77.3
6	415 (60)	—	12.5	—	—	76.9
7	552 (80)	—	12.5	—	—	75.3
8	586 (85)	121	12.5	—	99	75.1
9	690 (100)	—	12.5	—	—	73
10	724 (105)	—	12.5	67	—	72.7
11	828 (120)	—	12.5	—	—	72.2
12	965 (140)	—	12.5	—	—	71.4

(Continued)

Table 4 (Concluded)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Item	Pressure-control valve setting, kPa, gauge (psi)	Argon, refrigerated liquid, UN1951, at design service temperature –196 °C (–320°F)	Helium, refrigerated liquid, UN1963, at design service temperature –269 °C (– 452°F)	Nitrogen, refrigerated liquid, UN1977, at design service temperature –196 °C (–320°F)	Oxygen, refrigerated liquid, UN1073, at design service temperature –196 °C (–320°F)	Air, refrigerated liquid, UN1003
13	1000 (145)	115	12.5	64	94	70.9
14	1241 (180)	—	12.5	—	—	68.3
15	1379 (200)	110	12.5	61	91	67.3
16	1724 (250)	106	12.5	57	87	63.3
17	1896 (275)	105	12.5	56	86	62.3
18	2241 (325)	101	12.5	53	83	59.4

*****_Filling ratio means the ratio, expressed as a percentage, of the mass of the refrigerated liquefied gas in the tank to the mass of water that the tank would hold at its design service temperature, on the basis of water density at_ 1000 kg/m^3 _(8.328 lb/US gal; 10 lb/Imp. gal)._

68. TC 338 tanks shall
    (a) be equipped with an outer jacket made of steel;
    (b) not be equipped with any part made of aluminum that could contact the lading;
    (c) have a design service temperature of
        (i) –104 °C (–155°F) if used to transport ethylene, refrigerated liquid;
        (ii) –253 °C (– 423°F) if used to transport hydrogen, refrigerated liquid; and
        (iii) –162 °C (–260°F) if used to transport methane, refrigerated liquid; and
    (d) depending on the pressure-control valve setting listed in column 2 of Table 5, be filled to a filling ratio equal to or less than
        (i) that listed in column 3 for ethylene, column 4 for hydrogen, and column 5 for methane of the same item number listed in column 1; and
        (ii) a filling ratio that results in an outage of at least 2% under the inlet of the pressure-relief valve or the pressure-control valve.

Table 5
Maximum filling ratios* for ethylene, hydrogen, and methane, refrigerated liquids

(See Specific Requirement 68.)

Column 1	Column 2	Column 3	Column 4	Column 5
Item	Pressure-control valve setting, kPa, gauge (psi)	Ethylene, refrigerated liquid, UN1038, at design service temperature –104 °C (–155°F)	Hydrogen, refrigerated liquid, UN1966, at design service temperature –253 °C (– 423°F)	Methane, refrigerated liquid, UN1972, at design service temperature –162 °C (–260°F)
1	90 (13)	—	6.6	—
2	103 (15)	—	6.6	40.5
3	117 (17)	—	6.6	—
4	138 (20)	53.5	—	40.0
5	175 (25)	—	—	—
6	207 (30)	52.7	6.3	39.1
7	240 (35)	—	—	—
8	276 (40)	52.0	—	38.6
9	310 (45)	—	—	—
10	345 (50)	51.4	6.0	38.2
11	380 (55)	—	—	—
12	415 (60)	50.8	—	—
13	483 (70)	50.2	5.7	37.5
14	620 (90)	49.2	—	—
15	655 (95)	—	—	—
16	690 (100)	48.4	5.4	36.6
17	793 (115)	48.2	—	—
18	862 (125)	—	5.0	—
19	1 207 (175)	45.8	—	—
20	1 965 (285)	—	—	—

**Filling ratio means the ratio, expressed as a percentage, of the mass of the refrigerated liquefied gas in the tank to the mass of water that the tank would hold at its design service temperature, on the basis of water density at* 1000 kg/m^3 *(8.328 lb/US gal; 10 lb/Imp. gal).*

69. TC 341 tanks may be used if the tank
    (a) is equipped with a pressure-control valve set to release pressure at 175 kPa, gauge (25.3 psi) or less; and
    (b) has a design service temperature of –196 °C (–320°F) or less.

70. Tanks shall have a minimum MAWP of 1725 kPa, gauge (250 psi) or as specified in Clause 5.2.2.1(b), whichever is greater.
71. Tanks shall have a minimum MAWP of 2585 kPa, gauge (375 psi) or as specified in Clause 5.2.2.1(b), whichever is greater.
72. Tanks shall have
    (a) all valve outlets sealed with a threaded cap or solid threaded plug;
    (b) all valves protected by a metal cover; and
    (c) all fusible-plug-type safety relief devices
        (i) with a yield temperature greater than or equal to 69 °C (157°F), and less than or equal to 77 °C (170°F); and
        (ii) resistant to extrusion of the fusible alloy and leak-tight at 55 °C (131°F).
73. A tank securely mounted on a skid package designed to facilitate mounting and removal from a flat-deck vehicle and operated exclusively for agricultural purposes is not required to meet the specification requirements for a TC 51 tank if
    (a) it was constructed prior to 1 July 1998;
    (b) it is periodically inspected and tested in accordance with the requirements for TC 331 tanks in Clause 7 of CSA B620-14;
    (c) it has a MAWP greater than or equal to 1725 kPa, gauge (250 psi), meeting the requirements of the edition of the ASME *Code* under which it was built, and is marked accordingly;
    (d) it is equipped with safety relief valves meeting the requirements of CGA S-1.2;
    (e) it is painted white or aluminum;
    (f) it has a volumetric capacity of 11 365 L (3000 US gal; 2500 Imp. gal) or less;
    (g) it is loaded to a filling ratio no greater than 56;
    (h) it complies with the requirements in Clause 5.2.6 for TC 51 tanks;
    (i) any repairs made after the enforcement date of this Standard have been made in compliance with the requirements for TC 331 tanks in Clause 7.5 of CSA B620-14; and
    (j) it complies with the requirements of the following clauses of CSA B620-09:
        (i) Clauses 5.1.5.2 to 5.1.5.4 for rear-end protection;
        (ii) Clause 6.1.5 (b) and (c) for securement;
        (iii) Clause 6.2.9.1 for excess flow protection; and
        (iv) Clause 6.2.9.2 for manual shut-off.
74. These dangerous goods shall not be transported by road, except in ton containers selected and used as specified in CAN/CGSB-43.147 and in Clause 4.3 of this Standard.
75. Tanks shall be TC 11 and
    (a) have a design service temperature of
        (i) –196 °C (–320°F) or less; or
        (ii) for helium, refrigerated liquid, –269 °C (– 452°F) or less; and
    (b) if used to transport oxygen, shall not be equipped with any part made of aluminum that could contact the lading.
76. Notwithstanding the requirements of Clause 5.2.1.10(8)(b) of CAN/CSA-B620-98, Clause 5.3 Section 178.337-11(c) of CSA B620-1987, and Section 178.337-8(a)(5)(i) of 49 CFR, an internal self-closing stop valve is not required on a vapour opening of a TC 331, MC 331, or MC 330 tank if
    (a) the vapour opening is 32 mm (1-1/4 in) NPT or less and equipped with an excess flow valve together with a manually operated external stop valve;
    (b) the tank volumetric capacity is less than 22 680 L (6000 US gal); and
    (c) the tank was manufactured prior to 1 January 2003.

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