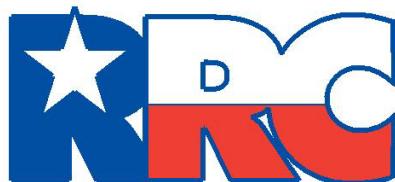


TEXAS LNG EXAMINATION STUDY GUIDE

Category 15
Container Manufacturer
and/or Fabricator
Management Level



RAILROAD COMMISSION OF TEXAS

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LNG EXAMINATION STUDY GUIDE

Management-LEVEL

Container Manufacturer and/or Fabricator

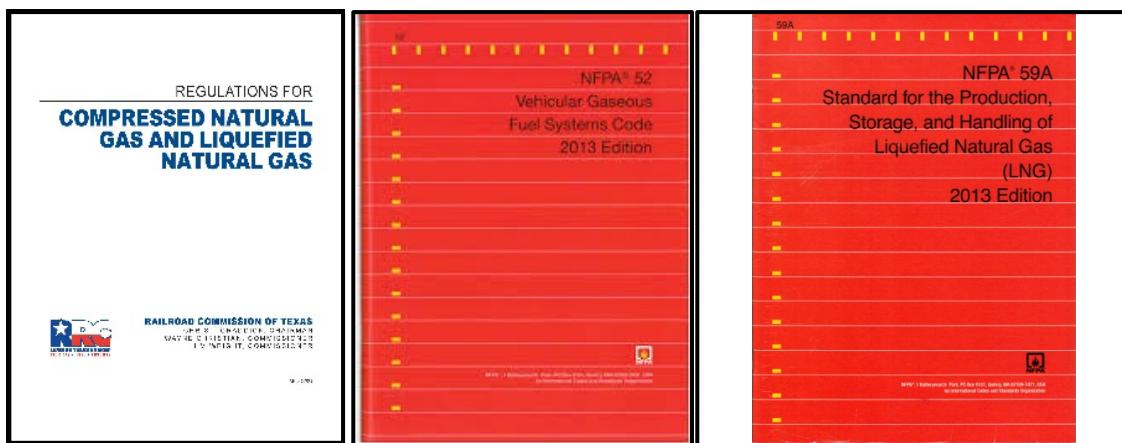
Management Level

Who should use this guide?

You should use this guide if you plan to take the Railroad Commission's management-level qualifying examination to perform LNG Container Manufacturer and/or Fabricator activities.

A **Category 15** examination qualifies an individual to assemble, repair, install, test, and sell LNG containers, including LNG motor or mobile fuel containers and systems, and to repair transport and transfer systems for use in Texas.

What books do I need?



This examination tests your knowledge of the laws and standards that apply to Container Manufacturer and/or Fabricator Management Level operations in Texas.

These laws and standards are found in:

Regulations for Compressed Natural Gas and Liquified Natural Gas (Texas Railroad Commission)
NFPA 52, Vehicular Natural Gas Fuel Systems Code (2013 Edition)
NFPA 59A, Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)
(2013 Edition)

Where do I get these books?

You may download or print the current edition of the Railroad Commission's Regulations for Compressed Natural Gas and Liquified Natural Gas in PDF format online at <https://www.rrc.texas.gov/alternative-fuels/alternative-fuels-regulations>. To order additional copies of the LP-Gas Safety Rules, please contact the Railroad Commission's Central Records Section at PublicSales@rrc.texas.gov or (512) 463-6882.

You may also order NFPA manuals online at www.nfpa.org; click on "Codes and Standards."

Sections and Topics

Before you take this examination, you should know the definitions found in this study guide and the contents of the sections of the codes and standards listed below. The actual examination questions may not cover all of the listed sections and topics.

Terms and Definitions

NOTE: The list below is **not** exhaustive.

You are responsible for knowing all the terms and definitions that apply to the CNG activities you will perform, as well as the rules and standards highlighted in this guide.

Regulations for Compressed Natural Gas and Liquified Natural Gas (2023)

Aggregate water capacity (AWC)--The sum of all individual container capacities as measured by weight or volume of water which are placed at a single installation location.

Regulations for LNG, §14.2007(2)

Automatic fuel dispenser--A fuel dispenser which requires transaction authorization.

Regulations for LNG, §14.2007(6)

Commercial installation--An LNG equipment installation located on premises other than a single-family dwelling used primarily as a residence.

Regulations for LNG, §14.2007(10)

Conversion--The changes made to a vehicle to allow it to use LNG as a motor fuel.

Regulations for LNG, §14.2007(15)

Ignition source--Any item, substance, or event having adequate temperature and energy release of the type and magnitude sufficient to ignite any flammable mixture of gases or vapors that could occur at a site.

Regulations for LNG, §14.2007(22)

LNG--Natural gas, consisting primarily of methane in liquid or semisolid state.

Regulations for LNG, §14.2007(28)

LNG system--A system of safety devices, containers, piping, fittings, valves, regulators, and other LNG equipment intended for use or used with a motor vehicle fueled by LNG and any system or other facilities designed to be used or used in the sale, storage, transportation for delivery, or distribution of LNG.

Regulations for LNG, §14.2007(29)

LNG transport--Any vehicle or combination of vehicles and LNG containers designed or adapted for use or used principally as a means of moving or delivering LNG from one place to another, including but not limited to any truck, trailer, semi-trailer, cargo tank, or other vehicle used in the distribution of LNG.

Regulations for LNG, §14.2007(30)

Mass transit vehicle--Any vehicle which is owned or operated by a political subdivision of a state, city, or county, and which is used primarily in the conveyance of the general public.

Regulations for LNG, §14.2007(31)

Mobile fuel container--An LNG container mounted on a vehicle to store LNG as the fuel supply for uses other than the engine to propel the vehicle, including use in an auxiliary engine.

Regulations for LNG, §14.2007(33)

Pressure relief device--A device, including a pressure relief valve, which is designed both to open automatically to prevent a continued rise of internal fluid pressure in excess of a specified value (set pressure) and to close when the internal fluid pressure is reduced below the set pressure.

Regulations for LNG, §14.2007(44)

Pressure vessel--A container or other component designed in accordance with the ASME Code.

Regulations for LNG, §14.2007(45)

PSIG--Pounds per square inch gauge.

Regulations for LNG, §14.2007(47)

Public Transportation Vehicle--A vehicle for hire to transport persons, including but not limited to taxis, buses (excluding school buses, mass transit or special transit vehicles), and airport courtesy cars.

Regulations for LNG, §14.2007(48)

Special Transit Vehicle--A vehicle designed with limited passenger capacity which is primarily used by a mass transit authority for special transit purposes such as transport of mobility impaired individuals.

Regulations for LNG, §14.2007(55)

Trainee--An individual who has not yet taken and passed an employee-level rules examination.

Regulations for LNG, §14.2007(57)

Transfer area--That portion of an LNG refueling station where LNG is introduced into or dispensed from a stationary installation.

Regulations for LNG, §14.2007(58)

Transfer system--All piping, fittings, valves, pumps, meters, hoses, bulkheads, and equipment used in transferring LNG between containers.

Regulations for LNG, §14.2007(59)

Transport--Any container built in accordance with ASME or DOT specifications and used to transport LNG for delivery.

Regulations for LNG, §14.2007(60)

Transport system--Any and all piping, fittings, valves, and equipment on a transport, excluding the container.

Regulations for LNG, §14.2007(61)

Ultimate consumer--The person controlling LNG immediately prior to its ignition.

Regulations for LNG, §14.2007(62)

NFPA 52 (2013)

ASME Code. The American Society of Mechanical Engineers *Boiler and Pressure Vessel Code*.

NFPA 52, §3.3.3

Container. A pressure vessel, cylinder, or cylinder(s) permanently manifolded together used to store CNG or LNG.

NFPA 52, §3.3.9

Cargo Transport Container. A mobile unit designed to transport LNG or CNG.

NFPA 52, §3.3.9.1

Composite Container. A container consisting of an inner metal or plastic gas-containing component, reinforced with a filament and resin outer layer.

NFPA 52, §3.3.9.2

Fuel Supply Container. A container mounted on a vehicle to store LNG or CNG as the fuel supply to the vehicle.

NFPA 52, §3.3.9.3

Fueling Facility Container. Primary storage for vehicular fueling.

NFPA 52, §3.3.9.4

Dispensing Station. A natural gas installation that dispenses CNG or LNG from storage containers or a distribution pipeline into vehicular fuel supply containers or into portable cylinders by means of a compressor, reformer, vaporizer, or pressure booster.

NFPA 52, §3.3.18

DOT. U.S. Department of Transportation.

NFPA 52, §3.3.19

Liquefied Natural Gas (LNG). A fluid in the cryogenic liquid state that is composed predominantly of methane.

NFPA 52, §3.3.30

Piping. A means of transporting natural gas. This term applies to refueling facilities.

NFPA 52, §3.3.42

Point of Transfer. The location where connections and disconnections are made.

NFPA 52, §3.3.43

Pressure.

Compression Discharge Pressure. The varying pressure at the point of discharge from the compressor.

NFPA 52, §3.3.44.1

Maximum Allowable Working Pressure (MAWP). The maximum pressure to which any component or portion of the pressure system can be subjected over the entire range of design temperatures. This value is $1.1 \times 1.25 \times$ the service pressure.

NFPA 52, §3.3.44.2

Operating Pressure. The varying pressure in a fuel supply container during normal container use.

NFPA 52, §3.3.44.3

Maximum Operating Pressure. The steady-state gauge pressure at which a part or system normally operates. This value is $1.25 \times$ the pressure.

NFPA 52, §3.3.44.3.1

Set Pressure. The start-to-discharge pressure for which a relief valve is set and marked.

NFPA 52, §3.3.44.5

Settled Pressure. The pressure in a container after the temperature of the gas reaches equilibrium.

NFPA 52, §3.3.44.6

Storage Pressure. The varying pressure in the storage containers.

NFPA 52, §3.3.44.7

Pressure Regulator. A device, either adjustable or nonadjustable, for controlling and maintaining, within acceptable limits, a uniform outlet pressure.

NFPA 52, §3.3.45

Vaporizer. A device other than a container that receives LNG in liquid form and adds sufficient heat to convert the liquid to a gaseous state, or a device used to add heat to LNG for the purpose of saturating LNG.

NFPA 52, §3.3.59

Water Capacity. The amount of water at 60°F required to fill a container.

NFPA 52, §3.3.63

NFPA 59A (2013)

Components. A part, or a system of parts, that functions as a unit in an LNG plant and could include, but is not limited to, piping, processing equipment, containers, control devices, impounding systems, electrical systems, security devices, fire control equipment, and communication equipment.

NFPA 59A, §3.3.4

Design Pressure. The pressure used in the design of equipment, a container, or a pressure vessel for the purpose of determining the minimum allowable thickness or physical characteristics of its parts.

NFPA 59A, §3.3.7

LNG Plant. A facility whose components can be used to store, condition, liquefy, or vaporize natural gas.

NFPA 59A, §3.3.16

Overfilling. Filling to a level above the maximum design liquid level.

NFPA 59A, §3.3.21

Sources of Ignition. Appliances or equipment that, because of their intended modes of use or operation, are capable of providing sufficient thermal energy to ignite flammable gas-air mixtures.

NFPA 59A, §3.3.24

Sample Question 1

Pressure Vessel is defined as a container or other component designed in accordance with the _____ Code.

- A. Railroad Commission
- B. DOT
- C. ASME
- D. Federal

Answer on last page.

CFR Title 49 (2020)

Design service temperature means the coldest temperature for which the tank is suitable.

49 CFR, §178.338-1(a)(2)

Key Topics

NOTE: The list below is **not** exhaustive.

You are responsible for knowing all the facts, rules, standards and procedures that apply to the Natural Gas activities you will perform, as well as the rules and standards highlighted in this guide.

When you take the examination, read each question very carefully.

ADMINISTRATIVE RULES - GENERAL REQUIREMENTS

Company License

A Category 15 license for container assembly and repair authorizes the assembly, repair, installation, subframing, testing, and sale of LNG containers, including LNG motor or mobile fuel containers and systems, and the repair and installation of transport and transfer systems. The original license fee is \$1,000; the renewal fee is \$600.

Regulations for LNG, §14.2013(b)(1)

No person may engage in any LNG activities until that person has obtained a license from the Commission authorizing the LNG activities.

Regulations for LNG, §14.2014(a)

Licensees, registered manufacturers, company representatives, and operations supervisors at each outlet shall have copies of all current licenses and/or manufacturer registration certificates and certification cards for employees at that location available for inspection during regular business hours.

Regulations for LNG, §14.2014(c)

Licenses and manufacturer registrations issued under this chapter expire one year after issuance at midnight on the last day of the month prior to the month in which they are issued.

Regulations for LNG, §14.2014(d)

Applicants for a new license shall file with AFS:

(1) a properly completed LNG Form 2001 listing all names under which LNG-related activities requiring licensing are to be conducted and the applicant's properly qualified company representative, and the following forms or documents as applicable:

(A) LNG Form 2001A if the applicant will operate any outlets pursuant to subsection (g) of this section;
(B) LNG Form 2007, 2007A or 2007T and any information requested in §14.2704 of this title if the applicant intends to register any LNG transports;

(C) LNG Form 2019 if the applicant will be transferring the operation of an existing storage or retail facilities;

(D) any form required to comply with §14.2031 of this title (relating to Insurance Requirements);
Railroad Commission of Texas Regulations for Compressed Natural Gas and Liquefied Natural Gas – 75
(E) a copy of current certificate of account status if required by §14.2028 of this title; and/or (F) copies of the assumed name certificates if required by §14.2028 of this title

Regulations for LNG, §14.2014(f)(1)

Application for a New Certificate

In addition to NFPA 52 §§4.1 and 4.2 and 59A §14.9, no person shall perform work, directly supervise LNG activities, or be employed in any capacity requiring contact with LNG unless that individual:

- (A) is a certificate holder who is in compliance with renewal requirements in subsection (g) of this section and is employed by a licensee; or
- (B) is a trainee who complies with subsection (f) of this section.

Regulations for LNG, §14.2019(a)(1)

An individual who passes the applicable rules examination with a score of at least 75% will become a certificate holder. AFS will send a certificate to the licensee listed on LNG Form 2016

- (A) Successful completion of any required examination shall be credited to the individual.
- (B) An individual who has been issued a certificate shall make the certificate readily available and shall present it to any Commission employee or agent who requests proof of certification.

Regulations for LNG, §14.2019(b)(1)

Certificate Renewal

Certificate holders shall pay the nonrefundable \$25 annual certificate renewal fee to AFS on or before May 31 of each year. Individuals who hold more than one certificate shall pay only one annual renewal fee.

- (A) Failure to pay the nonrefundable annual renewal fee by the deadline shall result in a lapsed certificate.
 - (i) To renew a lapsed certificate, the individual shall pay the nonrefundable \$25 annual renewal fee plus a nonrefundable \$20 late-filing fee. Failure to do so shall result in the expiration of the certificate.
 - (ii) If an individual's certificate lapses or expires, that individual shall immediately cease performance of any LNG activities authorized by the certificate.
 - (iii) If an individual's certificate has been expired for more than two years from May 31 of the year in which the certificate lapsed, that individual shall comply with the requirements of subsection (b) of this section.

Regulations for LNG, §14.2019(g)(3)

Rules Examination

An individual who files LNG Form 2016 and pays the applicable nonrefundable examination fee may take the rules examination.

Regulations for LNG, §14.2019(b)(3)

Failure of any examination shall immediately disqualify the individual from performing any LNG related activities covered by the examination which is failed, except for activities covered by a separate examination which the individual has passed.

Regulations for LNG, §14.2019(e)

Trainees

A licensee or ultimate consumer may employ an individual as a trainee for a period not to exceed 45 calendar days without that individual having successfully completed the rules examination.

(A) The trainee shall be directly and individually supervised at all times by an individual who has successfully completed the Commission's rules examination for the areas of work being performed by the trainee.

(B) A trainee who has been in training for a total period of 45 days, in any combination and with any number of employers, shall cease to perform any LNG activities for which the trainee is not currently certified, until the trainee successfully completes the rules examination.

Regulations for LNG, §14.2019(f)

Designation and Responsibilities of Company Representatives and Operations Supervisors

An applicant for license shall not engage in LNG activities until it has employed a company representative who meets the requirements of §14.2025 of this title.

Regulations for LNG, §14.2014(b)

Licensees, registered manufacturers, company representatives, and operations supervisors at each outlet shall have copies of all current licenses and/or manufacturer registration certificates and certification cards for employees at that location available for inspection during regular business hours. In addition, licensees and registered manufacturers shall maintain a current version of the rules in this chapter and any adopted codes covering LNG activities performed by the licensee or manufacturer, and shall provide at least one copy of all publications to each company representative and operations supervisor. The copies shall be available to employees during business hours.

Regulations for LNG, §14.2014(c)

Each licensee shall have at least one company representative for the license and at least one operations supervisor for each outlet.

(1) A licensee maintaining one or more outlets shall file LNG Form 2001 with AFS listing the physical location of the first outlet and designating the company representative for the license and file LNG Form 2001A designating the physical location and operations supervisor for each additional outlet.

(2) A licensee may have more than one company representative.

(3) An individual may be an operations supervisor at more than one outlet provided that: (A) each outlet has a designated LNG certified employee responsible for the LNG activities at that outlet; (B) the certified employee's and/or operations supervisor's telephone number is posted at the outlet on a sign with lettering at least 3/4 inches high, visible and legible during normal business hours; and (C) the certified employee and/or operations supervisor monitors the telephone number and responds to calls during normal business hours.

(4) The company representative may also serve as operations supervisor for one or more of the licensee's outlets provided that the person meets both the company representative and operations supervisor requirements in this section.

(5) A licensee shall immediately notify AFS in writing upon conclusion of employment, for whatever reason, of its company representative or any operations supervisor and shall at the same time designate a replacement.

(A) A licensee shall cease all LNG activities if it no longer employs a qualified company representative who complies with the Commission's requirements. A licensee shall not resume LNG activities until such time as it has a properly qualified company representative.

(B) A licensee shall cease LNG activities at an outlet if it no longer employs a qualified operations supervisor at that outlet who complies with the Commission's requirements. A licensee shall not resume LNG activities at that outlet until such time as it has a properly qualified operations supervisor.

Regulations for LNG, §14.2025(a)

A company representative shall:

- (1) be an owner or employee of the licensed entity;
- (2) be the licensee's principal individual in authority and be responsible for actively supervising all LNG activities conducted by the licensee, including all equipment, container, product, and system activities;
- (3) have a working knowledge of the licensee's LNG activities to ensure compliance with the rules in this chapter and the Commission's administrative requirements;
- (4) pass the appropriate management level rules examination;
- (5) be directly responsible for all employees performing their assigned LNG activities, unless an operations supervisor is fulfilling this requirement; and
- (6) submit any additional information as deemed necessary by AFS.

Regulations for LNG, §14.2025(b)

Qualified Personnel

The installation of LNG and CNG systems shall be supervised by qualified personnel with reference to their construction and use.

NFPA 52, §4.2

Qualification of Personnel. All persons employed in handling and dispensing LNG shall be trained in handling and operating duties and procedures.

NFPA 52, §12.4.1

Training shall be conducted upon employment and every 2 years thereafter.

NFPA 52, §12.4.3

Training shall include the following:

- (1) Information on the nature, properties, and hazards of LNG in both the liquid and gaseous phases
- (2) Specific instructions on the facility equipment to be used
- (3) Information on materials that are compatible for use with LNG
- (4) Use and care of protective equipment and clothing
- (5) Standard first aid and self-aid instruction
- (6) Response to emergency situations such as fires, leaks, and spills
- (7) Good housekeeping practices
- (8) Emergency response plan as required in 12.2.3
- (9) Evacuation and fire drills.

NFPA 52, §12.4.4

Sample Question 2

An individual who files an LNG Form _____ and pays the applicable nonrefundable examination fee may take the rules examination.

- A. 16
- B. 2001
- C. 2007
- D. 2016
- E. 2018B

Answer on last Page

Report of LP-Gas Incident/Accident

At the earliest practical moment or within two hours following discovery, a licensee owning, operating, or servicing equipment or an installation shall notify AFS by telephone of any incident or accident involving LNG which:

- (1) involves a single release of LNG during or following LNG transfer or during container transportation. Any loss of LNG which is less than 1.0% of the gross amount delivered, stored, or withdrawn need not be reported. Any loss occurring as a result of a pullaway shall be reported;
- (2) caused an estimated damage to the property of the operator, others, or both totaling \$50,000 or more, including gas loss;
- (3) caused a death or any personal injury requiring hospitalization;
- (4) required taking an operating facility out of service;
- (5) resulted in an unintentional ignition of LNG requiring an emergency response;
- (6) involved the LNG installation on any vehicle propelled by or transporting LNG;
- (7) could reasonably be judged as significant because of rerouting of traffic, evacuation of buildings, or media interest, even though it does not meet paragraphs (1) - (6) of this subsection; or
- (8) is required to be reported to any other state or federal agency (such as the Texas Department of Public Safety or U.S. Department of Transportation).

Regulations for LNG, §14.2049

Portable or wheeled fire extinguishers shall be recommended for gas fires by their manufacturer.

NFPA 59A, §12.6.1

Portable or wheeled fire extinguishers shall be available at strategic locations, as determined in accordance with 12.2.1, within an LNG facility and on tank vehicles.

NFPA 59A, §12.6.1.1

Portable and wheeled fire extinguishers shall conform to the requirements of NFPA 10, *Standard for Portable Fire Extinguishers*.

NFPA 59A, §12.6.1.2

Handheld portable dry chemical extinguishers shall contain minimum nominal agent capacities of 20 lb. or greater and shall have a minimum 1 lb./sec agent discharge rate.

NFPA 59A, §12.6.1.3

Control systems that are used as part of the fire protection system at the LNG plant shall be inspected and tested in accordance with the applicable fire codes.

NFPA 59A, §14.8.10.4

General Rules for Stationary LNG Installations

Testing of Containers

Any stationary LNG container previously in LNG service brought into Texas or which has not been subject to continuous LNG pressure or inert gas pressure shall be inspected by a currently licensed Category 15, 20, or 50 licensee to determine if the container shall be leak-tested or re-certified. A copy of the inspector's written report shall be filed with AFS. The container shall not be used until the appropriate leak test or certification process determines the container is safe for LNG service.

Regulations for LNG, §14.2104(b)

Any stationary LNG container which has been subject to continuous LNG or inert gas pressure may not require testing prior to installation provided the licensee or operator of the container files LNG Form 2023 at the time LNG Form 2500 is submitted for any facility requiring submission of a site plan in accordance with §14.2040 of this title (relating to Filings for Stationary LNG Installations).

Regulations for LNG, §14.2104(c)

Each container shall be identified by the attachment of a nameplate(s) in an accessible location marked with the information required by the ASME *Boiler and Pressure Vessel Code* and the following:

- (1) Builder's name and date container was built
- (2) Nominal liquid capacity
- (3) Design pressure at the top of the container
- (4) Maximum permitted liquid density
- (5) Maximum filling level
- (6) Minimum design temperature.

NFPA 52, §13.3.16

Installation of Valves

Extended bonnet valves shall be installed with packing seals in a position that prevents leakage or malfunction due to freezing.

NFPA 59A, §9.4.2.1

Where the extended bonnet in a cryogenic liquid line is installed at an angle greater than 45 degrees from the upright vertical position, it shall be demonstrated to be free of leakage and frost under operating conditions.

NFPA 59A, §9.4.2.2

Shutoff valves shall be installed on container, tank, and vessel connections, except for the following:

- (1) Connections for relief valves in accordance with the ASME *Boiler and Pressure Vessel Code*, Section VIII, Division 1, UG-125(d) and Appendix M-5
- (2) Connections for liquid level alarms as required by 10.2.1.3 or 13.15.2 if an ASME container
- (3) Connections that are blind flanged or plugged.

NFPA 59A, §9.4.2.3

Liquid Level Gauging

Gauging devices shall be designed and installed so that they can be replaced without taking the container out of operation.

NFPA 59A, §10.2.1.2

Pressure Gauging

Each container shall be equipped with a pressure gauge connected to the container at a point above the maximum intended liquid level.

NFPA 59A, §10.3

Emergency Procedures

Facility operators shall prepare and implement a maintenance program for all plant fire protection equipment.

NFPA 59A, §12.7

Each facility shall have a written manual of emergency procedures that shall include the types of emergencies that are anticipated from an operating malfunction, structural collapse of part of the facility, personnel error, forces of nature, and activities carried on adjacent to the facility, including the following:

(1) Procedures for responding to controllable emergencies, including notification of personnel and the use of equipment that is appropriate for handling of the emergency and the shutdown or isolation of various portions of the equipment and other applicable steps to ensure that the escape of gas or liquid is promptly cut off or reduced as much as possible

(2) Procedures for recognizing an uncontrollable emergency and for taking action to ensure that harm to the personnel at the facility and to the public is minimized

(3) Procedures for the prompt notification of the emergency to the appropriate local officials, including the possible need to evacuate persons from the vicinity of the facility

(4) Procedures for coordinating with local officials in the preparation of an emergency evacuation plan that sets forth the steps necessary to protect the public in the event of an emergency.

NFPA 59A, §13.18.3.1

(a) The emergency procedure manual required in NFPA 59A §13.18.3.1 shall be available in the operating area and shall be updated as required by changes in equipment or procedures

(b) In addition to NFPA 59A §12.7, safety and fire protection equipment shall be visually inspected at least once a month and tested at least once a year. Documentation shall be maintained on inspections and tests for at least two years or consistent with other safety record retention schedules, whichever is greater.

Regulations for LNG, §14.2131

Engine Fuel Systems

Containers shall be designed, fabricated, tested, and marked (or stamped) in accordance with the Regulations of DOT Specification 4L or the “Rules for the Construction of Unfired Pressure Vessels,” ASME Boiler and Pressure Vessel Code, applicable at the date of manufacture.

NFPA 52, §9.3.1

Container appurtenances shall have a rated working pressure not less than the maximum allowable working pressure of the container.

NFPA 52, §9.3.1.2

Containers shall be equipped with a device or devices that provide an indication of when the container is filled to the maximum allowable liquid level.

NFPA 52, §9.3.2.1

Manual fuel shutoff valves shall be readily accessible, operable without tools, and labeled as to their function.

NFPA 52, §9.12.1.13

Installation of Vehicle Fuel Containers

Containers shall be located in a place and in a manner so as to minimize the possibility of damage to the container and its appurtenances.

NFPA 52, §9.12.1.2

No part of the container or its appurtenances shall protrude beyond the sides or top of any vehicle to prevent the container from being struck or punctured.

NFPA 52, §9.12.1.5.1

In addition to NFPA 52 §9.12.1.2, vehicle fuel containers on school buses, mass transit vehicles, and other public transportation vehicles shall be installed on the underside of the vehicle, except as specified in subsection (c) of this section. Fuel containers on special transit vehicles shall be installed in a location which will not interfere with vehicle operation.

Regulations for LNG, §14.2610(a)

Non-roof-mounted containers shall not be mounted ahead of the front axle or beyond the rear bumper on motor vehicles.

NFPA 52, §9.12.1.5.2

The minimum clearance from the road to the container, its housing, or its fittings, whichever is lowest, shall not, with the vehicle loaded to its gross weight rating, be less than that defined by the vehicle manufacturer’s design, or allow any component to touch the surface should the vehicle have a flat tire or require the removal of any tire.

NFPA 52, §9.12.1.6.1

If fuel or container vent piping containing fuel is installed within 8 in. of engine or exhaust system components that exceed 250°F, it shall be shielded against direct heating.

NFPA 52, §9.12.1.2.2

Container markings shall be visible after the container's permanent installation on a vehicle.

NFPA 52, §9.12.1.3.1

Containers shall be mounted to prevent their jarring loose, slipping, or rotating.

NFPA 52, §9.12.1.7

The mounting system shall minimize fretting corrosion between the container and the mounting system.

NFPA 52, §9.12.1.10

Containers shall not be installed so as to affect adversely the operating characteristics of the vehicle.

NFPA 52, §9.12.1.11

Containers shall be installed and fitted so that no gas from fueling operations can be released inside the passenger compartment, by permanently installing the fueling receptacle outside the passenger compartment of the vehicle in a location protected from physical damage and dislodgment.

NFPA 52, §9.12.2.1

Enclosures, structures, seals, and conduits used to vent enclosures shall be fabricated of materials designed to resist damage, blockage, or dislodgment caused by the movement of articles carried in the vehicle or by the closing of luggage compartment enclosures or vehicle doors.

NFPA 52, §9.12.2.2

Enclosures shall require the use of tools for removal.

NFPA 52, §9.12.2.2.1

Roof-mounted containers are allowed if the vehicle was originally designed and manufactured to have roof-mounted containers or if the original manufacturer approves the design of the structure mounting. Vehicles shall not be modified to have roof-mounted containers.

Regulations for LNG, §14.2610(c)

Engine Fuel Delivery Equipment

Pressure gauges shall be designed for the maximum pressure and temperature conditions to which they can be subjected, with a minimum burst pressure safety factor of 4.

NFPA 52, §9.5.2

Dials shall be graduated to indicate at least 1.2 times the pressure at which the pressure relief device incident to the pressure gauge is set to function.

NFPA 52, §9.5.3

A gauge opening shall not exceed 0.055 in. (No. 54 drill size) at the inlet connection.

NFPA 52, §9.5.4

The engine pressure regulator inlet and each chamber shall have a design operating pressure not less than the maximum pressure of the container.

NFPA 52, §9.6

Piping, tubing, and fittings shall be designed, installed, inspected, and tested in accordance with ANSI/ASME B31.3, *Process Piping*.

NFPA 52, §9.7

Sample Question 3

Roof-mounted containers are allowed if the _____ approves the design of the structure mounting.

- A. Original Manufacturer
- B. Texas Railroad Commission
- C. National Fire Protection Association
- D. Department of Transportation

Answer on last page

Installation of Venting Systems and Monitoring Sensors

All safety relief devices on vehicular fuel containers that discharge to the atmosphere shall vent outside of the vehicle.

NFPA 52, §9.4.4

All discharge lines and outlets shall be installed in accordance with 9.4.5.1 through 9.4.5.11.

NFPA 52, §9.4.5

The discharge lines shall be able to withstand the pressure of the relief vapor discharge when the PRD is in the full-open position.

NFPA 52, §9.4.5.4

The detection system shall activate a visual alarm within the driver's compartment of the vehicle at a gas concentration not exceeding 20 to 30 percent of the LFL and sound an audible and visual alarm at a gas concentration not greater than 50 to 60 percent of the LFL.

NFPA 52, §9.13.3.1

Sensor locations shall include at a minimum the engine and driver's compartment and any enclosed fuel container or installation within a compartment.

NFPA 52, §9.13.3.1.1

Motor vehicles equipped with a gas detection system shall provide warnings at two different levels in accordance with 9.13.3.1 and the following:

- (1) At the 50 percent to 60 percent LFL level, a warning that is audible and visible to the driver outside the vehicle
- (2) An 87 dBA warning that is audible outside the vehicle with windows up and doors closed
- (3) A visual warning that is visible in direct sunlight.

NFPA 52, §9.13.3.1.2

Onboard methane detection, fire suppression, and fire protection systems shall be installed, inspected, validated, and maintained in accordance with the system OEM written recommendations and shall be maintained as a permanent vehicle record.

NFPA 52, §9.13.3.2

Periodic testing shall be done at a minimum of three times per year.

NFPA 52, §9.13.3.2.1

Installation of Valves

Valves, valve packing, gaskets, and seats shall be designed for the intended service.

NFPA 52, §9.8.1

All parts of container shutoff valves shall be stainless steel, brass, or copper except gaskets, packing, and seats.

NFPA 52, §9.8.2.1

Valves shall be mounted securely and shielded or installed in a protected location to prevent damage from vibration, shock, and unsecured objects.

NFPA 52, §9.12.4.1

The vehicular fueling system shall be equipped with a backflow check valve to prevent the return flow of LNG from the container(s) to the filling connection.

NFPA 52, §9.12.4.6

Installation of Pressure Gauges

A pressure gauge located within a driver or passenger compartment shall be installed in such a manner that no gas flows through the gauge in the event of gauge failure.

NFPA 52, §9.12.6.1

Gauges shall be mounted securely, shielded, and installed in a protected location to prevent damage from vibration and unsecured objects.

NFPA 52, §9.12.6.2

Pressure gauges installed outside driver or passenger compartments shall be equipped with a limiting orifice, a shatter-proof dial lens, and a body relief.

Regulations for LNG, §14.2625

Installation of Pressure Regulators

Components outside the engine compartment that are in contact with LNG shall be designed for service over a temperature range of -260°F to 180°F .

NFPA 52, §9.11.3.1

Other components that are not in contact with LNG shall be designed for service over a temperature range of -40°F to 180°F .

NFPA 52, §9.11.3.2

On fuel delivery systems that have operating pressures that exceed the engine operating pressure requirements, automatic pressure regulating equipment shall be installed between the vehicular fuel container and the engine to regulate the pressure of the fuel delivered to the engine.

NFPA 52, §9.12.5.1

Pressure regulating equipment shall be installed so that its weight is not placed on, or supported by, the attached lines.

NFPA 52, §9.12.5.2

LNG Transports

Testing Requirements

Each cargo tank must consist of a suitably supported welded inner vessel enclosed within an outer shell or jacket, with insulation between the inner vessel and outer shell or jacket, and having piping, valves, supports and other appurtenances as specified in this subchapter.

For the purpose of this specification, *tank* means inner vessel and *jacket* means either the outer shell or insulation cover.

49 CFR, §178.338-1(b)

The exterior surface of the tank must be insulated with a material compatible with the lading.

(1) Each cargo tank must have an insulation system that will prevent the tank pressure from exceeding the pressure relief valve set pressure within the specified holding time when the tank is loaded with the specific cryogenic liquid at the design conditions of—

(i) The specified temperature and pressure of the cryogenic liquid, and

(ii) The exposure of the filled cargo tank to an average ambient temperature of 85 °F.

(2) For a cargo tank used to transport oxygen, the insulation may not sustain combustion in a 99.5 percent oxygen atmosphere at atmospheric pressure when contacted with a continuously heated glowing platinum wire. The cargo tank must be marked in accordance with § 178.338-18(b)(7).

(3) Each vacuum-insulated cargo tank must be provided with a connection for a vacuum gauge to indicate the absolute pressure within the insulation space.

49 CFR, §178.338-1(d)

The insulation must be completely covered by a metal jacket. The jacket or the insulation must be so constructed and sealed as to prevent moisture from coming into contact with the insulation (see § 173.318(a)(3) of this subchapter).

49 CFR, §178.338-1(e)

An evacuated jacket must be in compliance with the following requirements:

(1) The jacket must be designed to sustain a minimum critical collapsing pressure of 30 psig.

(2) If the jacket also supports additional loads, such as the weight of the tank and lading, the combined stress, computed according to the formula in § 178.338-3(b), may not exceed 25 percent of the minimum specified tensile strength.

49 CFR, §178.338-1(f)

Material.

- (a) All material used in the construction of a tank and its appurtenances that may come in contact with the lading must be compatible with the lading to be transported. All material used for tank pressure parts must conform to the requirements in Section II of the ASME Code. All material used for evacuated jacket pressure parts must conform to the chemistry and steelmaking practices of one of the material specifications of Section II of the ASME Code or the following ASTM Specifications: A 242, A 441, A 514, A 572, A 588, A 606, A 633, A 715, A 1008/A 1008M, A 1011/A 1011M.
- (b) All tie-rods, mountings, and other appurtenances within the jacket and all piping, fittings and valves must be of material suitable for use at the lowest temperature to be encountered.
- (c) Impact tests are required on all tank materials, except materials that are excepted from impact testing by the ASME Code, and must be performed using the procedure prescribed in Section VIII of the ASME Code.
- (d) The direction of final rolling of the shell material must be the circumferential orientation of the tank shell.
- (e) Each tank constructed in accordance with part UHT in Section VIII of the ASME Code must be postweld heat treated as a unit after completion of all welds to the shell and heads. Other tanks must be postweld heat treated as required in Section VIII of the ASME Code. For all tanks the method must be as prescribed in the ASME Code. Welded attachments to pads may be made after postweld heat treatment.
- (f) The fabricator shall record the heat and slab numbers and the certified Charpy impact values of each plate used in the tank on a sketch showing the location of each plate in the shell and heads of the tank. A copy of the sketch must be provided to the owner of the cargo tank and a copy must be retained by the fabricator for at least five years and made available, upon request, to any duly identified representative of the Department.

49 CFR, §178.338-2

Structural integrity.

General requirements and acceptance criteria.

- (1) Except as permitted in paragraph (d) of this section, the maximum calculated design stress at any point in the tank may not exceed the lesser of the maximum allowable stress value prescribed in Section VIII of the ASME Code, or 25 percent of the tensile strength of the material used.
- (2) The relevant physical properties of the materials used in each tank may be established either by a certified test report from the material manufacturer or by testing in conformance with a recognized national standard. In either case, the ultimate tensile strength of the material used in the design may not exceed 120 percent of the minimum ultimate tensile strength specified in either the ASME Code or the ASTM standard to which the material is manufactured.
- (3) The maximum design stress at any point in the tank must be calculated separately for the loading conditions described in paragraphs (b), (c), and (d) of this section. Alternate test or analytical methods, or a combination thereof, may be used in lieu of the procedures described in paragraphs (b), (c), and (d) of this section, if the methods are accurate and verifiable.
- (4) Corrosion allowance material may not be included to satisfy any of the design calculation requirements of this section.

49 CFR, §178.338-3(a)

Static design and construction.

(1) The static design and construction of each tank must be in accordance with appendix G in Section VIII of the ASME Code. The tank design must include calculation of stress due to the design pressure, the weight of lading, the weight of structures supported by the tank wall, and the effect of temperature gradients resulting from lading and ambient temperature extremes. When dissimilar materials are used, their thermal coefficients must be used in calculation of the thermal stresses.

(2) Stress concentrations in tension, bending, and torsion which occur at pads, cradles, or other supports must be considered in accordance with appendix G in Section VIII of the ASME Code.

49 CFR, §178.338-3(b)

In order to account for stresses due to impact in an accident, the design calculations for the tank shell and heads must include the load resulting from the design pressure in combination with the dynamic pressure resulting from a longitudinal deceleration of "2g". For this loading condition the stress value used may not exceed the lesser of the yield strength or 75 percent of the ultimate tensile strength of the material of construction. For a cargo tank constructed of stainless steel, the maximum design stress may not exceed 75 percent of the ultimate tensile strength of the type steel used.

49 CFR, §178.338-3(d)

The minimum thickness of the shell or heads of the tank must be 0.187 inch for steel and 0.270 inch for aluminum. However, the minimum thickness for steel may be 0.110 inches provided the cargo tank is:

- (1) Vacuum insulated, or
- (2) Double walled with a load bearing jacket designed to carry a proportionate amount of structural loads prescribed in this section.

49 CFR, §178.338-3(e)

The design, construction and installation of an attachment, appurtenance to the cargo tank or structural support member between the cargo tank and the vehicle or suspension component or accident protection device must conform to the following requirements:

- (1) Structural members, the suspension subframe, accident protection structures and external circumferential reinforcement devices must be used as sites for attachment of appurtenances and other accessories to the cargo tank, when practicable.
- (2) A lightweight attachment to the cargo tank wall such as a conduit clip, brakeline clip, skirting structure, lamp mounting bracket, or placard holder must be of a construction having lesser strength than the cargo tank wall materials and may not be more than 72 percent of the thickness of the material to which it is attached. The lightweight attachment may be secured directly to the cargo tank wall if the device is designed and installed in such a manner that, if damaged, it will not affect the lading retention integrity of the tank. A lightweight attachment must be secured to the cargo tank shell or head by a continuous weld or in such a manner as to preclude formation of pockets that may become sites for corrosion. Attachments meeting the requirements of this paragraph are not authorized for cargo tanks constructed under part UHT in Section VIII of the ASME Code.

49 CFR, §178.338-3(g)(1)&(2)

Except as prescribed in paragraphs (g)(1) and (g)(2) of this section, the welding of any appurtenance the cargo tank wall must be made by attachment of a mounting pad so that there will be no adverse effect upon the lading retention integrity of the cargo tank if any force less than that prescribed in paragraph (b)(1) of this section is applied from any direction. The thickness of the mounting pad may not be less than that of the shell or head to which it is attached, and not more than 1.5 times the shell or head thickness. However, a pad with a minimum thickness of 0.187 inch may be used when the shell or head thickness is over 0.187 inch. If weep holes or tell-tale holes are used, the pad must be drilled or punched at the lowest point before it is welded to the tank. Each pad must:

- (i) Be fabricated from material determined to be suitable for welding to both the cargo tank material and the material of the appurtenance or structural support member; a Design Certifying Engineer must make this determination considering chemical and physical properties of the materials and must specify filler material conforming to the requirements in Section IX of the ASME Code.
- (ii) Be preformed to an inside radius no greater than the outside radius of the cargo tank at the attachment location.
- (iii) Extend at least 2 inches in each direction from any point of attachment of an appurtenance or structural support member. This dimension may be measured from the center of the attached structural member.
- (iv) Have rounded corners, or otherwise be shaped in a manner to minimize stress concentrations on the shell or head.
- (v) Be attached by continuous fillet welding. Any fillet weld discontinuity may only be for the purpose of preventing an intersection between the fillet weld and a tank or jacket seam weld.

49 CFR, §178.338-3(g)(3)

Joints.

- (a) All joints in the tank, and in the jacket if evacuated, must be as prescribed in Section VIII of the ASME Code, except that a butt weld with one plate edge offset is not authorized.
- (b) Welding procedure and welder performance tests must be made in accordance with Section IX of the ASME Code. Records of the qualification must be retained by the tank manufacturer for at least five years and must be made available, upon request, to any duly identified representative of the Department, or the owner of the cargo tank.
- (c) All longitudinal welds in tanks and load bearing jackets must be located so as not to intersect nozzles or supports other than load rings and stiffening rings.
- (d) Substructures must be properly fitted before attachment and the welding sequence must minimize stresses due to shrinkage of welds.
- (e) Filler material containing more than 0.05 percent vanadium may not be used with quenched and tempered steel.
- (f) All tank nozzle-to-shell and nozzle-to-head welds must be full penetration welds.

49 CFR, §178.338-4

Openings.

- (a) The inlet to the liquid product discharge opening of each tank intended for flammable ladings must be at the bottom centerline of the tank.
- (b) If the leakage of a single valve, except a pressure relief valve, pressure control valve, full trycock or gas phase manual vent valve, would permit loss of flammable material, an additional closure that is leak tight at the tank design pressure must be provided outboard of such valve.

49 CFR, §178.338-7

Transports required to be registered with AFS shall be tested at least once every five years by a Category 15, 20, or 50 licensee.

- (1) Documentation of the required testing shall be filed by the Category 15, 20, or 50 licensee.
- (2) The results of any test required under this section shall clearly indicate whether the transport container unit is safe for LNG service. The Category 15, 20, or 50 licensee shall send LNG Form 2008 to AFS within 30 calendar days of the due date of any tests required under this section.
- (3) If evidence of any unsafe condition is discovered as a result of any tests performed under this section, the transport container unit shall be immediately removed from LNG service and shall not be returned to LNG service until AFS notifies the licensee in writing that the transport container unit may be returned to LNG service.

Regulations for LNG, §14.2707(a)

Containers shall be tested in accordance with 49 CFR §180.407.

Regulations for LNG, §14.2707(b)

Containers shall be inspected for corroded areas, dents, or other conditions (including leakage under test pressure) which could render the container unsafe for LNG service.

Regulations for LNG, §14.2707(c)

Marking

LNG transports shall be marked on each side and the rear with the name of the licensee or the ultimate consumer operating the unit.

Such lettering shall be legible and at least two inches in height and in sharp color contrast to the background. AFS will determine whether the name marked on the transport is sufficient to properly identify the operator.

Regulations for LNG, §14.2710

Pressure Gauge

Transport containers shall be equipped with a pressure gauge for LNG service which shall be maintained in good operating condition at all times. An isolation valve shall be installed between the container and the pressure gauge.

Regulations for LNG, §14.2713

Liquid Level Gauging Devices

Truck and trailer containers shall be equipped with a liquid level gauging device of approved design, such as a fixed tube device.

Fixed tube devices shall be arranged so that the maximum liquid level to which the container may be filled is set at the maximum permitted for the container based on an initial liquid temperature not to exceed 40 degrees Fahrenheit. An isolation valve shall be installed between the container and the liquid level gauging device.

Regulations for LNG, §14.2722

Uniform Protection Standards

LNG transport units and container delivery units, including appurtenances, shall be maintained in a safe operating condition at all times.

Regulations for LNG, §14.2740(a)

Any transport unit or container delivery unit discovered to be in an unsafe condition while being operated on a public roadway may be continued in operation only to the nearest place where repairs can safely be made. Such operation shall be conducted only if it is less hazardous to the public than to permit the transport unit or container delivery unit to remain on the public roadway.

Regulations for LNG, §14.2740(b)

Delivery of Inspection Reports to Licensee

The transport driver of any transport unit receiving an inspection report from AFS shall deliver that report to the licensee in whose name the transport unit is registered.

Regulations for LNG, §14.2746

Sample Question 4

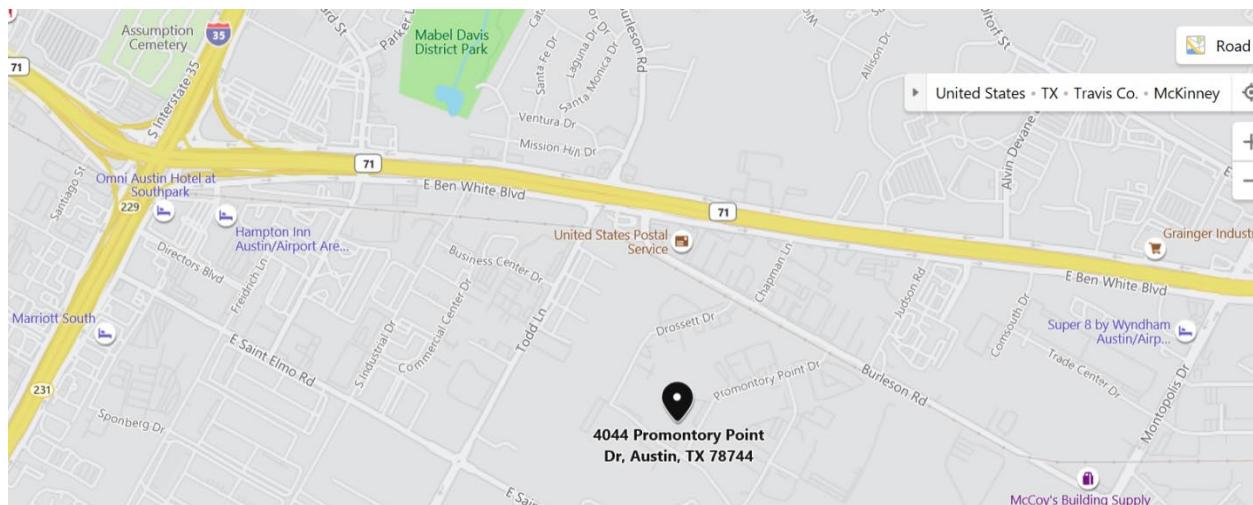
LNG transports shall be marked _____ with the name of the licensee or the ultimate consumer operating the unit.

- A. in the Front
- B. in the rear
- C. on each side
- D. on the front and rear
- E. on each side and the rear

Answer on last page

ALTERNATIVE FUELS TRAINING CENTER

4044 Promontory Point Austin Texas 78744



Sample
Question
Answers

1. C
2. D
3. A
4. E