

TEXAS CNG EXAMINATION STUDY GUIDE

Service and Installation
Employee Level



NOTICE

This publication is intended for use in its entirety as a guide for persons preparing to take Railroad Commission CNG qualifying examinations. Any other use or distribution of this publication or use or distribution of any portion of this publication for any purpose whatsoever is considered by the Railroad Commission of Texas to be misuse of this publication.

This publication is not intended to be an exhaustive treatment of the subjects covered and should not be interpreted as precluding the use of other safety programs or procedures that comply with (1) applicable federal, state, and/or local code provisions, statutes, ordinances, and/or other regulations, including, but not limited to, the Railroad Commission of Texas' CNG Safety Rules (16 Texas Administrative Code, Chapter 13) and codes adopted by the Railroad Commission of Texas, and/or (2) other industry standards and/or practices.

Every effort was made to ensure that this publication was accurate and up-to-date as of the date of publication. The reader is cautioned, however, about reliance on this publication or any portion thereof at any time thereafter, particularly because changes in technology are likely to occur that might make portions of this publication inaccurate and out-of-date. The Railroad Commission of Texas assumes no liability, under any circumstances, for any actions taken or omissions made in reliance of the contents of this publication, from whatever source, or any other consequences of any such reliance.

All rights reserved. No part of this publication may be reproduced or transmitted in any form without written permission from the Railroad Commission of Texas.

Exam administration

Taking an examination in Austin

You may take any Railroad Commission qualifying examination in Austin without pre-registering (“walk-in”) on any business day, excluding holidays, from 8:00 a.m. to 12:00 noon at the Commission’s Alternative Fuels Training Center. The training center is located at 6506 Bolm Road, on the northwest corner of the intersection of Bolm Road and U.S. Highway 183.

Tuesdays and Thursdays are the preferred days for walk-in examinations.

(See map to Training Center on page 25.)

Taking an examination outside of Austin

You may also take any Railroad Commission qualifying examination at more than two dozen other locations statewide. Exam dates, times and locations are listed three months in advance on the Commission’s web site. To view a complete schedule, go to www.rrc.state.tx.us. From the drop-down menu under “Education and Training,” choose “Training Classes & Qualifying Exams” and click on “Class/Exam Schedule.” The online schedule has links to maps showing each class and exam location.

You must register at least two business days in advance to take an examination outside of Austin. To register online, go to www.rrc.state.tx.us. From the drop-down menu under “Education and Training,” choose “Training Classes & Qualifying Exams” and click on “Register Now.” The web site allows you to register up to four people for an examination.

When you register online, you will receive a return e-mail confirming the registration and the dates and locations of the exams. Registering online also ensures that you will receive advance notification of any changes in the examination date, time or location.

Payment for exams; CNG Form 1016; ID required

The fee is \$40.00 for each employee-level exam and \$70.00 for each management-level exam. Fees are non-refundable by state law, and cash cannot be accepted.

You may pay the required examination fee at any exam location by check or money order payable to the Railroad Commission of Texas. CNG Form 1016, “Application for Examination,” may also be completed at the examination site. Examinees must also present an official state-issued driver’s license and photo ID at the exam site.

You may also pay your examination fee by credit card in advance online. To pay by credit card, go to www.rrc.state.tx.us. From the drop-down menu under “Education and Training,” choose “Training Classes & Qualifying Exams” and click on “Pay Online.” Be sure to print out the confirmation page in Step 6. Make a copy of the confirmation page for your records and bring a copy with you to the examination site.

Open-book examinations

All Railroad Commission employee-level qualifying examinations are open book. Examinees may use a copy of the Commission’s *Regulations for Compressed Natural Gas and Liquefied Natural Gas*. This study guide may not be used during any employee-level examination.

Examination time limit

Railroad Commission employee-level qualifying examinations must be completed within two hours after the examination is given to you, including any breaks you elect to take. The examination proctor is the official timekeeper. You must submit both the examination itself and your answer sheet to the proctor within the two-hour limit.

Grades, reports and retakes

The minimum passing grade is 75 percent on all Railroad Commission qualifying examinations.

Examinations administered at the Training Center in Austin are graded on-site, and examinees are immediately informed of the results. If you fail an examination that you took in Austin, you may retake that same examination only one additional time during a business day. Any subsequent examination must be taken on another business day, unless approved by the Commission.

Exams taken outside of Austin are graded as soon as possible, and the results of the examination are reported within 10 working days.

If you pass an examination, the Railroad Commission will issue you a blue certification card within 10 working days. You will be notified by letter if you fail an examination.

Contacts

Alternative Fuels Research and Education (AFRED)

Rayfield Hearne, Certification Manager	(512) 463-6845	rayfield.hearne@rrc.state.tx.us
Amber Flaherty, Examination Coordinator	(512) 463-6933	amber.flaherty@rrc.state.tx.us
Carol Goodman, Training Coordinator	(512) 463-2682	carol.goodman@rrc.state.tx.us

LP-Gas Operations

April Dawn Richardson, LP-Gas Safety	(512) 463-6935	april.richardson@rrc.state.tx.us
--------------------------------------	----------------	--

TEXAS CNG EXAMINATION STUDY GUIDE EMPLOYEE-LEVEL SERVICE AND INSTALLATION

Who should use this guide?

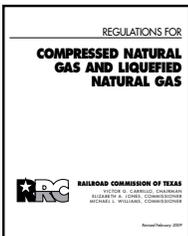
You should use this guide if you plan to take the Railroad Commission's employee-level qualifying examination authorizing the sale, installation, service and repair of CNG systems, including cylinders, in Texas.

What books do I need?

This examination tests your knowledge of the laws and standards that apply to the sale, installation, service and repair of CNG systems, including cylinders, in Texas.

These laws and standards are found in the Railroad Commission's *Regulations for Compressed Natural Gas and Liquefied Natural Gas* (16 Texas Administrative Code, Chapter 13), known informally as the Commission's CNG Safety Rules.

Where do I get the book?



You may download the current edition of the Railroad Commission's *Regulations for Compressed Natural Gas and Liquefied Natural Gas* free online. Go to the Commission's home page at www.rrc.state.tx.us. From the drop-down menu under "Education and Training," choose "Training Classes & Qualifying Exams" and click on "CNG/LNG Safety Rules (PDF)." You may also buy a printed copy of the book for \$10.00, tax included, by calling the Railroad Commission's publications office at (512) 463-7309.

Sections and topics

Before you take this examination you should know the definitions on page 9 of this study guide and the contents of the sections of the codes and standards listed below. The actual examination may not include questions on each of the listed sections and topics, and the examination questions are not organized by topic as they are in this study guide.

Regulations for Compressed Natural Gas and Liquefied Natural Gas

§13.26 Design and Construction of Cylinders, Pressure Vessels, and Vapor Recovery Receivers.

§13.27 Pressure Relief Devices

§13.30 Piping

§13.31 Valves

§13.32 Hose and Hose Connections

§13.33 Compression Equipment

§13.34 Vehicle Fuel Connection
§13.40 Manufacturer's Nameplates and Markings on ASME Containers

§13.93 General
§13.95 Installation of Cylinders and Cylinder Appurtenances
§13.96 Installation of Pressure Relief Devices
§13.99 Installation of Piping and Hoses

§13.100 Testing
§13.101 Installation of Emergency Shutdown Equipment
§13.102 Installation of Electrical Equipment
§13.103 Stray or Impressed Currents and Bonding
§13.104 Operation
§13.105 Fire Protection

§13.132 System Component Qualification
§13.133 Installation of Fuel Supply Cylinders
§13.134 Installation of Venting Systems
§13.135 Installation of Piping
§13.136 Installation of Valves
§13.138 Installation of Pressure Regulators

§13.141 System Testing
§13.142 Maintenance and Repair
§13.143 Venting of CNG to the Atmosphere

§13.182 Applicability
§13.183 System Component
§13.184 General
§13.185 Installation
§13.186 Outdoor Installations
§13.187 Installation of Pressure Relief Valves
§13.188 Installation of Pressure Gauges
§13.189 Pressure Regulation

§13.190 Piping and Hose
§13.191 Testing
§13.192 Installation of Emergency Shutdown Equipment
§13.193 Operation
§13.194 Maintenance and Inspection

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.

Regulations for Compressed Natural Gas and Liquefied Natural Gas

A **cascade storage system** is defined as storage in multiple cylinders.

CNG Safety Rules, §13.3(9)

A **CNG system** includes safety devices, cylinders, piping, fittings, valves, compressors, regulators, gauges, relief devices, vents, installation fixtures, and other CNG equipment.

CNG Safety Rules, §13.3(13)

Compressed natural gas is a mixture of hydrocarbons in gases and vapors consisting principally of methane.

CNG Safety Rules, §13.3(17)

A **fuel supply cylinder** is a cylinder mounted upon a vehicle for storage of CNG as a fuel supply for the vehicle's internal combustion engine.

CNG Safety Rules, §13.3(23)

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 CNG activities you will perform, as well as the rules and standards highlighted in this guide.

As you study the applicable codes and standards, pay special attention to the facts, rules and procedures related to the following key topics. Then, when you take the examination, read each question very carefully.

Design and Construction of Cylinders, Pressure Vessels, and Vapor Recovery Receivers

(a) Cylinders and pressure vessels must be fabricated of steel, aluminum, or composite materials.

(b) Cylinders must be manufactured, inspected, marked, tested, and retested in accordance with United States Department of Transportation (DOT) regulations and exemptions for compressed natural gas (CNG) service.

Fuel supply cylinders must have a rated service pressure of not less than 2,400 psig at 70 degrees Fahrenheit.

Cascade storage cylinders must have a rated service pressure of not less than 3,600 psig at 70 degrees Fahrenheit.

Steel cylinders must be manufactured and tested in compliance with DOT 3AA specifications.

Fiber reinforced plastic and full composite cylinders must comply with DOT FRP1 standard.

Fiber reinforced plastic and hoop-wrapped composite cylinders must comply with DOT FRP2 standard.

Vapor recovery receivers must have a minimum rated service pressure of 250 psig and be manufactured, inspected, marked, tested, and, if applicable, retested in accordance with DOT regulations or the American Society of Mechanical Engineers (ASME) Code.

(d) Pressure vessels and containers other than cylinders shall be manufactured, inspected, marked, and tested in accordance with the "Rules for the Construction of Unfired Pressure Vessels," ASME Boiler and Pressure Vessel Code, Section VIII (Division I or II).

CNG Safety Rules, §13.26

Pressure Relief Devices

(a) Each fuel supply cylinder must be fitted with a pressure relief device in accordance with the following:

(4) The discharge flow rate of the pressure relief device must not be reduced below that required for the capacity of the container upon which the device is installed.

CNG Safety Rules, §13.27

Piping

(a) Piping, tubing, fittings, gaskets, and packing material must be compatible with the fuel under the service conditions.

(b) All tubing must be a minimum of Type 304 Stainless Steel. All tubing connectors must be a minimum of Type 304 Stainless Steel industrial type connectors having a minimum design pressure of 5,000 psig.

(c) Piping, tubing, fittings, and other piping components between a cylinder or pressure vessel and the first shutoff valve must be capable of withstanding a hydrostatic test of at least four times the rated working pressure without structural failure.

(d) Piping must be American Standard Testing Material (ASTM) steel, Schedule 80, or better. All pipe fittings must be forged steel stamped 6,000 psi or greater.

All tubing connectors must be a minimum of Type 304 Stainless Steel industrial type connectors having a minimum design pressure of 5,000 psig.

CNG Safety Rules, §13.30

Valves

(a) Valves, valve packing, and gaskets must be suitable for the fuel over the full range of pressures and temperatures to which they may be subjected under normal operating conditions.

(b) Shutoff valves must have a design working pressure not less than the rated working pressure of the entire system and must be capable of withstanding a hydrostatic test of at least four times the rated service pressure without failure. Leakage must not occur at less than one and one half times the rated service pressure using dry air as the test medium.

(c) Valves of cast iron or semi-steel other than those complying with ASTM Specifications A-536 (Grade 60-40-18), A-395, and A-47 (Grade 35018) must not be used as primary shutoff valves.

(d) Valves of a design that will allow the valve stem to be removed without removal of the complete bonnet or disassembly of the valve body must not be used.

(e) The manufacturer must stamp or otherwise permanently mark the valve body to indicate the service ratings. Exception: Fuel supply container valves need not be marked as such.

CNG Safety Rules, §13.31

Hose and Hose Connections

(a) Hose and metallic hose must be of or lined with materials that are resistant to corrosion and the actions of CNG.

(b) Hose, metallic hose, flexible metal hose, tubing, and their connections must be suitable for the most severe pressure and temperature conditions expected under normal operating conditions with a burst pressure of at least four times the maximum working pressure.

(c) Hose assemblies must be tested by the manufacturer or its designated representative prior to use at pressure at least twice the service pressure.

(d) Hose must be continuously and distinctly marked with the manufacturer's name or trademark, the words "CNG service," and the working pressure. Metallic hose must have a manufacturer's permanently attached tag marked with the manufacturer's name or trademark, the words "CNG service," and the working pressure. This subsection does not apply to the hose installed from the regulator to the mixer on a motor vehicle.

(e) Hose, metallic hose, or flexible metal hose used in CNG vehicle fuel system areas where a high degree of flexibility is required for vehicle safety must comply with the requirements of subsections (a)–(d) of this section.

(f) Hose, metallic hose, or flexible metal hose may be used in fuel lines provided it meets the following requirements:

(1) The hose must be capable of conducting an electrical current from one end of the hose to the other end without the necessity of connecting a jumper wire from end to end.

(2) The length of the hose including the swaged fittings on each end must not exceed 48 inches.

(3) The hose must be protected from fretting and sources of extremely high heat.

(4) The hose must have fittings or connectors on each end made of Type 304 or better stainless steel with a minimum design pressure of at least 5,000 psig.

CNG Safety Rules, §13.32

Compression Equipment

(a) Compression equipment must be designed for use with CNG and for the pressures and temperatures to which it may be subjected under normal operating conditions. It must have pressure relief devices which must limit each stage pressure to the maximum allowable working pressure for the cylinder and piping associated with that stage of compression.

CNG Safety Rules, §13.33

Vehicle Fuel Connection

(d) The refueling connection on an engine fuel system shall be firmly supported, and must:

(1) receive the fueling connector and accommodate the service pressure of the vehicle fuel system;

(2) incorporate a means to prevent the entry of dust, water, and other foreign material. If the means used is capable of sealing system pressure, it must be capable of being depressurized before removal;

(3) have a different fueling connection for each pressure base vehicle fuel system.

CNG Safety Rules, §13.34

Manufacturer's Nameplates and Markings on ASME Containers

CNG must not be introduced into any ASME container not equipped with a manufacturer's original or manufacturer's replacement nameplate permanently attached to the container.

CNG Safety Rules, §13.40

SAMPLE QUESTION

Shutoff valves must have a design working pressure _____ than the rated working pressure of the entire system and must be capable of withstanding a hydrostatic test of at least _____ times the rated service pressure without failure.

- A. Three times greater / three
- B. Two times greater / three
- C. Not less / four
- D. One and one-half times greater / four

Answer: C

CNG COMPRESSION, STORAGE, AND DISPENSING SYSTEMS

General

(a) Equipment related to a compression, storage, or dispensing installation, excluding automatic dispensers and residential fueling facilities, must be protected from tampering and damage and the protection must be maintained in good condition at all times and in accordance with one of the three standards set forth in this subsection. Automatic dispensers for general public use must be protected against collision damage in accordance with subsection (d) of this section.

(1) Fencing

(A) Fencing material must be chain link type with wire no smaller than 12 ½ American wire gauge (AWG).

(B) Fencing must be no less than six feet in height at all points. Fencing may be five feet in height when topped with at least three strands of barbed wire, with the strands no more than four inches apart.

(C) All uprights, braces, and/or corner posts must be composed of noncombustible material if located within distances for sources of ignition or combustible materials required in Table 1 of §13.94 of this title (relating to Location of Installations) of the enclosed CNG transfer systems or CNG cylinders.

(D) All fenced enclosures must have at least one gate suitable for ingress and egress. All gates must be locked whenever the area enclosed is unattended.

(E) A minimum clearance of two feet must be maintained between the fencing and the compression equipment, cylinder cascades, or containers, and the entire dispensing systems.

(F) Fencing which is located more than 25 feet from any point of a CNG dispensing system, container, or compression equipment is designated as perimeter fencing. If a CNG dispensing system, cylinder cascade, or compression equipment is located inside perimeter fencing and is subject to vehicular traffic, it must be protected against damage according to the specifications set forth in paragraph (2) of this subsection.

(G) The cylinder cascade containers, compression equipment, and the entire dispensing system must be completely enclosed by fencing.

(2) Guardrails

(A) Where fencing is not used to protect the installation as provided in paragraph (1) of this subsection, then valve locks, a means of locking the electric control for the compressor(s), or other suitable means must be provided to prevent unauthorized withdrawal of CNG.

(B) Vertical supports for guardrails must be a minimum of three-inch Schedule 40 steel pipe, or material with equal or greater strength. The vertical supports must be capped on the top and anchored below the ground a minimum of 18 inches in concrete, with a minimum height of 30 inches above the ground. Supports must be spaced no more than four feet apart.

(C) The top of the horizontal guard railing must be secured to the vertical supports a minimum of 30 inches above the ground. The horizontal guard railing must be no less than three-inch Schedule 40 steel pipe, or material with equal or greater strength. The horizontal guard railing must be welded or bolted to the vertical supports with bolts of sufficient size and strength to prevent displacement of the horizontal guard railing.

(D) No opening in the horizontal guard railing may exceed 36 inches. A means of temporarily removing the guard railing and/or vertical supports to facilitate the handling of heavy compression equipment may be incorporated into the horizontal guard railing and vertical supports. In no case must the protection provided by the guard railing and vertical supports be decreased.

(E) A minimum clearance of 24 inches must be maintained between the railing and any part of the CNG compression equipment, cylinder cascades, containers, or dispensing equipment.

(F) The operating end of the container and any part of the CNG compression equipment, piping, or cylinder cascade which is exposed to vehicular traffic must be protected from damage by the vehicular traffic. The protection must extend at least 24 inches beyond any part of the CNG compression equipment, cylinder cascade, container, or dispensing equipment which is exposed to vehicular traffic.

(3) **Protection.** Each automatic dispenser must be secured to a concrete island a minimum of six inches above the normal grade and two inches above the grade of any other fuel dispenser. Each automatic dispenser must be protected against collision damage. Support columns or other such protection installed at the approach ends of the concrete island must prevent collision with the automatic dispenser. If such protection cannot be provided, then the requirements of paragraph (2) of this subsection must apply.

(d) The authorized automatic dispenser must have the following features:

(1) A key, card, or code system must be used.

(2) All appurtenances, metering equipment, and other related equipment installed on an automatic dispenser must meet all applicable requirements of the Railroad Commission's *Regulations for Compressed Natural Gas*.

(3) All dispensing equipment must be fabricated of material suitable for CNG, and resistant to the action of CNG under service conditions. Pressure-containing parts must be of steel, ductile iron, forged steel, brass, or an equivalent material. Aluminum may be used for approved meters. All piping must be Schedule 80, and all pipe fittings must be forged steel stamped 6,000 psi or greater.

(4) The automatic dispensing system must incorporate a cutoff valve with an opening and closing device which ensures the valve is in a closed position when the dispenser is deactivated.

(5) A device must be installed in the CNG piping in such a manner that displacement of the dispenser will result in the displacement of such piping on the downstream side of the device.

(6) The transfer hose on an automatic dispenser must incorporate a pull-away device. The pull-away device must be installed so as to separate by a force not greater than 45 pounds when applied in any horizontal direction. The device must stop the flow of CNG in the event of a separation.

- (7) All electric installations within the automatic dispenser enclosure and the entire pit or open space beneath the dispenser must comply with the National Electrical Code, Class 1, Group D, Division 2, except for dispenser components located at least 48 inches above the dispenser base which are intrinsically safe according to the National Electrical Code.
- (8) The fueling connector on an automatic dispenser must have a remote vapor discharge and a manual shut-off valve.

CNG Safety Rules, §13.93

Installation of Cylinders and Cylinder Appurtenances

- (a) Storage cylinders must be installed aboveground on stable noncombustible foundations.
- (b) Cylinders must be protected by painting or other equivalent means where necessary to inhibit corrosion.
- (c) All external steel surfaces on cylinders subjected to direct or indirect sunlight or heat must be painted white.
- (d) A means must be provided to prevent the flow or accumulation of flammable or combustible liquids under cylinders, such as by diversion curbs, grading or pads.

CNG Safety Rules, §13.95

Installation of Pressure Relief Devices

- (a) Pressure relief valves must be so arranged so that escaping gas will not impinge upon buildings, other equipment, or areas that could be occupied by the public.

- (b) A pressure relief device must be provided in the transfer system to prevent overpressure of a vehicle.

CNG Safety Rules, §13.96

Installation of Piping and Hoses

- (a) Piping and tubing must be installed with adequate provisions for expansion, contraction, jarring, vibration, and settling.

(b) All exterior piping installed underground must be installed with a minimum of 18 inches of cover unless it is located beneath driveways, roads, or streets. If the piping is installed beneath driveways, roads, or streets, it must be buried at a depth to prevent damage from vehicular traffic or encased in steel pipe or bridged (shielded). The 18-inch cover may be reduced to 12 inches if external damage to the piping is not likely to result (e.g., piping is under a lawn area not subjected to traffic). If a minimum of 12 inches of cover cannot be maintained, the pipe must be encased in steel pipe or bridged (shielded) or protected against mechanical injury by means of curbs, slabs, substantial posts, or other suitable means.

- (1) All underground piping must be installed with sufficient clearance from any other underground structure, and to protect against damage from proximity to other structures.

- (2) Underground piping must be protected from corrosion in compliance with industry recognized practices.
 - (3) Uncoated threaded or socket-welded joints must not be used in piping in contact with soil or where internal or external crevice corrosion may occur.
- (c) The use of hose in an installation is limited to:
- (1) a vehicle fueling hose; and
 - (2) a section of metallic reinforced hose not exceeding 36 inches in length to provide flexibility where necessary. Each section must be installed so as to be protected against mechanical damage and be readily visible for inspection. The manufacturer's identification must be retained in each section.
- CNG Safety Rules, §13.99***

Testing

- (a) Piping, tubing, hoses, and hose assemblies must be leak-tested to prove free from leaks at a pressure equal to at least the normal operating pressure of that portion of the system.
- CNG Safety Rules, §13.100***

Installation of Emergency Shutdown Equipment

- (a) Manually operated cylinder valves must be provided for each cylinder.
- (b) A manually operated shutoff valve must be installed in a manifold as close to a cylinder or group of cylinders as practical.
- (c) Where excess flow check valves are used, the closing flow must be less than the flow rating of the piping system which would result from a pipeline rupture between the excess flow valve and the equipment downstream of the excess flow check valve.
- (d) The fill line on storage cylinders must be equipped with a backflow check valve to prevent discharge of natural gas from the cylinder in case of a line, hose, or fittings rupture.
- (e) Device(s) for emergency shutdown of the compression and dispensing equipment must be provided at a location remote from the dispensing area. The device(s) must operate to activate a valve installed at the compression and dispensing area that when activated shuts off the power and gas supply to the compressor(s) and dispenser(s). The emergency shutdown device(s) must be visible from the dispensing area(s).
- (f) Emergency gas shutdown devices(s) must be distinctly marked for easy recognition.
- (g) Break-away protection must be provided in a manner such that, in the event of a pull-away, natural gas will cease to flow at any separation.
- CNG Safety Rules, §13.101***

Installation of Electrical Equipment

(a) Electrical installations located within the vicinity of any compressor, cascade, or dispensing equipment must be in accordance with the *National Electrical Code* (NEC) for Class 1, Group D; Hazardous Locations, Division 2. A Division 2 electrical area at a compressor, cascade, or dispensing equipment does not extend beyond an unpierced wall, roof or vapor-tight partition.

CNG Safety Rules, §13.102

Stray or Impressed Currents and Bonding

(a) When stray or impressed currents are used or may be present on dispensing systems (such as for cathodic protection), protective measures must be taken to prevent ignition.

(b) Static protection is not required when CNG is loaded or unloaded by conductive or nonconductive hose, flexible metallic tubing, or pipe connections where both halves of the metallic couplings are in contact.

CNG Safety Rules, §13.103

Operation

(a) DOT cylinders must not be subjected to pressure in excess of 125 percent of the marked service pressure, even if, on cooling, the pressure settles to the marked service pressure.

(b) A fuel supply cylinder must not have a settled pressure above the working pressure stamped on the cylinder and displayed on a label near the filling connection, corrected for the ambient temperature at time of filling.

(c) Compressed natural gas (CNG) dispensing systems must be equipped to automatically stop fuel flow when a fuel supply cylinder reaches the temperature corrected fill pressure.

(d) When CNG is being transferred to or from a motor vehicle, the engine must be stopped.

(e) Each CNG transport must carry no fewer than two chock blocks designed to effectively prevent the rolling of the transport. These blocks must be used any time the transport is parked and during the transfer of fuel regardless of the level of the surrounding terrain.

(f) Bleed connections must be provided in transfer systems to permit depressurizing before disconnecting the line. These bleed connections must lead to a safe point of discharge.

(g) Compressed natural gas (CNG) must not be used to operate any device or equipment which has not been designed or properly modified for CNG service.

(h) Sources of ignition must not be permitted within ten feet of any filling connection during a transfer operation.

(i) Fuel dispenser(s), including automatic dispenser(s), may be operated only by an individual who has been properly trained.

(1) Any consumer who operates an automatic dispenser must be provided with written instructions and safe operating procedures by the licensee. The consumer should be cautioned to study and preserve such instructions and procedures, and to educate all those with access to the automatic dispenser(s) in the proper operating procedures. Each licensee must maintain a current list of all entities and/or individuals trained by the licensee in the operation of an automatic dispenser.

(2) Step-by-step operating instructions provided by the manufacturer must be posted at or on each automatic dispenser, readily visible to the operator during transfer operations. The instructions shall describe each action necessary to operate the automatic dispenser.

(3) Each person or entity who operates a fuel dispenser, excluding an automatic dispenser, must be provided with written instructions and safe operating procedures by the licensee. The person operating the dispenser should be cautioned to study and preserve such instructions and procedures.

CNG Safety Rules, §13.104

Fire Protection

Automatic CNG dispensing or refueling areas must be provided with a portable fire extinguisher having a rating not less than 20-B:C

CNG Safety Rules, §13.105

SAMPLE QUESTION

A device must be installed in the CNG piping of an automatic dispenser in such a manner that displacement of the dispenser will result in the displacement of the piping on the _____ side of the device.

- A. Downstream
- B. Upstream

Answer: A

ENGINE FUEL SYSTEMS

System Component Qualification

(b) Components in the engine compartment must be suitable for service over a range of temperatures from -40 degrees Fahrenheit to 250 degrees Fahrenheit. All other components must be suitable for service over a range from -40 degrees Fahrenheit to 180 degrees Fahrenheit.

(c) Fuel-carrying components must be labeled or stamped with the following:

- (1) the manufacturer's name or symbol;
- (2) the model designation;
- (3) the design working pressure;
- (4) the direction of fuel flow when necessary for correct installation; and
- (5) the capacity or electrical rating.

CNG Safety Rules, §13.132

Installation of Fuel Supply Cylinders

(a) Fuel supply cylinders on vehicles other than school buses, mass transit, or other vehicles used in public transportation may be located within, below, or above the driver or passenger compartment, provided all connections to the cylinders are external to, or sealed and vented from those compartments.

(b) Fuel supply cylinders on school buses, mass transit, and other public transportation vehicles must not be located above or within the driver or passenger compartment. The motor fuel containers installed on a special transit vehicle may be installed in the passenger compartment, provided it complies with subsection (a) of this section.

(c) Each fuel supply cylinder must be mounted in a location to minimize damage from collision. No part of a cylinder or its appurtenances must protrude beyond the sides or top of the vehicle at the point where it is installed.

(d) The fuel system must be installed with as much road clearance as practical, but not less than the minimum road clearance of the vehicle when loaded to its gross vehicle weight rating. This minimum clearance shall be measured from the lowest part of the fuel system.

(e) No portion of a fuel supply cylinder or cylinder appurtenance must be located ahead of the front axle or behind the rear bumper mounting face of a vehicle. Cylinder valves must be protected from physical damage using the vehicle structure, valve protectors, or a suitable metal shield.

(f) Each cylinder bracket must be secured to the vehicle body, bed, or frame with bolts, lock washers and nuts, or self-locking nuts of a size and strength capable of withstanding a static force in any direction of eight times the weight of a fully pressurized cylinder. The cylinder bracket must be designed and manufactured by a cylinder manufacturer. Each specific mounting bracket manufactured on or after January 1, 1994, must have the manufacturer's name or logo on it in order to properly identify the bracket manufacturer. If self-locking nuts are installed, such nuts must not be reused once they are removed. The container mounting brackets must prevent the container from jarring loose, slipping, or rotating.

- (g) Each fuel supply cylinder must be secured in the mounting brackets by bolts, lock washers and nuts, or self-locking nuts of a size and strength capable of withstanding a static force applied in any direction eight times the weight of the fully pressurized cylinder. If self-locking nuts are installed, such nuts must not be reused once they are removed.
- (h) The cylinder weight must not be supported by the outlet, service valves, manifolds, or other fuel connections.
- (i) Fuel supply cylinders located less than eight inches from the exhaust system must be shielded against direct heat.
- (j) The mounting system must minimize fretting corrosion between the cylinder and the mounting system by means of rubber insulators or other suitable means.
- (k) Fuel supply cylinders must not be installed so as to adversely affect the driving characteristics of the vehicle.
- (l) Containers must be secured to a school bus, mass transit, or special transit vehicle frame (not the floor) by container fastenings or mounting brackets described in subsection (f) of this section. The fastenings or brackets must be secured to the frame or securely mounted to a supporting structure so as not to compromise the strength of that structure (i.e., backing plates or other acceptable means may be used to accomplish this purpose). Containers which are currently installed on school buses or mass transit vehicles by means of strap mounting brackets may continue to be used.
- (m) The motor fuel containers installed on a school bus or mass transit vehicle must be installed on the underside of the vehicle.
- (n) If necessary, a plumbing chamber door must be provided in the sidewall of the school bus, mass transit, or special transit vehicle to allow easy access for filling or securing the service valve in the event of an emergency. The plumbing chamber door must be hinged and latched, but not locked.

CNG Safety Rules, §13.133

Installation of Venting Systems

- (a) All pressure relief devices and pressure-carrying components installed within a closed compartment must be vented to the outside of the vehicle in a suitable location.
- (b) The venting system for the discharge of pressure relief devices (pressure relief device channels) must be constructed in such a manner to channel the natural gas out of the closed compartment. The vent collection bag must be constructed from a fabric that is tear resistant, flame resistant, abrasion resistant, and inert with mechanical properties. The fabric must be bonded to the cylinder and joints constructed using an adhesive compatible with the container fabric. This bag must be repaired or replaced at any such time the bag fails to comply with the requirements of this subsection.
- (c) The vent or vents for the venting system must not exit into a wheel well.
- (d) A vent must not restrict the operation of a cylinder pressure relief device or pressure relief device channel.

CNG Safety Rules, §13.134

Installation of Piping

- (a) Manifolds connecting fuel cylinders must be fabricated to minimize vibration and shall be installed in a protected location or shielded to prevent damage from unsecured objects.
- (b) Pipe thread jointing material impervious to the action of CNG must be applied to all male pipe threads prior to assembly.
- (c) Piping and fittings must be clear and free from cutting or threading burrs, and scaling. The ends of all piping must be reamed.
- (d) Where necessary to prevent abrasion, supply lines passing through a panel must be protected by grommets or similar devices such as bulkhead fittings, which shall snugly fit both the supply lines and the holes in the panel.
- (e) Supply lines must either have at least eight inches' clearance from the engine exhaust system or shall be shielded against direct heat.
- (f) Supply lines must be mounted, braced, and supported to minimize vibration, and shall be protected against damage, corrosion, or breakage due to strain or wear. Supply lines shall be supported at least every 21 to 27 inches.
- (g) Bends in piping or tubing are prohibited if such bends will weaken the pipe or tubing. Bends must be made only with tools designed for this purpose.
- (h) Joints or connections must be located only in accessible locations.
- (i) Hose, metallic hose, or flexible metal hose may be used in place of piping as specified in §13.32(e) and (f) of this title (relating to Hose and Hose Connections).

CNG Safety Rules, §13.135

Installation of Valves

- (a) A manually or electronically operated cylinder service valve must be installed on each fuel cylinder. Any electronically operated cylinder service valve must incorporate in the design a means of manually closing the valve should the valve fail to close electronically.
- (b) In addition to the cylinder service valve, a manual shutoff valve must be installed in an accessible location which will permit isolation of the cylinder(s) from the remainder of the fuel system. Manual shutoff valves on school buses must be installed on the exterior and as near as possible to the front entrance for immediate accessibility to the driver in case of emergency.
- (c) The valve must be securely mounted and shielded or installed in a protected location to minimize damage from vibration and unsecured objects.
- (d) The valve location must be marked with the words "Manual Shutoff Valve." Decals or stencils are acceptable.
- (e) A means must be provided in the system which automatically prevents the flow of gaseous fuel to the engine when the engine is not running even if the ignition is in an "on" position.

(f) When multiple fuel systems are installed on the vehicle, automatic valves must be provided, as necessary, to shut off the fuel not being used.

(g) The fueling system must be equipped with a backflow check valve which will prevent the return of gas from the cylinder to the filling connection.

CNG Safety Rules, §13.136

Installation of Pressure Regulators

(a) An automatic pressure reducing regulator(s) must be installed to reduce the fuel cylinder pressure to a level consistent with the working pressure required by the gas-air mixer.

(b) Means must be provided to prevent regulator malfunctions due to refrigeration effects.

(c) Regulators must be installed so that their weight is not placed on, or supported by, the attached gas lines.

CNG Safety Rules, §13.138

System Testing

(a) The complete CNG fuel-assembly must be leak tested using natural gas or inert gas (carbon dioxide or nitrogen, or a mixture of these).

(b) After installation, every connection must be checked with a non-ammonia soap solution or a leak-detection instrument after the equipment is connected and pressurized to its working pressure.

(c) If a completed CNG fuel system assembly is leak-tested with natural gas, the testing must be done under adequately ventilated conditions.

(e) When a vehicle is involved in an accident or fire causing damage to any part of the CNG fuel system, the system must be retested before being returned to service.

CNG Safety Rules, §13.141

Maintenance and Repair

(a) Damaged supply lines must be replaced, not repaired.

(b) The owner or user, or both, must maintain all cylinders, cylinder appurtenances, piping systems, venting systems, and other components in a safe condition.

(c) As a precaution to keep pressure relief devices in reliable operating condition, care must be taken in the handling or storing of compressed natural gas (CNG) cylinders to avoid damage. Care must also be exercised to avoid plugging by paint or other dirt accumulation of pressure relief device channels or other parts which could interfere with the functioning of the device.

(d) No repair or alteration will be permitted on pressure relief devices.

CNG Safety Rules, §13.142

Venting of CNG to the Atmosphere

All venting of CNG must be done outdoors only, under conditions that will result in rapid dispersion of the product being released. When venting CNG to the atmosphere, consideration must be given for the use of a vent pipe or stack so that a flammable mixture will not reach a point of ignition.

CNG Safety Rules, §13.143

SAMPLE QUESTION

Compression, storage or dispensing installations, excluding automatic dispensers and residential fueling facilities, must be protected from tampering by a chain link type fence a minimum of _____ feet in height.

- A. 8
- B. 7
- C. 6
- D. 5

Answer: C

RESIDENTIAL FUELING FACILITIES

General

(a) All equipment related to a residential fueling facility must be suitably packaged and located to be protected from physical damage and vandalism.

CNG Safety Rules, §13.184

Installation

(c) All residential fueling facility equipment must be installed in accordance with the equipment manufacturer's instructions.

(d) The residential fueling facility must have a nameplate marked with minimum and maximum gas inlet pressure and flow rate, gas outlet maximum pressure, and electrical requirements.

CNG Safety Rules, §13.185

Installation of Pressure Relief Valves

The discharge vent line on a residential fueling facility must be able to withstand the pressure from the relief vapor discharge when the relief valve is in full open position and must permit sufficient pressure relief relieving capacity.

CNG Safety Rules, §13.187

Installation of Pressure Gauges

For measurement and test purposes, pressure gauges may be installed, but are not required.

CNG Safety Rules, §13.188

Piping and Hoses

(b) The maximum length of a fueling hose on a residential fueling facility is limited to 12 feet.

CNG Safety Rules, §13.190

Installation of Emergency Shutdown Equipment

(a) A residential fueling facility must be equipped with emergency manual shutdown of the gas supply power and electrical power.

(b) Break-away protection must be provided in a manner such that, in the event of a pull-away, natural gas will cease to flow at any separation.

CNG Safety Rules, §13.192

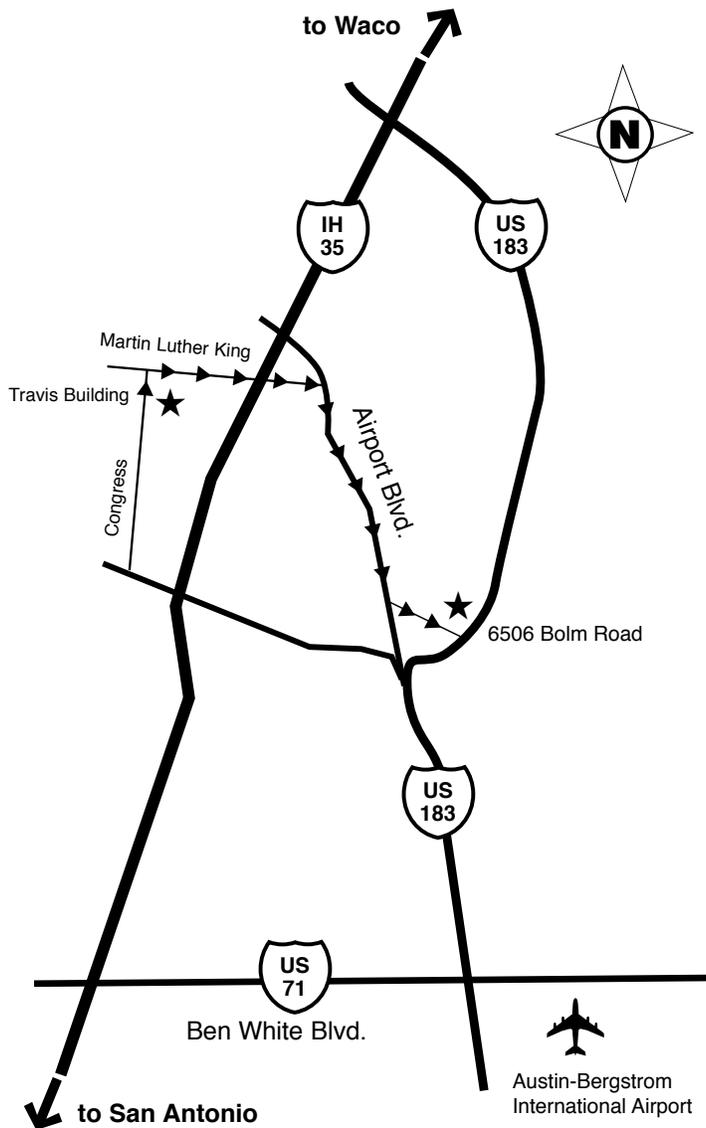
SAMPLE QUESTION

A vehicle is not considered a source of ignition if the fuel-fired equipment is shut off completely before entering an ignition source area.

- A. True
- B. False

Answer: A

RRC/AFRED TRAINING CENTER 6506 BOLM RD., AUSTIN



DIRECTIONS TO RRC ALTERNATIVE FUELS TRAINING CENTER, AUSTIN

From the Travis Building:

Go one block north to Martin Luther King, Jr. Blvd. Turn right on MLK and go about 2 miles to Airport Blvd. Turn right (south) on Airport and go about 1 1/2 miles. The fifth traffic light, just over the railroad bridge, is Bolm Road. Turn left (east) onto Bolm Road and go about 1 mile. 6506 is the last building on the left before U.S. 183.

Entering Austin on I-35 going south:

Take exit 239/240 for Hwy 183 South/ Austin-Bergstrom International Airport. Stay on 183 past Cameron Road, U.S. 290, Manor Road, Loyola Lane, and Techni-Center Drive. Proceed down the hill on 183 and take the Bolm Road exit. At the light, turn right onto Bolm Road. The Training Center is on the northwest corner of 183 and Bolm Road. Enter through the double glass doors on the south side of the building.

Entering Austin on I-35 going north:

Take exit 230 for Texas Hwy. 71/Ben White Blvd. Turn right toward Bastrop. Stay on 71 for approximately 4.3 miles. Exit onto U.S. 183 North. Stay on 183 past the Colorado River bridge. Stay in the right lane and take the Bolm Road exit. Turn left at the light onto Bolm Road and go under the overpass. The Training Center is on the northwest corner of 183 and Bolm Road. Enter through the double glass doors on the south side of the building.