Δ **11.9.1.4** Fuel containers and piping shall be installed so that no gas from fueling and gauging operations can be released inside of the passenger or enclosed compartments of the vehicle.

11.9.1.5 Enclosures, structures, seals, and conduits used to vent enclosures shall be designed and fabricated of durable materials and shall be designed to resist damage, blockage, or dislodgement through movement of articles carried in the vehicle or by the closing of luggage compartment enclosures or vehicle doors and shall require the use of tools for removal.

11.10 Pipe and Hose Installation.

11.10.1 General Requirements.

11.10.1.1 The piping system shall be designed, installed, supported, and secured in such a manner as to minimize damage due to expansion, contraction, vibration, strains, abrasion, UV deterioration, and wear.

11.10.1.2* Pipe, tubing, and hoses shall be installed in a manner that protects them from damage due to accidental contact with stationary objects, impact from stones, mud, or ice, or a vehicular accident.

11.10.1.3 Piping and hose shall be installed in a manner that permits visual inspection.

11.10.1.4 Fastening or other protection shall be installed to prevent damage due to vibration or abrasion.

11.10.1.5 At each point where piping passes through sheet metal or a structural member, a rubber grommet or equivalent protection shall be installed to prevent chafing.

11.10.1.6 Fuel line piping that must pass through the floor of a vehicle shall be installed to enter the vehicle through the floor directly beneath or adjacent to the container.

11.10.1.7 If a branch fuel line is required, the tee connection shall be in the main fuel line outside the passenger compartment of the vehicle.

11.10.1.8 Where liquid service lines of two or more individual containers are connected together, a spring-loaded backflow check valve or equivalent shall be installed in each of the liquid lines prior to the point where the liquid lines tee together to prevent the transfer of LP-Gas from one container to another.

11.10.1.9 Exposed parts of the piping system shall be of corrosion-resistant material or shall be protected to minimize exterior corrosion.

11.10.1.10 Piping systems, including hose, shall be tested and proven free of leaks at not less than normal operating pressure.

11.10.1.11 There shall be no fuel connection between a tractor and trailer or other vehicle units.

11.10.2 Hydrostatic Relief Valves.

11.10.2.1 A hydrostatic relief valve or device providing pressure-relieving protection shall be installed in each section of piping (including hose) in which liquid LP-Gas can be isolated between shutoff valves, so as to relieve to the atmosphere.

11.10.2.2 Hydrostatic relief valves shall have a pressure setting of not less than 400 psig (2.8 MPag) or more than 500 psig (3.5 MPag).

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11.11 Industrial (and Forklift) Trucks Powered by LP-Gas.

11.11.1 Scope. Section 11.11 applies to LP-Gas installation on industrial trucks (including forklift trucks), both to propel them and to provide the energy for their materials-handling attachments.

11.11.2 Industrial Truck Cylinders.

11.11.2.1 Cylinders shall be designed, constructed, or fitted for installation and filling in either the vertical or horizontal position or, if the cylinder is a universal cylinder, in either position.

11.11.2.2 Universal cylinders shall be permitted to be filled in the vertical position or in the horizontal position, provided the positioning hole or slot is in the proper orientation.

11.11.2.3 The fixed maximum liquid level gauge shall indicate the maximum permitted filling level in either position.

11.11.2.4 The pressure relief valves shall be in direct communication with the vapor space of the cylinder in either position.

11.11.2.5 The cylinder vapor or liquid withdrawal valves shall function in either position.

11.11.2.6 The cylinder pressure relief valve discharge shall be directed upward within 45 degrees of vertical and otherwise shall not impinge on the cylinder, the exhaust system, or any other part of the industrial truck.

11.11.2.7 The discharge opening shall be provided with a protective cover to minimize the possibility of the entry of water or any extraneous matter.

Δ **11.11.2.8** Industrial truck cylinders shall have pressure relief valves that conform with 5.9.4.1(C)(11) or 5.9.4.1(C)(12).

Δ **11.11.3 Hose.**

N **11.11.3.1** Hose used in vapor service and greater than 5 ft (1.5 m) in length shall be of stainless steel wire braid construction.

N **11.11.3.2** Hose used in liquid service shall be of stainless steel wire braid construction.

11.11.4 Operations. The operation of industrial trucks (including forklift trucks) powered by LP-Gas engine fuel systems shall comply with 11.11.4.1 through 11.11.4.4.

11.11.4.1 Industrial trucks shall be refueled outdoors.

11.11.4.2 Where cylinders are exchanged indoors, the fuel piping system shall be equipped to minimize the release of fuel when cylinders are exchanged, in accordance with either of the following:

(1) Using an approved quick-closing coupling in the fuel line
(2) Closing the shutoff valve at the fuel cylinder and allowing the engine to run until the fuel in the line is exhausted

11.11.4.3 Where LP-Gas–fueled industrial trucks are used in buildings or structures, the following shall apply:

(1) The number of fuel cylinders on such a truck shall not exceed two.
(2) The use of industrial trucks in buildings frequented by the public, including those times when such buildings are occupied by the public, shall require the approval of the authority having jurisdiction.

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(3) The total water capacity of the fuel cylinders on an individual truck shall not exceed 105 lb (48 kg) [nominal 45 lb (20 kg) propane capacity].
(4) Trucks shall not be parked and left unattended in areas occupied by or frequented by the public without the approval of the authority having jurisdiction. If left unattended with approval, the cylinder shutoff valve shall be closed.
(5) In no case shall trucks be parked and left unattended in areas of excessive heat or near sources of ignition.

11.11.4.4 All cylinders used in industrial truck service (including forklift truck cylinders) shall have the cylinder pressure relief valve replaced in accordance with 5.9.2.14.

11.12 General Provisions for Vehicles Having Engines Mounted on Them (Including Floor Maintenance Machines).

11.12.1 Scope.

11.12.1.1 Section 11.12 applies to the installation of equipment on vehicles that supply LP-Gas as a fuel for engines installed on these vehicles.

11.12.1.2 Vehicles include floor maintenance and any other portable mobile unit, whether the engine is used to propel the vehicle or is mounted on it for other purposes.

11.12.2 General Requirements.

11.12.2.1 Industrial trucks (including forklift trucks) and other engines on vehicles operating in buildings other than those used exclusively to house engines shall have an approved automatic shutoff valve installed in the fuel system.

11.12.2.2 The source of air for combustion shall be isolated from the driver and passenger compartment, ventilating system, or air-conditioning system on the vehicle.

11.12.2.3 Non–self-propelled floor maintenance machinery (floor polishers, scrubbers, buffers) and other similar portable equipment shall be listed.

(A) A label shall be affixed to the machinery or equipment, with the label facing the operator, with the text denoting that the cylinder or portion of the machinery or equipment containing the cylinder shall be stored in accordance with Chapter 8.

(B) The use of floor maintenance machines in buildings frequented by the public, including the times when such buildings are occupied by the public, shall require the approval of the authority having jurisdiction.

11.13 Engine Installation Other Than on Vehicles.

11.13.1 Portable Engines.

11.13.1.1 The use of portable engines in buildings shall be limited to emergencies.

11.13.1.2 Portable engines shall be used only where sufficient air for combustion and cooling is available.

11.13.1.3 Exhaust gases shall be discharged to a point outside the building or to an area in which they will not constitute a hazard.

11.13.1.4 Where atmospheric-type regulators (zero governors) are used on engines operated only outdoors, a separate automatic shutoff valve shall not be required.

11.13.1.5 Engines used to drive pumps and compressors shall be equipped in accordance with 5.20.7.

11.14 Garaging of Vehicles. Where vehicles with LP-Gas engine fuel systems mounted on them, and general-purpose vehicles propelled by LP-Gas engines, are stored or serviced inside garages, the following conditions shall apply:

(1) The fuel system shall be leak-free.
(2) The container shall not be filled beyond the limits specified in Chapter 7.
(3) The container shutoff valve shall be closed when the vehicle or the engine is being repaired, except when the engine is required to operate. Containers equipped with an automatic shutoff valve as specified in 11.4.1.7 satisfy this requirement.
(4) The vehicle shall not be parked near sources of heat, open flames, or similar sources of ignition or near inadequately ventilated pits.

Δ Chapter 12 Motor Vehicles Intended for Over-the-Road Use or Designed to Transport Passengers and Are Fueled by LP-Gas

12.1 Scope.

12.1.1* This chapter applies to the design, installation, operation, and maintenance of LP-Gas fuel system components and ASME containers installed on motor vehicles intended for onroad use, where LP-Gas is used for the engine propulsion of the vehicle.

12.1.2 This chapter shall not apply to vehicles qualified under the U.S. Federal Motor Vehicle Safety Standards (FMVSS).

12.1.3 This chapter shall not apply to LP-Gas systems used on boats.

12.1.4 Where the term *LP-Gas* is used, the requirements of this chapter include and apply equally to any material that is composed predominantly of any of the following hydrocarbons or a mixture of them: propane, propylene, butane (normal butane or isobutane), and butylenes.

Δ **12.1.5** With the permission of the Canadian Standards Association (operating as CSA Group), certain material contained within Chapter 12 hereof is reproduced from CSA Group standard, B149.5 entitled *Installation Code for Propane Fuel Systems and Containers on Motor Vehicles*, which is copyrighted by CSA Group, 178 Rexdale Blvd., Toronto, ON, M9W 1R3. This material is not the complete and official position of CSA Group on the referenced subject, which is represented solely by the standard in its entirety. While use of the material has been authorized, CSA Group is not responsible for the manner in which the data is presented, nor for any interpretations thereof. For more information or to purchase standards from CSA Group, please visit http://shop.csa.ca/ or call 1-800-463-6727.

• *N* **12.2 Installation of Components and Systems.** Components and systems shall be installed in accordance with the manufacturer's instructions.

12.3 ASME Containers, Materials, and Equipment.

12.3.1 General.

12.3.1.1 Materials in contact with LP-Gas shall be compatible with LP-Gas and recommended by the manufacturer for their intended service.

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12.3.1.2* A cylinder *(see 3.3.18)* shall not be utilized as a permanent container to supply fuel to an LP-Gas vehicle engine.

12.3.1.3* Where the materials and equipment referred to in this chapter are not addressed by any standards referenced in this code, the requirements of ECE R67.01, *Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts Which Can Be Fitted and/or Be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions,* shall be used to evaluate those materials and equipment.

(A)* Evaluations and testing shall be performed by an approved testing laboratory.

(B) Cold weather testing shall be performed at a temperature no warmer than -40°F (-40°C).

12.3.2 ASME Containers.

12.3.2.1 ASME containers used for any LP-Gas application shall comply with the applicable requirements in 11.3.1, 11.3.3, and 11.3.4.

12.3.2.2 ASME containers manufactured after April 1, 2001, and for use on vehicles within the scope of this chapter, shall have a design pressure of not less than 312 psig (2150 kPag).

12.3.2.3 The capacity of individual containers shall comply with 6.26.3.1(C).

Δ **12.3.2.4** The maximum aggregate capacity of containers supplying fuel to a LP-Gas–powered vehicle shall be 300 gal (1.1 m^3) water capacity.

12.3.2.5* A new or reconditioned ASME container, or an ASME container that has had its interior exposed to the atmosphere, shall be purged and have contaminants removed prior to being filled with LP-Gas.

12.3.2.6 ASME containers having internal electrical components within them shall not be prepared for service by purging with LP-Gas unless the components are de-energized and the entire vehicle, including the LP-Gas system, is grounded to earth.

12.3.2.7 An ASME container intended for vapor service only shall be installed or equipped in a manner to minimize the possibility of withdrawing liquid LP-Gas.

12.3.2.8 Openings in an LP-Gas ASME container other than those for the pressure relief valve and liquid level gauge shall bear a stamped or durable adhesive label.

N **12.3.2.8.1** The label shall be made of metal or of a material that is resistant to the effects of water, UV radiation exposure, and temperature extremes.

N **12.3.2.8.2** The label or stamp shall be adjacent to the inlet and outlet openings and designate the vapor or liquid service of the opening.

N **12.3.2.8.3** The label shall be marked with lettering a minimum of 0.25 in. (6.4 mm) in height.

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12.3.2.9 Multiple-function valves with integrated functions in a single body or flange shall be permanently marked to indicate whether the openings in the valves communicate with the liquid or vapor space in the ASME container.

12.3.3 ASME Container Appurtenances and Pressure Relief Valves.

12.3.3.1 Container appurtenances shall comply with the applicable requirements of Section 11.4.

12.3.3.2 ASME container appurtenances, other than pressure relief valves, shall be rated for at least the maximum allowable working pressure (MAWP) of the ASME container, as indicated on the ASME data plate.

12.3.3.3 An ASME container shall be provided with one or more internal spring-type pressure relief valves in accordance with 5.9.2.

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N **12.3.3.4** Manifold ASME containers shall consist of two or more containers fabricated by the original manufacturer interconnected to each other by rigid, integral, nonremovable liquid and vapor passages and braced to form a single rigid unit that is certified under the ASME *Boiler and Pressure Vessel Code* as a single pressure vessel.

12.3.3.5 Manifold ASME containers with interconnecting piping providing adequate relief capacity and one or more pressure relief valves shall not require a pressure relief valve on each container.

12.3.4 Fixed Maximum Liquid Level Gauges.

12.3.4.1 Systems installed with fixed liquid level gauges shall have a water- and weather-resistant label placed near the bleeder valve with the following text: "Do not use fixed maximum liquid level gauge at low-emissions fueling stations. OPD verification shall be done elsewhere."

12.3.4.2 The use of a fixed maximum liquid level gauge during refilling shall not be required where the ASME container is equipped with an overfilling prevention device (OPD) in accordance with 12.3.7.

12.3.5 Filler Valves and Excess-Flow Valves.

12.3.5.1 Filler valves and excess-flow check valves shall be listed in accordance with UL 125, *Standard for Flow Control Valves for Anhydrous Ammonia and LP-Gas (Other than Safety Relief).*

12.3.5.2 Filler valves shall comply with 5.9.4.1(C)(7) and shall be installed in the fill opening of the container.

12.3.5.3 A filler valve used for remote filling shall be permitted to incorporate a single backflow check valve and shall be connected to the filler valve on the container by metal tubing or hose.

12.3.5.4 Engine fuel systems installed after January 1, 2020, shall incorporate the fill connection of quick-connect/release Type K15 in accordance with ISO/DIS 19825, *Road vehicles — Liquefied petroleum gas (LPG) refuelling connector.*

12.3.6 Fuel Supply Control Valves.

12.3.6.1 An LP-Gas fuel supply line on an ASME container shall be equipped with a manual shutoff valve that incorporates an internal excess-flow valve.

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12.3.6.2 The excess-flow valve shall meet the following requirements:

(1) Either be part of the valve (where installed in a dedicated opening), internal to the container, or be located in the opening portion of a multipurpose valve body or manifold, in the container opening
(2) Be of the fully internal type
(3) Have a rated flow not exceeding the flow capacity of the piping, tubing, or hose it is protecting

12.3.6.3 The fuel delivery system shall be designed to prevent the flow of fuel to the engine unless the engine is operating or the system is preparing to begin engine operation.

12.3.6.4 Flow control and purge valves shall maintain the operating pressure of the fuel delivery system within the design MAWP.

N **12.3.6.5** Where installed, a purge valve shall remove vapor from liquid fuel lines prior to engine operation.

12.3.6.6 Electric solenoid valves shall be listed in accordance with UL 125, *Standard for Flow Control Valves for Anhydrous Ammonia and LP-Gas (Other than Safety Relief)*.

12.3.7 Overfilling Prevention Devices.

Δ **12.3.7.1** All LP-Gas ASME containers manufactured after January 1, 1984, shall be equipped with a listed overfilling prevention device (OPD).

12.3.7.2 Overfilling prevention devices shall be listed in accordance with UL 2227, *Standard for Overfilling Prevention Devices*.

12.3.7.3 ASME containers shall be filled in compliance with Section 11.5.

12.3.7.4 Where the overfilling prevention device is used as the primary means to fill the ASME container, the fixed maximum liquid level gauge or other approved means shall be used at least once annually to verify the operation of the overfilling prevention device.

12.3.7.4.1 If the container is found to be overfilled during the test, corrective action shall be taken.

12.3.7.4.2 The result of the verification attempt shall be documented.

12.3.7.4.3 A label shall be affixed to the container near the fill point indicating the date of the next required verification test.

12.3.8 Fuel Pumps.

Δ **12.3.8.1** Fuel pumps shall comply with Annex 4 of ECE R67.01.

12.3.8.2 The fuel delivery system shall be designed so that the pressure inside the ASME container does not exceed its MAWP.

12.3.8.3 Modifications to fuel pumps used on high-pressure direct injection systems shall only be performed in accordance with the LP-Gas fuel system manufacturer's requirements.

12.3.8.4 Modifications to fuel pumps used on high-pressure direct injection systems shall comply with the following:

(1) Modifications shall only be performed by the LP-Gas fuel system manufacturer.
(2) Modified or remanufactured fuel pumps shall have been tested to verify compatibility with the MAWP of the fuel system prior to installation.
(3) Where modified or remanufactured fuel pumps are used, the pump or the vehicle shall be marked with the pump modifier's name, the date of the modification or remanufacturing, and the maximum allowable working pressure (MAWP) prior to installation.

12.3.9 Fuel Injectors, Fuel Rails, and Distribution Blocks.

Δ **12.3.9.1** Fuel injectors, fuel rails, distribution blocks, and fuel-switching devices shall comply with the requirements of Annex 11 of ECE R67.01.

N **12.3.9.2** Where installed, a distribution block shall establish a connection point to convey fuel from the container to other components in the fuel system.

12.3.9.3* Electrical connections for fuel injectors shall comply with SAE J1292, *Automobile and Motor Coach Wiring*, and shall plug into the harness with either a direct connection using the same connector or an adapter.

N **12.3.9.4** Where installed, a fuel rail shall deliver regulated quantities of fuel to the injectors.

12.3.9.5* Fuel rails and distribution blocks shall be fabricated from corrosion-resistant materials compatible with LP-Gas and other fluids in the engine compartment and shall be rated for the maximum design pressure within the system.

12.3.9.6 Fuel rails and distribution blocks shall be marked with the model number, MAWP, and manufacturer's name.

12.3.9.7 Distribution blocks and other components on systems operating at pressures greater than 350 psig (2.4 MPag) shall be designed and rated for their intended pressures and shall incorporate into their design a means for protecting downstream fuel lines and components that are designed for a lower operating pressure, from exposure to pressures in excess of their ratings.

12.3.9.8* Distribution blocks and other components that are capable of retaining liquid between two positive shutoff valves shall have a means to protect the system from pressures exceeding its rated maximum operating pressure.

N **12.3.9.9** Where installed, a fuel-switching device shall provide a means for delivering dissimilar fuels to common fuel system components.

12.3.9.10 Fuel-switching devices used on bifuel vehicles shall be designed to prevent the unintended migration of either fuel into the container or piping system of the other fuel.

Δ **12.3.9.11** Fuel-switching devices shall be marked with a MAWP that is equal to or greater than that of the systems in which they are installed.

12.3.10 Piping and Tubing.

12.3.10.1 Pipe shall comply with 11.7.1.

12.3.10.2 Fittings shall comply with 11.7.2.

12.3.10.3 LP-Gas vapor-phase piping with design pressures not exceeding 125 psig (860 kPag) shall be at least Schedule 40.

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12.3.10.4 Vapor phase piping with design pressures over 125 psig (860 kPag) and all liquid piping shall be at least Schedule 80.

Δ **12.3.10.5** Tubing shall be stainless steel, brass, or copper and shall comply with 11.7.1.2.

12.3.11 Joints, Fittings, and Connections.

12.3.11.1 Pipe joints shall be threaded, welded, or brazed.

12.3.11.2 A pipe or pipe fitting thread shall be tapered and shall comply with ANSI/ASME B1.20.1, *Pipe Threads, General Purpose, Inch.*

Δ **12.3.11.3** Tube fittings operating at a pressure below 125 psig (860 kPag) shall be made of steel, stainless steel, brass, or anodized aluminum with a design pressure of not less than 125 psig (860 kPag).

Δ **12.3.11.4** Tubing and fittings operating above 125 psig (860 kPag) shall be rated for a minimum of 250 psig (1725 kPag) or the design pressure of the system, whichever is greater.

12.3.11.5 Joints in the tubing shall be made by means of a flare joint, compression fitting, or other approved fitting that is compatible with the tubing.

12.3.11.6 A bulkhead fitting used to secure a LP-Gas fuel line passing through a partition, firewall, frame, or other such vehicle part shall meet the following requirements:

(1) Be made of either steel, brass, or anodized aluminum, and rated for the service pressure of the fuel line
(2) Use a flare, tapered pipe, compression fitting, or other approved fitting to connect the LP-Gas fuel line fitting to the bulkhead fitting

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12.3.11.7 The separation and disconnection of quick-connect fittings shall require either two separate actions, a special removal tool, or another means to prevent unintended separation.

N **12.3.11.8** Quick-connect fittings shall be rated by the manufacturer for the specific application and use.

12.3.11.9 Bulkhead fittings for protecting penetrations of piping or tubing shall be steel or brass.

12.3.11.10 Nesting of bushings shall be prohibited.

12.3.11.11 A pipe fitting containing both left-hand and right-hand threads shall not be used.

12.3.11.12 A bend in piping or tubing shall be as follows:

(1) The minimum bend radius shall be equal to or greater than that recommended by the fuel line manufacturer.
(2) All bends shall be made with tooling recommended by the fuel line manufacturer.

12.3.12 Hose.

12.3.12.1 Hose and hose fittings used for vapor service shall be constructed of a material resistant to the action of LP-Gas.

12.3.12.2 Hose and hose fittings shall be rated by the manufacturer of the hose for the service, with a minimum pressure rating of the greater between 350 psig (2.4 MPag) or the rated pressure of the system.

12.3.12.3 Hose and hose fittings in liquid service shall comply with UL 21, *Standard for LP-Gas Hose*, or CSA CAN/CGA-8.1-M86, *Elastomeric Composite Hose and Hose Couplings for Conducting Propane and Natural Gas*, Type III.

12.3.12.4 Hose and hose fittings in liquid service shall be of either stainless -steel or synthetically reinforced and recommended for the intended use.

12.3.12.5 Hose shall be marked with the following information:

(1) LP-GAS HOSE or LPG HOSE
(2) Maximum working pressure
(3) Manufacturers' name or coded designation
(4) Month or quarter and year of manufacture
(5) Product identification

12.3.12.6 Hose assemblies shall be assembled and tested in accordance with the hose manufacturer's recommendations.

12.3.12.7 Minimum test pressures for assemblies shall be 120 percent of the rated working pressure.

12.3.12.8 Bends in installed sections of hose shall be equal to or greater than the minimum bend radius recommended by the manufacturer.

12.3.12.9 Hose sections shall be secured to minimize chaffing, rubbing, or abrasion.

12.3.12.10* The temperature of hose shall not exceed its maximum rated temperature.

12.3.12.11 Sections of hose that have been kinked or bent beyond their minimum bend radius or otherwise weakened shall be replaced prior to placing the vehicle into service.

12.3.13 Vaporizers, Pressure Regulators, and Carburetors.

12.3.13.1 Every vaporizer and pressure regulator shall be of sufficient size to provide the required flow and system-required regulated outlet pressure of LP-Gas, at the rated extremes of inlet pressures.

12.3.13.2 Carburetors, carburetor mixers, and carburetor adapters shall be recommended for the application by the manufacturer of the equipment.

12.3.13.3 Vaporizers, pressure regulators, carburetors, carburetor mixers, and carburetor adapters shall not be fabricated or modified by an installer.

12.3.13.4 Vaporizers, pressure regulators, and carburetors shall be listed to UL 1337, *Outline of Investigation for LP-Gas, Natural Gas, and Manufactured Gas Devices for Engine Fuel Systems.*

12.3.14 Wiring.

12.3.14.1* Electrical wiring and connectors used on vehicles shall be recommended by the manufacturer for automotive applications.

12.3.14.2 All wiring shall be of the stranded type.

12.3.14.3 All wiring shall have insulation recommended by the manufacturer for automotive use equal to or greater than the wire type used in the wiring of the vehicle and shall be of a gauge size sufficient for the rated current of the circuit in maximum amperes of normal operational power levels.

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N **12.3.14.4** Soldered connections shall be sealed with shrink tubing.

N **12.3.14.5** Where installed, a power supply bushing shall be used to seal the electrical conductors passing from the inside to the outside of the ASME container.

Δ **12.3.14.6** Electrical power supply bushings installed within the container and used for conducting electricity into the container for any purpose shall be made from a material compatible with LP-Gas, in accordance with the following:

(1) The power supply bushing shall be rated to operate at a pressure of not less than 1.5 times the MAWP of the container.
(2) The power supply bushing shall be designed in such a way that it is installed from the inside of the container or the appurtenance and shall not be capable of blowing out in the event of a failure of the retaining fixtures.
(3) The power supply bushing shall have mating electrical connectors complying with SAE J2223-1, *Connections for On-Board Road Vehicle Electrical Wiring Harnesses — Part 1: Single-Pole Connectors — Flat Blade Terminals — Dimensional Characteristics and Specific Requirements*, and SAE J2223-3, *Connections for On-Board Road Vehicle Electrical Wiring Harnesses — Part 3: Multipole Connectors — Flat Blade Terminals — Dimensional Characteristics and Specific Requirements*, and such connections shall permit disconnection for service and inspection without removing the fitting or damaging the wiring harness.
(4) The power supply bushing conductors shall be compatible with LP-Gas and resistant to chemical or electrolysis corrosion.
(5) The power supply bushing shall be approved in accordance with Annex 3 of ECE R67.01.

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N **12.3.15 Evaporative Emissions Control.**

N **12.3.15.1** LP-Gas system evaporative emissions control devices shall be managed by the LP-Gas system controller.

N **12.3.15.2** LP-Gas system evaporative emissions control devices shall be designed so that all captured vapors are retained and controlled.

12.4 LP-Gas Fuel Systems.

12.4.1 General.

12.4.1.1 Accessories, components, and equipment shall be installed in accordance with the manufacturer's installation instructions and this Code.

12.4.1.2 Where an ASME container is being repaired, removed, or scrapped, its liquid contents shall be removed by flaring or by transfer to another ASME container, or the gas shall be vented in accordance with Section 7.3.

Δ **12.4.1.3** Replacement parts shall be at least the equivalent of the original part with respect to its performance and safety attributes and shall be compatible with the original equipment.

12.4.1.4 Smoking, welding, torch cutting, grinding, or any other source of ignition shall not be permitted in the area where work is being done on piping, tubing, or equipment that contains or has contained LP-Gas unless the piping, tubing, or equipment has been purged of LP-Gas.

12.4.1.5 Before returning an ASME container purged of LP-Gas back into service, the ASME container and all connecting components and fuel lines shall be tested by pressurizing the ASME container and connecting components to 140 psig (965 KPag) using LP-Gas, air, or an inert gas, and the system shall not experience a loss of pressure for a minimum time of 10 minutes.

Δ **12.4.1.6** Fuel shall not be released from a system in an enclosed area or within 35 ft (11 m) of any sources of ignition.

12.4.1.7 Where a vehicle is configured to operate on LP-Gas only, existing gasoline or diesel tank fill connections shall have their fill connections removed or plugged after purging of any residual fuel or vapors.

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12.4.1.8 An ASME container providing engine fuel for the vehicle shall not be mounted on a trailer or an articulated portion of a vehicle separate from the portion where the engine is mounted.

12.4.1.9 The use of a cargo tank for supplying fuel to an engine powering a cargo tank LP-Gas motor vehicle shall be permitted when the cargo tank is mounted on the same frame as the engine and the installation is compatible with the specific engine system installed.

12.4.1.10 The source of combustion air for an LP-Gas fueled engine shall be isolated from the ventilating or air-conditioning system of the vehicle.

12.4.1.11 Any part of the LP-Gas fuel system equipment that utilizes a drain valve or plug shall have the drain valve or plug located in the lowest possible position unless the equipment is removable for maintenance purposes.

12.4.1.12 Equipment service drains or pressure taps shall be capable of attaching a hose or tube for the remote discharge.

Δ **12.4.1.13** ASME container fittings shall be leak checked with a liquid leak detector solution or listed combustible gas detector after the equipment is connected, activated, and pressurized.

N **12.4.1.14** If leakage is detected, leaks shall be repaired before the container is put into service.

12.4.1.15 When a vehicle is involved in an accident or fire, the system shall be inspected and tested prior to being put back into service.

12.4.2 Training Requirements.

Δ **12.4.2.1*** Each person engaged in installing or maintaining a LP-Gas engine fuel system shall be trained as follows:

(1) In accordance with the requirements of Section 4.4
(2) With general training on the nature of LP-Gas engine fuel systems and their components
(3) With training on the specific LP-Gas fuel system to be installed or maintained

N **12.4.2.2** All training in accordance with 12.4.2.1 shall be documented.

12.4.3 Welding. Welding shall be performed as follows:

(1) Welding shall be performed in accordance with the ASME *Boiler and Pressure Vessel Code*.
(2) Welding shall be performed by a certified ASME pressure vessel welder with an ASME "U" or "R" certification.

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(3) Welding by a qualified welder for brackets or other attachments shall be permitted on weld pads or other non-pressure containing portions of the ASME container.
(4) Welding of attachments or supports to ASME containers shall not reduce the structural integrity of the ASME container.

12.4.4 Structural Requirements for Mounting ASME Containers. ASME containers shall be mounted and fastened in accordance with the following:

(1)* ASME containers shall be installed to prevent them from jarring loose and slipping or rotating.
(2) The fastenings shall be designed and constructed to withstand static loading in any direction equal to four times the weight of the container filled with fuel.
(3)* Prior to being returned to service, an ASME container shall be inspected to determine its suitability for continued service.
(4) Structural members that have been drilled shall be protected from corrosion.
(5)* ASME container mounting brackets shall be provided by or recommended by the ASME container manufacturer and shall be provided with a resilient material to be installed between the supports or clamping bands and the ASME container such that there is no direct metal-to-metal contact.
(6) Welding shall not be used as a means of attaching ASME container brackets to a vehicle.
(7) ASME containers shall not be used as structural members.
(8) Filling connections for ASME containers shall be located such that the attendant is not required to lay on the ground.
(9) Filling connections and related fittings shall not be installed in a manner that will necessitate access for filling from the passenger compartment or any contiguous portion of the vehicle where the potential for vapors to migrate into the passenger compartment is possible.
(10) ASME containers and their means of attachment shall be protected from corrosion and abrasion.

12.4.5 ASME Containers Located within Vehicles. ASME containers located within an enclosed space of a vehicle shall be installed in accordance with either 12.4.5.1 or 12.4.5.2.

12.4.5.1* The ASME container and its appurtenances shall be installed in an enclosure that is securely mounted to the vehicle.

(A) The enclosure shall be gastight with respect to driver or passenger compartments and to any space containing radio transmitters or other sources of ignition.

(B) The enclosure shall be vented to the outside of the vehicle.

Δ **12.4.5.2** The ASME container appurtenances and their connections shall be installed in an enclosure on the ASME container.

(A) The appurtenances and their connections shall be installed in an enclosure that is gastight with respect to the driver or passenger compartments or with any space.

(B) The enclosure shall be vented to the outside of the vehicle.

Δ **12.4.5.3** ASME containers and piping shall be installed so that no gas from fueling and gauging operations can be released inside of the passenger or enclosed compartments of the vehicle.

12.4.5.4 Enclosures, structures, seals, and conduits used to vent enclosures shall be designed and fabricated to resist damage, blockage, or dislodgement through movement of articles carried in the vehicle or by the closing of luggage compartment enclosures or vehicle doors and shall require the use of tools for removal.

12.4.5.5 The remote fill outside fittings shall be located so as to provide access for refueling without requiring a person to lie on the ground.

12.4.6 Multiple ASME Containers. Multiple ASME container installations shall be installed in accordance with 12.4.4, 12.4.5, and the following:

(1) Multiple ASME containers shall either have separate fill connections, or the system shall be designed to prevent the overfilling or over-pressurization of any of the containers.
(2) Where individual ASME containers are interconnected by piping, tubing, or hoses, each liquid withdrawal line shall be equipped with a backflow check valve or an equivalent means of preventing unintended transfer between containers.
(3) Multiple ASME containers installed with separate fill connections located on separate sides of the vehicle, or that are separated by a distance greater than 3 ft (1 m), shall each have all applicable safety markings and labels on the containers and at each fill connection.

12.4.7 ASME Container Road Clearances. Where an LP-Gas container is substituted for the fuel container installed by the original manufacturer of the vehicle, the LP-Gas container either shall fit within the space in which the original fuel container was installed or shall comply with either of the following:

(1) Containers installed between axles shall not be lower than the lowest point forward of the container on the following points:
  (a) Lowest structural component of the body as illustrated in Figure 12.4.7
  (b) Lowest structural component of the frame or subframe
  (c) Lowest point on the engine
  (d) Lowest point of the transmission (including the clutch housing or torque converter housing, as applicable)
(2) Containers installed behind the rear axle and extending below the frame shall not be lower than the lowest of the following points and surfaces:
  (a) Containers shall not be lower than the lowest point of a structural component of the body, engine, and transmission (including clutch housing or torque converter housing, as applicable) forward of the container.

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(b) Containers shall not be lower than lines extending rearward from each wheel at the point where the wheels contact the ground directly below the center of the axle to the lowest and most rearward structural interference, as illustrated in Part 2 of Figure 12.4.7. This determination shall be made when the vehicle is loaded to its gross vehicle weighted rating (GVWR) of the vehicle.

Δ **12.4.8 ASME Container Protection.** ASME containers shall comply with the following:

(1) An ASME container shall be located to minimize the possibility of damage due to external forces.

(2) If mounted within 10 in. (254 mm) of the engine or the exhaust system, not including the catalytic converter, an ASME container shall be protected with a radiation heat shield located not less than 1 in. (25 mm) from the ASME container.

(3) Adhesive heat shielding/radiant barriers that are recommended by the manufacturer for automotive application shall be permitted to be affixed to the ASME container.

(4) Modifications of a spare tire well to accommodate the installation of an ASME container shall be permitted, provided the space between the opening created in the tire well and the surface of the ASME container is sealed to prevent the infiltration of water and road debris.

(5) An ASME container shall not be mounted within 8 in. (203 mm) of a catalytic converter unless thermal protection is provided to maintain the pressure in the container below the MAWP.

(6) An ASME container shall not project beyond the side of the vehicle.

(7) No part of an ASME container shall be located above the highest point of the vehicle as received from the manufacturer or ahead of the front axle of a self-propelled vehicle.

(8) An ASME container located behind the rear axle of a passenger bus with a frame and body that are constructed as a single assembly without a separate frame on which the body is installed shall comply with all of the following:

(a) The vehicle bumper shall be reinforced by the addition of two 2 in. × 2 in. × 0.25 in. (50 mm × 50 mm × 6.4 mm) hollow square steel members (or equivalent) attached to the existing bumper mounting points.

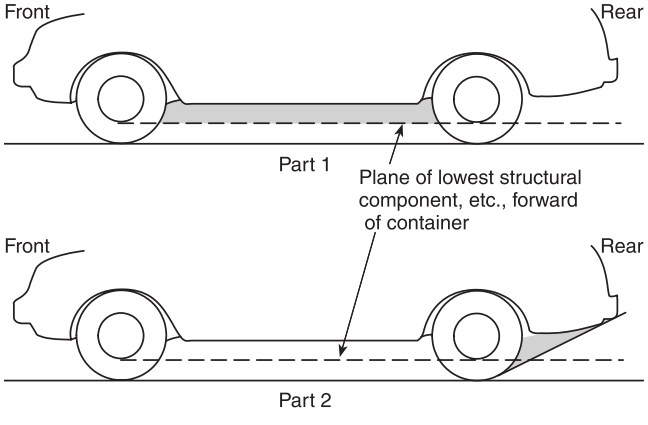


FIGURE 12.4.7 Plane of Lowest Structural Component for Container Placement with Vehicle Loading.

(b) The ASME container shall be located as follows:

i. A minimum of 4 in. (100 mm) from the differential housing

ii. Not less than 12 in. (305 mm) from the rearmost point of the bumper to the ASME container, ASME container valve(s), or any ASME container appurtenance — unless the bumper is reinforced

iii. As high as practical without modifying the vehicle structure *(see Figure 12.4.8)* and in accordance with 12.4.7

12.4.9 Protection for Appurtenances and Remote Fill Connections and Fittings. All valves, connections, and gauging devices on an ASME container shall be protected from external damage in accordance with the following:

(1) All openings greater than a No. 54 orifice shall be protected by an excess flow valve or a double back check valve or shall be protected from shearing forces by recess or guarding.

(2) Parts of the vehicle shall be permitted to provide protection to valves and fittings.

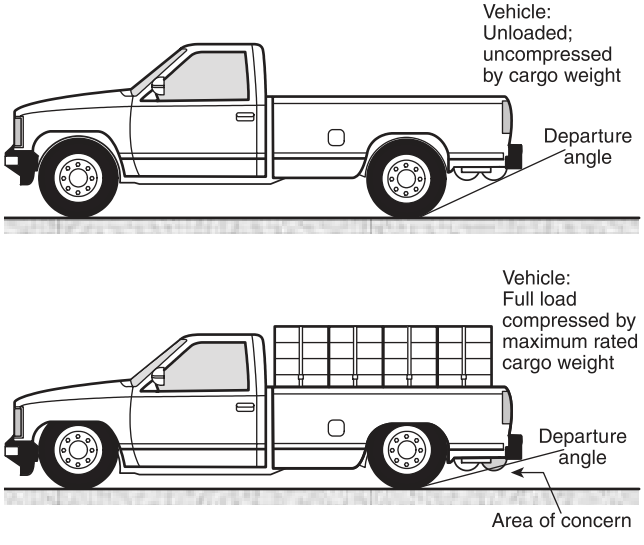
(3) Filling and gauging fittings in a location remote from the ASME container shall be protected from physical damage by one of the following means:

(a) In a metal enclosure, or using another material that provides an equivalent level of protection to that provided for the fuel receptacle, which is permanently mounted to the vehicle and does not protrude outside the vehicle's body

(b) Located in such a way that the rear bumper or another part of the vehicle will provide protection

(c) By attachment of the protective devices that are designed and installed to fail prior to the failure of the container

(d) By not mounting remote valves and fittings in or on the bumpers of a vehicle or beyond the portion of the body from which the bumper protrudes



Δ **FIGURE 12.4.8 ASME Container Mounted Behind the Rear Axle.**

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(4) Valves and appurtenances shall either be constructed of corrosion-resistant material or be coated or protected to minimize exterior corrosion.

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Δ **12.4.10 Pressure Relief and Hydrostatic Pressure Control.** Pressure relief valves and hydrostatic relief valves shall be installed in accordance with the following:

(1) Pressure relief valves shall be installed to communicate with the vapor space of the ASME container.
(2) The system shall be designed to ensure that during normal operation or refueling the pressure relief valve will not open.
(3) Shutoff valves or other equipment shall not be installed between the pressure relief valves and the opening in the ASME container.
(4) Where liquefied LP-Gas is isolated in piping or between shutoff valves, hydrostatic pressure shall be controlled by one of the following methods:
   (a) A backflow check valve or internal relief valve that is installed in such a manner as to relieve any increase in pressure in the isolated portion of the fuel lines, either into the container or into another portion of the system that is protected by a hydrostatic relief valve
   (b) A hydrostatic relief valve complying with Section 5.15
   (c) Any method recommended by the manufacturer
(5) The discharge of the hydrostatic relief valve shall be located outside the engine compartment and in accordance with 12.4.10.
(6) The discharge of an installed hydrostatic pressure relief valve underneath the vehicle shall be directed downward and away from any potential sources of ignition, the catalytic converter, or any portion of the exhaust system.

Δ **12.4.11 Pressure Relief Valve Discharge System.** The pressure relief valve discharge from an ASME container shall be in accordance with the following:

(1) It shall be sized for the minimum required flow rate for all relief valves it serves.
(2) It shall be directed upward or downward within 45 degrees of vertical.
(3) It shall not directly impinge on the ASME container(s), the exhaust system, or any other part of the vehicle.
(4) It shall not be directed into the interior of the vehicle.
(5) Where the pressure relief valve discharge is piped away, the pipe-away system shall have a breakaway adapter in accordance with the following:
   (a) The breakaway adapter shall have a melting point greater than the melting point of the hose or conduit connected to it for the purpose of redirecting discharged pressure.
   (b) The breakaway adapter either shall be an integral part of the pressure relief valve or shall be a separate adapter attached directly to the pressure relief valve.
   (c) The pipe-away system shall be permitted to utilize a length of nonmetallic hose or conduit with a melting point less than the pipe-away adapter connected to the pressure relief valve. The hose or conduit shall be permitted to have metallic reinforcement.
   (d) The nonmetallic hose shall be as short as practical and shall be able to withstand the downstream pressure from the pressure relief valve in the full open position, and the hose shall be fabricated of materials resistant to the action of LP-Gas.
   (e) Where hose is used to pipe away the pressure relief valve discharge on ASME containers installed on the outside of the vehicle, the breakaway adapter and any attached fitting shall deflect the pressure relief valve discharge upward or downward within 45 degrees of vertical and shall meet the other requirements of 11.8.5.1 without the hose attached, and any additional fitting necessary to meet this requirement shall have a melting point not less than that of the pipe-away adapter connected to the pressure relief valve or the discharge hose/conduit.
   (f) The pipe-away system shall have a protective cover to minimize the possibility of the entrance of water or dirt into either the pressure relief valve or its discharge system, and the cover shall not restrict the flow.
   (g) No portion of the system shall have an internal diameter less than the minimum internal diameter of the recommended breakaway adapter.
   (h) The breakaway adapter either shall be threaded for direct connection to the pressure relief valve and shall not interfere with the operation of the pressure relief valve, or it shall be an integral part of the pressure relief valve and shall break away without impairing the function of the pressure relief valve.
   (i) The pipe-away system connections shall be mechanically secured, shall not depend on adhesives or sealing compounds, and shall not be routed between a bumper system and the vehicle body.
   (j) Where a pipe-away system is not required, the pressure relief valve shall have a protective cap or cover to protect it from water or debris.

12.4.12 Shutoff Valves. ASME container shutoff valves shall be installed in accordance with the following:

(1) A manual shutoff valve on an ASME container shall be accessible.
(2) Where the manual shutoff valve is not visible from the outside of the vehicle, a label visible with an arrow pointing to the area of the valve, and marked "Shutoff Valve" shall be affixed.
(3) An electrically operated solenoid valve shall be installed in the ASME container.
(4) All safety controls for the original fuel pump, including but not limited to crash sensors, inertia switches, run dry protection, or other safety functions, shall be retained and fully functional when operating the LP-Gas shutoff valve for bifuel systems.

Δ **12.4.13* Fuel Pumps.** Fuel pumps shall comply with the following:

(1) ASME containers with the fuel pump installed inside shall be identified by the words "Fuel Pump Inside."
(2) The electrical power to a fuel pump shall be switched off in the event of a crash that actuates a crash sensor, if so equipped.
(3) All safety controls for the fuel pump, including, but not limited to, crash sensors, inertia switches, run dry protection, or other safety functions, shall be retained and fully

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functional when operating the fuel pump for either bifuel or monofuel systems.

(4) All fuel pump power circuits shall be fuse protected.

(5) To prevent overpressurization, fuel pump discharge piping shall have a means of relieving pressure inside the ASME container in the event of a restriction or blockage in the discharge piping.

(6) Internal fuel pump wiring shall have an insulation material that is compatible with LP-Gas.

(7) Internal fuel pump wiring connectors shall comply with SAE J2223-1, *Connections for On-Board Road Vehicle Electrical Wiring Harnesses — Part 1: Single-Pole Connectors — Flat Blade Terminals — Dimensional Characteristics and Specific Requirements*, and SAE J2223-3, *Connections for On-Board Road Vehicle Electrical Wiring Harnesses — Part 3: Multipole Connectors — Flat Blade Terminals — Dimensional Characteristics and Specific Requirements*.

(8) Internal fuel pump wiring shall be secured in a manner that prevents damage from vibration, chaffing, or abrasion.

12.5 Electrical Installation.

12.5.1 The electrical components of the LP-Gas fuel system shall be protected against overloads, with at least one separate fuse that is sized for the rated load of the system provided, and its location shall be marked in the operator's manual.

12.5.2 Electrical cables shall be protected from damage due to flexing, abrasion, and other stresses, and they shall be secured to the vehicle chassis or other vehicle structure.

12.5.3 Installed sections of wire(s) shall be enclosed in a protected sheath of materials recommended by the manufacturer for that application.

12.5.4 The use of electrical tape to insulate bare wire connections shall not be permitted.

12.5.5 Installed sections of wiring shall be protected from abrasion, chaffing, snags, or external forces.

12.5.6 Electrical connections shall be sized for the rated load and shall be made with sealed connections having positive locking mechanisms.

12.5.7 All wiring connections shall either use connectors recommended by the manufacturer or be soldered, and the connections shall be protected by heavy wall shrink insulation or other approved insulation.

12.5.8* Electrical connections made inside of an ASME container, or in any portion of the system that contains fuel, shall use positive locking connectors that comply with SAE J2223-1, *Connections for On-Board Road Vehicle Electrical Wiring Harnesses — Part 1: Single-Pole Connectors — Flat Blade Terminals — Dimensional Characteristics and Specific Requirements*, and SAE J2223-3, *Connections for On-Board Road Vehicle Electrical Wiring Harnesses — Part 3: Multipole Connectors — Flat Blade Terminals — Dimensional Characteristics and Specific Requirements*.

12.5.9* All wiring bundles shall be protected with loom or another protective cover that complies with recognized testing methods.

12.5.10 Where wiring bundles will be exposed to radiant heat from the engine or exhaust components, protection from overheating shall be provided.

12.6 Installation of Pipe, Tubing, and Hose.

12.6.1* Where applicable, all threaded connections shall be tightened to the torque specification of the fitting or fuel system manufacturer's specifications.

12.6.2 LP-Gas piping, tubing, and hose shall be secured to the vehicle at intervals not greater than 24 in. (61 cm) by corrosion-resistant hose/tubing mounting fixtures that are constructed of a material recommended for the application.

12.6.3 Any pipe, tubing, or hose connection not in use shall be capped or plugged.

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12.6.4 All pipe and tubing joints and hose connections shall be accessible for service and inspection after installation.

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12.6.5 All piping and tubing fittings shall be inspected or tested to assure that they are correctly installed.

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12.6.6 Defects in LP-Gas piping or tubing that can affect its performance shall not be repaired, and the piping or tubing shall be removed from service.

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12.7 Protection of Pipe, Tube, and Hose.

12.7.1 Exposed metallic piping or tubing shall be protected against exterior corrosion by the application of a corrosion-resistant coating or material.

Δ **12.7.2** Piping, tubing, and hose shall be protected against damage or breakage due to vibration, abrasion, strain, or wear.

12.7.3 Tubing and hose within a luggage compartment or other area contiguous to the passenger area of the vehicle shall be protected from damage and installed so that in the event of a leak or permeation of the hose, vapor cannot migrate into the passenger space of the vehicle.

Δ **12.7.4** Hose shall be protected from the engine exhaust system by either of the following requirements:

(1) A clearance of not less than 8 in. (203 mm) shall be maintained between a hose or sheathed copper and an engine exhaust system.

(2) The hose or sheathed copper shall be shielded against heat radiation, with the shield located not less than 1 in. (25 mm) from the hose or sheathed copper and a minimum of 1 in. (25 mm) from the exhaust system, and shall meet the following requirements:

(a) The heat shield shall be noncombustible material and shall extend for a minimum distance of 10 in. (250 mm) beyond either edge of the heat source that it is shielding.

(b) The heat shield shall not be attached to or in contact with any portion of the exhaust system.

(c) As an alternative to 12.7.4(1), the use of an insulated or radiant barrier sleeve shall be permitted to be extended to a point no less than 8 in. (203 mm) in each direction from the area of the hose/tubing exposed to the heat source.

12.8 Testing of Piping, Tubing, Hose, and Fittings.

12.8.1 Prior to installation on the vehicle, all piping, tubing, and hose assemblies in the fuel system shall be pressure tested to a minimum 120 percent of the design operating pressure of the system using air or an inert gas.

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12.8.2 After installation or prior to returning to service, the fuel system shall be proven to be free of leaks at the operating pressure of the system.

Δ **12.9 LP-Gas Liquid and Vapor Injectors.**

12.9.1 Injectors shall be securely mounted.

12.9.2 Injectors shall be installed so that vibration, rubbing, and abrasion shall not damage or affect the operation of the injectors.

12.9.3 The use of tie straps or other nonrigid mounting of injectors shall not be permitted.

12.9.4 Injectors shall not be mounted to any portion of the exhaust system.

Δ **12.9.5** Injectors shall be recommended by the system manufacturer.

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N **12.10 Fuel Rails and Distribution Blocks.**

N **12.10.1** Fuel rails and distribution blocks shall be installed so that vibration, rubbing, and abrasion will not damage or affect their operation.

N **12.10.2** Fuel rails and distribution blocks shall be installed in accordance with the manufacturer's recommendations.

N **12.10.3** The mounting position of fuel rails and distribution blocks shall be accessible to connections for service and inspection.

N **12.10.4** Fuel rails shall be mounted so there is no relative movement between the fuel rails and the engine.

N **12.10.5** The use of tie straps or other nonrigid mounting of fuel rails shall not be permitted.

N **12.10.6** Fuel rails shall not be mounted to any portion of the exhaust system.

N **12.10.7** Fuel rails shall be mounted to brackets with fasteners that are stainless steel, plated, or otherwise protect the rail body from corrosion.

12.11 Vaporizer/Regulator Systems.

12.11.1 A vaporizer/pressure regulator system shall be securely fastened in a manner that will prevent damage to the component or the vehicle due to vibration, operating temperature, or corrosion.

12.11.2 Exhaust gas shall not pass through any vaporizer/pressure regulator unless the vaporizer/pressure regulator is designed for exhaust gas utilization.

12.11.3 A vaporizer/pressure regulator system shall not be equipped with a fusible plug.

12.11.4 Any pressure relief valve installed in the unit shall discharge at a point outside of the vehicle and the vehicle engine compartment.

12.11.5 A LP-Gas supply line to the vaporizer/pressure regulator shall be equipped with a fuel lock-off valve that prevents the flow of LP-Gas to the carburetor or fuel injector when the ignition switch is turned off or when the engine is not running.

12.11.6 The fuel lockoff valve shall be installed at the container opening or in accordance with the following:

(1) On carbureted systems, the lockoff valve shall be located upstream of the primary pressure regulator or vaporizer.
(2) On LP-Gas fuel injection systems, the lockoff valve shall be located upstream of the LP-Gas injection device provided as part of the LP-Gas fuel system.
(3) The lockoff valve shall be controlled by one or more of the following:
    (a) Vacuum from the engine
    (b) Oil pressure from the engine
    (c) An electrical circuit that closes the valve whenever the engine is not running, unless it is in a prestart purge mode initiated prior to engine operation to remove all vapor from the fuel system

12.11.7 An atmospheric-type regulator (zero governor) shall not be permitted to be used as a safety lockoff valve.

12.12 Fuel Lockoffs.

12.12.1 A bifuel system shall prevent the unintended flow of either fuel.

12.12.2 Where a lockoff valve is added between the fuel pump for the alternate fuel and the engine, the connection between the fuel pump and the lockoff valve shall be made with tubing or with hose and fittings equivalent to those used on the outlet of the fuel pump by the original manufacturer of the vehicle.

12.12.3 Fuel lockoffs shall be installed in accordance with the manufacturer's recommendations and shall be installed to prevent movement or damage from vibration.

12.12.4 The LP-Gas fuel lockoff shall be installed so that it prevents the uncontrolled flow of fuel to the engine in the event of an accident, or at any time the key is in the "run" position but the engine is not running or is in a "start-purge" mode.

12.13 Servicing, Parking, and Display of Vehicles Indoors.

12.13.1 Garaging Vehicles. Where vehicles with LP-Gas engine fuel systems mounted on them, and general-purpose vehicles propelled by LP-Gas engines, are stored or serviced inside garages, the following conditions shall apply:

(1) The fuel system shall be leak-free.
(2) The ASME container shall not be filled beyond the limits specified in Section 7.4.
(3) The ASME container shutoff valve shall be closed when the vehicle or the engine is being repaired, except when the engine is required to operate and the ASME containers equipped with an automatic shutoff valve as specified in 11.4.1.7 satisfy this requirement.
(4) The vehicle shall not be parked near sources of heat, open flames, or similar sources of ignition or near inadequately ventilated pits.

12.13.2 Displaying Vehicles Indoors.

Δ **12.13.2.1** Vehicles parked indoors for display or nonrunning demonstration shall have the following:

(1) No more than 50 percent of fuel capacity or 10 gal (37.9 dm^3), whichever is less
(2) All manual shutoff valves in the closed position
(3) The battery is disconnected

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