

NFPA 1192

Standard for Recreational Vehicles

1999 Edition



National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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NFPA 1192

Standard on

Recreational Vehicles

1999 Edition

This edition of NFPA 1192, *Standard on Recreational Vehicles*, was prepared by the Technical Committee on Recreational Vehicles and acted on by the National Fire Protection Association, Inc., at its Fall Meeting held November 16–18, 1998, in Atlanta, GA. It was issued by the Standards Council on January 15, 1999, with an effective date of February 4, 1999, and supersedes all previous editions.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

This edition of NFPA 1192 was approved as an American National Standard on February 4, 1999.

Origin and Development of NFPA 1192

1937–1970

The earliest activity of the NFPA in the field of mobile homes and recreational vehicles was the formation of an NFPA Committee on Trailers and Trailer Camps in 1937. Its first standard was adopted in 1940. That edition remained unchanged until after World War II, when a 1952 revision was approved. These editions were entitled *Standards for Fire Prevention and Fire Protection in Trailer Coaches and Trailer Courts*. In 1960 the NFPA acted to approve a revised version, dividing the text into two parts — one designated 501A, covering trailer courts, and the other designated 501B, covering trailer coaches. In 1961 a new edition of 501B was adopted under the title *Standard for Fire Prevention and Fire Protection in Mobile Homes and Travel Trailers*, and in 1963 a revision of same was approved. Revisions of both NFPA 501A and 501B were acted upon in 1964.

In the early 1960s the Mobile Homes Manufacturers Association (MHMA) and the Trailer Coach Association (TCA) prepared, under the aegis of the American Standards Association (now ANSI), two standards that were subsequently approved as the *American Standard Installations of Plumbing, Heating and Electrical Systems in Travel Trailers* (A119.2-1963) and *Standard for Fire Prevention and Fire Protection in Mobile Homes and Travel Trailers* (A119.1-1963). In 1964 the two separate standards activities were consolidated with the approval of the United States of America Standards Institute (formerly American Standards Association and subsequently ANSI) as of October 16, 1964. In 1969 the Recreational Vehicle Institute (RVI) was added to the MHMA, NFPA, and TCA as a fourth cosponsor of the project. The first *Standard for Recreational Vehicles* developed under the consolidated efforts of NFPA, MHMA, TCA, and RVI was that approved by NFPA in 1970 and by ANSI in 1971. This replaced ASA Standard A119.2-1963.

The Mobile Homes Manufacturers Association and the Trailer Coach Association were merged in 1975 to become the Manufactured Housing Institute. The Recreational Vehicle Institute was redesignated the Recreation Vehicle Industry Association also in 1975, absorbing the Recreational Vehicle Division of the Trailer Coach Association.

1970–1977

Previous editions of the *Standard on Recreational Vehicles* were published in 1970 (approved by NFPA May 20, 1970), 1972 (approved by NFPA May 16, 1972, and approved by ANSI on April 19, 1973), 1974 (approved by NFPA May 21, 1974, and approved by ANSI on February 5, 1975), and 1976 (adopted by NFPA November 17, 1976).

The 1977 edition of the standard was developed by the Sectional Committee on Recreational Vehicles, processed through the Correlating Committee on Mobile Homes and Recreational Vehicles, approved by the National Fire Protection Association at its 1977 Annual Meeting held in Washington, DC, May 16–19, and approved by ANSI on October 18, 1977. The *only* substantive changes since the previous (1975) edition were revisions to Part 8 on mobile home park electrical systems. Some editorial revisions were accomplished in other parts, and references to other standards were updated.

1977–present

Subsequent to the 1977 edition, the NFPA withdrew as a cosponsor of the ANSI project and established its own project covering only the subject of fire safety for recreational vehicles.

The 1982 edition of the standard was produced by the newly formed committee (June 20, 1979) that was charged with the responsibility of developing a standard for fire safety for recreational vehicles and recreational vehicle parks. Therefore, the 1982 edition and the 1986 edition both excluded all sections of the previous editions not considered within the committee scope. Notably excluded were sections dealing with plumbing. Modifications were made in sections dealing with heating, fire, and life safety and included conformance with the NFPA *Manual of Style*.

The 1986 edition included minor changes in all chapters and a new Chapter 5 to replace Appendix C so that all mandatory provisions were contained in the body of the document.

The 1990 edition contained minor revisions to Chapters 2 and 3 and one new definition added to Chapter 1.

A few definitions were revised in the 1993 edition, and minor changes were incorporated in Chapters 2 and 3, including the size of alternate exits.

Minor changes were made in all chapters of the 1996 edition, including a new section on clothes dryers, 2-6.8; the requirement for an LP-Gas detector, 3-4.7; and the expansion of provisions for recreational vehicles used for transporting or storing internal combustion engine vehicles, 3-4.8 (formerly 3-4.7).

In the 1999 edition, NFPA 501C has been renumbered as NFPA 1192. Chapter 2 requirements on LP-Gas containers and connectors have been updated. Changes also include modifications to Chapter 3 requirements for exit facilities and special transportation provisions.

NOTICE

Requirements for plumbing are developed by the ANSI A119 Committee of which the Recreation Vehicle Industry Association is Secretariat. Those requirements and the fire safety requirements of NFPA 1192 are published and distributed under one cover as ANSI A119.2/NFPA 1192 by ANSI, NFPA, and RVIA.

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on the fire safety criteria for recreational vehicles and recreational vehicle parks.

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Appendix A.

Information on referenced publications can be found in Chapter 5 and Appendix C.

Chapter 1 General

1-1 Introduction.

1-1.1 Need for Standard. Those members of the engineering profession and others associated with the design, manufacturing, and inspection of recreational vehicles have been aware of the need for uniform technical standards leading to the proper use of this special type of equipment. They also have recognized that, because of conditions of transport, size, and use, existing standards for motor vehicles or permanent buildings are not completely applicable to recreational vehicles. It is with these factors in mind that this standard has been developed.

1-1.2 Basis for Standard. Much of the material in this standard has been taken from or is based on nationally recognized standards for fire and life safety. Applicable standards are shown in Chapter 5.

1-2 Scope.

1-2.1 Applicability. This standard shall cover fire and life safety criteria for recreational vehicles that are considered necessary to provide a reasonable level of protection from loss of life from fire and explosion. These criteria reflect situations and the state of the art prevalent at the time the standard was issued.

Unless otherwise noted, it shall not be intended that the provisions of this document be applied to facilities, equipment, structures, or installations that were existing or approved for construction or installation prior to the effective date of the document, except in those cases where it is determined by the authority having jurisdiction that the existing situation involves a distinct hazard to life or adjacent property.

1-2.2 Limitations. This standard shall not be intended as a design specification or an instruction manual.

1-2.3 Alternate Materials, Equipment, and Procedures. The provisions of this standard shall not be intended to prevent the use of any material, method of construction, or installation procedure not specifically prescribed by this standard, provided any such alternate is acceptable to the authority having jurisdiction. The authority having jurisdiction shall require that sufficient evidence be submitted to substantiate any claims made regarding the safety of such alternates.

1-2.4 Differing Standards. Wherever nationally recognized standards and this standard differ, the requirements of this standard shall apply.

1-2.5 U.S. Federal Regulations. Federal regulations under the National Highway Traffic Safety Administration can super-

sede all or part of this standard as applied to any category of regulated motor vehicles.

1-3* Definitions.

Approved.* Acceptable to the authority having jurisdiction.

Authority Having Jurisdiction.* The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

Axle Height. The distance to the lower connection of the axle spindle assembly and the outboard end of the lower control arm (lever ball joint or kingpin), excluding shock mounting, grease fitting, or similar component. A single or dual beam axle is measured at the lowest point of that beam axle at the spring location.

Camping Trailer. A vehicular portable unit mounted on wheels and constructed with collapsible partial side walls that fold for towing by another vehicle and unfold at the campsite to provide temporary living quarters for recreational, camping, or travel use. (*See definition of Recreational Vehicle.*)

Compartment. A completely enclosed volume designed to provide for a separate area.

Connection, Gas Supply. The terminal end or connection where a gas supply connector is attached.

Connector, Gas Supply. Tubing or pipe connecting the recreational vehicle to the gas supply source.

Container. A tank or cylinder.

Cylinder. A portable container constructed in accordance with U.S. Department of Transportation *Specifications for LP-Gas Containers* (49 CFR).

Dry Weight. The weight of the completed finished vehicle when factory-equipped, without fluids.

Fifth Wheel Trailer. A vehicular unit, mounted on wheels, designed to provide temporary living quarters for recreational, camping, or travel use, of such size or weight as not to require special highway movement permit(s), of gross trailer area not to exceed 400 ft² (37.2 m²) in the set-up mode, and designed to be towed by a motorized vehicle that contains a towing mechanism that is mounted above or forward of the tow vehicle's rear axle. (*See definition of Recreational Vehicle.*)

Frame. Chassis rail and any addition thereto of equal or greater strength.

Fuel System. Any arrangement of pipe, tubing, fittings, connectors, tanks, controls, valves, and devices designed and intended to supply or control the flow of fuel.

Gross Trailer Area.* The total plan area measured to the maximum horizontal projections of exterior walls in the set-up mode.

Heat Appliance. An appliance for comfort heating of a recreational vehicle or for water heating.

Heat-Producing Appliance. An appliance that produces heat by utilizing electric energy or by burning fuel.

Identified (as applied to equipment). Recognizable as suitable for the specific purpose, function, use, environment, application, and so forth, where described in a particular requirement.

Interior Finish. The exposed interior surface in combination with the substrate to which it is applied. Interior finish shall include any material (e.g., paint, wallpaper, decorative

panels) that is affixed to such surfaces by permanent or semi-permanent means.

Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Liquefied Petroleum Gas (LP-Gas and LPG). Any material having a vapor pressure not exceeding that allowed from commercial propane composed predominantly of the following hydrocarbons, either by themselves or as mixtures: propane, propylene, butane (normal butane or iso-butane), and butylene.

Listed.* Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets identified standards or has been tested and found suitable for a specified purpose.

Motor Home. A vehicular unit designed to provide temporary living quarters for recreational, camping, or travel use, built on or permanently attached to a self-propelled motor vehicle chassis or on a chassis cab or van that is an integral part of the completed vehicle. (*See definition of Recreational Vehicle.*)

Overfilling Prevention Device. A safety device that is designed to provide an automatic means to prevent the filling of a container in excess of the maximum permitted filling limit.

Pipe. Rigid materials (e.g., iron pipe) of the gas system.

Piping. The materials of the gas supply system that convey gas from source to appliance, including both rigid (e.g., iron pipe) and semi-rigid (e.g., copper) materials of the gas supply system.

Pressure Relief Valve. A type of pressure relief device designed to both open and close to maintain internal fluid pressure.

Recreational Park Trailer. See ANSI A119.5, *Standard for Park Trailers*.

Recreational Vehicle (RV). A vehicular-type unit primarily designed as temporary living quarters for recreational, camping, travel, or seasonal use that either has its own motive power or is mounted on, or towed by, another vehicle. The basic entities are camping trailer, fifth wheel trailer, motor home, recreational park trailer, travel trailer, and truck camper (*see individual definitions*).

Remote. The width of the RV or one-half the length of the RV, whichever is greater, when measured in a straight line edge to edge of each exit opening.

Shall. Indicates a mandatory requirement.

Tank. A container constructed in accordance with the ASME *Boiler and Pressure Vessel Code*, Section VIII, Rules for Construction of Pressure Vessels.

Travel Trailer. A vehicular unit, mounted on wheels, designed to provide temporary living quarters for recre-

ational, camping, or travel use, of such size or weight as not to require special highway movement permits when towed by a motorized vehicle, and of gross trailer area less than 320 ft² (29.7 m²). (*See definition of Recreational Vehicle.*)

Truck Camper. A portable unit that is constructed to provide temporary living quarters for recreational, travel, or camping use, consists of a roof, floor, and sides, and is designed to be loaded onto and unloaded from the bed of a pickup truck. (*See definition of Recreational Vehicle.*)

Tubing. Semi-rigid (e.g., copper tubing) materials of the gas system.

1-4 Exterior Labels Required by This Standard. Exterior labels required by Chapters 2 and 3 shall be made of etched, metal-stamped, or embossed brass, stainless steel, plastic laminates [0.005-in. (0.13-mm) minimum], or anodized or alclad aluminum not less than 0.020 in. (0.5 mm) thick. These labels shall be mounted by permanent attachment methods compatible with the surface to which they are applied. Other types of labels shall be permitted to be approved if there is adequate proof of permanency and comparable life expectancy to those types specified herein.

1-5 Electrical Requirements. All electrical installations, systems, and equipment shall comply with Article 551, Part A, and other applicable sections of NFPA 70, *National Electrical Code*®.

1-6* Use of International System of Units (SI). In some cases SI equivalents to U.S. units have been inserted in this standard. Where used, the conversions have been rounded to the number of digits commensurate with their intended precision. Use of the SI units herein is in accordance with the NFPA *Manual of Style*. Alternate usage of U.S. and SI units to determine distance, size (capacity), or dimensions shall not be used to regulate same. Where SI equivalents are not given, it is because the U.S. units shall be employed by anyone enforcing this standard.

Chapter 2 Fuel Systems and Equipment

2-1 Quality of Design and Installation. All design, construction, and workmanship shall be in conformance with accepted engineering practices.

2-2 LP-Gas Systems.

2-2.1 Maximum Container Capacities. Where LP-Gas fuel utilization equipment is installed by the recreational vehicle manufacturer, the recreational vehicle shall be provided with one of the following:

- (a) One but not more than three nonpermanently mounted cylinders having individual water capacities of 105 lb (47.6 kg) maximum [approximately 45 lb (20.4 kg) LP-Gas capacity]
- (b) One or more permanently mounted tanks having a maximum aggregate water capacity of 200 gal (757 L) [approximately 712 lb (323 kg) LP-Gas capacity]

2-2.2 Construction of LP-Gas Containers. Cylinders shall be constructed and marked in accordance with the specifications for LP-Gas cylinders of the U.S. Department of Transportation (DOT). Tanks utilizing vapor withdrawal shall be constructed and marked in accordance with the Rules for Construction of Pressure Vessels, Section VIII, Division I, ASME *Boiler and Pres-*

sure Vessel Code, and shall have a design pressure of at least 312.5 psi (2155 kPa).

2-2.3 Location of LP-Gas Containers. LP-Gas containers shall be in accordance with the following:

(a) LP-Gas containers shall not be installed nor shall provisions be made for installing or storing any LP-Gas containers, even temporarily, inside any recreational vehicle. Containers shall not be mounted on the exterior of the rear wall or the rear bumper of the vehicle.

Exception: New LP-Gas cylinders that have never contained LP-Gas, supplied as original equipment, shall be permitted to be transported inside the vehicle.

(b) LP-Gas containers with their control valves shall be installed in compliance with one of the following:

1. In a recess or compartment other than on the roof that is vaportight to the inside of the recreational vehicle.
2. Mounted on the tongue or A frame of a travel or camping trailer or forward of the front bulkhead below the overhang of a fifth wheel travel trailer and not lower than the bottom of the trailer frame.
3. Tanks mounted on the chassis or to the floor of a motor home or chassis-mount camper, provided neither the tank nor its support is located ahead of the front axle. Tanks mounted between the front and rear axles shall be installed with as much road clearance as practical but not lower than the front axle height. Tanks mounted behind the rear axle of a motor home or chassis-mount camper shall be installed in such a manner that the bottom of the tank and any connection thereto shall not be lower than either the rear axle height (excluding the differential) or any section of the frame immediately to the rear of the tank, whichever is higher. All clearances shall be determined from the bottom of the tank or from the lowest fitting, support, or attachment on the tank or tank housing, whichever is lower when all axles are loaded to their gross axle weight rating.
4. Tanks mounted to the chassis or to the floor of a travel trailer or fifth wheel. Tanks mounted behind the rear axle of a travel trailer or fifth wheel shall be installed in such a manner that the bottom of the tank and any connection thereto shall not be lower than either the rear axle(s) height or the lowest section of the frame to the rear of the tank, whichever is highest. Tanks mounted forward of the rear axle(s) shall be installed in such a manner that the bottom of the tank and any connection thereto shall not be lower than the lowest section of the frame in front of the tank.

2-2.4 Securing of LP-Gas Containers. Containers shall be secured in place so they will not become dislodged when a load equal to eight times the container's filled weight is applied to the filled container's center of gravity in any direction. If the recreational vehicle is supplied with cylinders not in place, the recreational vehicle manufacturer shall provide mounting instructions and required materials with the vehicle.

2-2.5 Heat Shielding of LP-Gas Containers. LP-Gas containers located less than 18 in. (475 mm) from the exhaust system, the transmission, or a heat-producing component of the internal combustion engine shall be shielded by a vehicle frame member or by a noncombustible baffle, with an air space on both sides of the frame member or baffle.

2-2.6 LP-Gas Container Enclosures.

2-2.6.1 Ventilation of Compartments Containing LP-Gas Cylinders. Compartments shall be ventilated at or near the top and at the extreme bottom to facilitate diffusion of vapors. The compartment shall be ventilated with at least two vents having an aggregate free area equal to at least 1 in.² for each 7 lb (1 cm² per gram) of the total LP-Gas fuel capacity of the maximum number of the largest cylinder(s) the compartment can hold. The vents shall be equally distributed between the floor and ceiling of the compartment. If the lower vent is located in the access door or wall, the bottom edge of the vent shall be flush with the floor level of the compartment. The top vent shall be located in the access door or wall with the bottom of the vent within 12 in. (305 mm) of the ceiling of the compartment. Vents shall have an unrestricted discharge to the outside atmosphere. Doors or panels providing access to valves shall not be equipped with locks or require special tools to open.

2-2.6.2 Securing LP-Gas Cylinder Housings. Doors, hoods, domes, housings (or portions of housings), and enclosures required to be removed or opened for replacement of cylinders shall incorporate means for clamping them firmly in place and preventing them from working loose during transit. Hoods or housings covering valves shall not be equipped with locks or require special tools to open.

2-2.6.3 Fastenings for LP-Gas Cylinders in Compartments. Cylinder compartments or carriers shall be provided with hold-down fastenings complying with 2-2.4 for as many cylinders as the carriers or compartments are capable of holding.

2-2.6.4 Elimination of Ignition Sources. LP-Gas containers shall not be installed in compartments or under hoods or housings that contain flame- or spark-producing equipment.

2-2.7 LP-Gas Container Valves and Accessories.

2-2.7.1 Container Appurtenances. Pressure relief valves, container shutoff valves, overfilling prevention devices, back-flow check valves, excess-flow check valves, and liquid level gauges shall be listed.

2-2.7.2 Location of Tank Appurtenances. The manual control of the tank's shutoff valve, the LP-Gas fill connection, and the liquid level outage valve of permanently installed tanks shall be located not more than 18 in. (457 mm) from the vehicle's outside wall. The LP-Gas fill connection and its liquid level outage valve shall be located in accordance with like requirements for LP-Gas pressure relief valves (see 2-2.8.3).

Exception: Vehicles shall be permitted to be equipped with a remotely controlled normally closed electronic shutoff valve installed on the high-pressure side of the LP-Gas regulator. A double back-flow valve shall be installed in the fill opening of the tank. The remote fill connection, liquid level outage valve, and electronic shutoff valve control shall be located within 18 in. (45.7 cm) of the vehicle outside wall and shall be located in accordance with like requirements for LP-Gas pressure relief valves (see 2-2.8.3).

2-2.7.3* Valves for Multiple LP-Gas Cylinder Assembly System. Valves in a multiple LP-Gas cylinder assembly system shall be arranged so that replacement of cylinders can be made without shutting off the flow of gas to the appliance(s).

2-2.7.4 Overfilling Prevention Device. Tanks shall be equipped with a listed overfilling prevention device. Cylinders with a 4-lb through 40-lb propane capacity shall be equipped

with a listed overfilling prevention device and a CGA 791 (Type 1, 1⁵/₁₆ in. Acme) outlet as described in Compressed Gas Association (CGA) V-1, *Compressed Gas Cylinder Valve Outlet and Inlet Connections*.

2-2.7.5 Protection of LP-Gas Container Shutoff Valves. Container shutoff valves shall be protected by a ventilated cap or collar, fastened to the container, capable of withstanding a blow from any direction equivalent to that of a 30-lb (13.6-kg) weight dropped 4 ft (1.2 m). Construction shall be such that the blow will not be transmitted to the valve.

2-2.7.6 LP-Gas Regulators. A listed two-stage regulator system or an integral two-stage regulator shall be required for vapor withdrawal systems. Such regulator(s) shall have a capacity that is not less than the total input of all LP-Gas appliances installed in the recreational vehicle. The regulator(s) shall be installed with the pressure relief vent opening pointing downward within 45 degrees of vertical to vertical to allow for drainage of any moisture collected on the diaphragm of the regulator. Regulator(s) installed below floor level shall be installed in a compartment that provides protection against the weather and wheel spray. The compartment shall be of sufficient size to permit tool operation for connection to and replacement of the regulator(s), shall be vaportight to the interior of the vehicle, shall have a 1 in.² (6.5 cm²) minimum vent opening to the exterior located within 1 in. (25 mm) of the bottom of the compartment, and shall not contain flame- or spark-producing equipment. The regulator vent outlet shall be at least 2 in. (51 mm) above the compartment vent opening.

Regulators installed elsewhere and not installed in compartments as specified above shall be equipped with a durable cover [that will not become brittle at temperatures as low as -40°F (-40°C)] designed to protect the regulator vent opening from sleet, snow, freezing rain, ice, mud, and wheel spray.

If the regulator is not mounted by the recreational vehicle manufacturer, instructions for proper installation shall be supplied.

2-2.7.7 LP-Gas Shutoff Valves and Excess Flow Valves. A listed LP-Gas excess flow valve shall be provided in accordance with the following:

(a) Permanently mounted tanks shall require a manual shutoff valve equipped with a listed internal excess flow valve that is designed to close automatically at the rated closing flow of vapor or liquid specified by the manufacturer. The internal excess flow valve shall be designed with a bypass not to exceed a number 60 drill size opening to allow equalization of pressure.

(b) Cylinders shall require a manual shutoff valve for vapor service that will not allow gas to flow until a positive seal is achieved between that valve and its mating connection. The mating connection shall be installed in the regulator furnished with the vehicle as follows.

1. The mating connection to the cylinder valve shall be furnished with a thermal element that will activate at a temperature range of 240°F to 300°F and will positively shut off the flow of gas from the cylinder valve.
2. The mating connection to the cylinder valve shall also incorporate a listed excess flow valve that will close at a flow not greater than 200 ft³/hr at 100 psi and has a bypass area that will not allow a flow greater than 10 ft³/hr at 100 psi.
3. The mating connection to the cylinder valve shall be provided with a CGA 791 female connection that will not attach to a CGA 510 female POL connector.

2-2.8 Pressure Relief Valves for LP-Gas Containers and for Two-Stage Regulator Systems.

2-2.8.1 LP-Gas Container Pressure Relief Valves. Cylinders shall be provided with pressure relief valves as required by the regulations of the U.S. Department of Transportation. Tanks for recreational vehicle use shall be provided with full internal or flush-type full internal pressure relief valves in accordance with 8-2.3.1(e) of NFPA 58, *Liquefied Petroleum Gas Code*. Containers shall have pressure relief valves in direct communication with the vapor space of the container.

2-2.8.2 Regulator and Pressure Relief Valves. The second stage of a two-stage regulator system shall be equipped with one or both of the following:

(a) An integral pressure relief valve on the outlet pressure side having a start-to-discharge pressure setting within the limits specified in UL 144, *Standard for LP-Gas Regulators*. This pressure relief valve shall limit the outlet pressure of the second stage of a two-stage regulator system to 2.0 psi (14 kPa) when the regulator seat disc is removed and the inlet pressure to the regulator is 10.0 psi (69 kPa) or less as specified in UL 144.

(b) An integral overpressure shutoff device that shuts off the flow of LP-Gas vapor when the outlet pressure of the regulator reaches the overpressure limits specified in UL 144. Such a device shall not open to permit flow of gas until it has been manually reset.

2-2.8.3 Discharge from LP-Gas Container Pressure Relief Valves. Pressure relief valves shall be located in accordance with the following:

(a) LP-Gas containers shall be so located that the discharge from their pressure relief valves shall be not less than 3 ft (0.9 m) measured horizontally along the surface of the vehicle from any of the following located below the level of the vents:

1. Openings into the recreational vehicle
2. Fuel-burning appliance intake and exhaust vents
3. All internal combustion engine exhaust terminations

Exception: This section does not apply to unventilated compartment doors containing either door or body side seals and entry doors not containing screens or openable windows below the level of the LP discharge outlet(s).

(b) The LP-Gas tank pressure relief valve discharge system(s) shall be installed as follows:

1. The pressure relief valve discharge shall be directed upward or downward within 45 degrees of vertical so that its discharge shall not directly impinge on the prime mover engine nor be directed into the interior of the vehicle.
2. Where the pressure relief valve discharge must be piped away, the pipeaway system shall consist of a breakaway adapter recommended by the pressure relief valve manufacturer, and at the terminal discharge end of the pipeaway system, a protective cover shall be installed to minimize the possibility of the entrance of water or dirt into either the pressure relief valve or its pipeaway discharge system.
3. No portion of the pipeaway system shall have an internal diameter less than the internal diameter of the recommended breakaway adapter.
4. The breakaway adapter shall be threaded for direct connection to the pressure relief valve and shall not interfere with the operation of the pressure relief valve.

5. The breakaway adapter shall be installed so that it breaks away without impairing the function of the relief valve; however, the breakaway adapter shall be permitted to be an integral part of the pressure relief valve.
 6. The breakaway adapter shall have a melting point of not less than 1450°F (788°C).
 7. Metallic pipe or a length of nonmetallic hose shall be permitted as a part of the pipeaway system and located after the breakaway adapter and before the terminal discharge end of the pipeaway system.
 8. The terminal discharge end of the pipeaway system shall be directed upward or downward within 45 degrees of vertical.
 9. Metallic pipe or nonmetallic hose used in the pipeaway system shall be fabricated of materials resistant to the action of LP-Gas.
 10. Nonmetallic hose, where used, shall be able to withstand the downstream pressure from the pressure relief valve when in the full open position.
 11. Where hose is used to pipe away the pressure relief valve discharge from LP-Gas containers installed on the outside of the vehicle, the breakaway adapter and any attached fittings, without the hose attached, shall deflect the pressure relief valve discharge upward or downward within 45 degrees of vertical and shall meet the other requirements of 2-2.8.3(b). All fittings shall have a melting point of not less than 1450°F (788°C).
 12. The pipeaway system connections shall be mechanically secured and shall not depend on adhesives or sealing compounds.
 13. Where a pipeaway system is not required, the pressure relief valve shall have a protective cover in accordance with 2-2.8.3(b)2.
 14. Where the pressure relief valve outlets on cylinders are located in a compartment vaportight to the vehicle interior, discharge from these valves shall be considered to be located at the compartment vents and shall meet the location requirements of 2-2.8.3(a).
- (c) Where the relief device outlets on cylinders are located in a compartment vaportight to the vehicle interior, discharge from these devices shall be considered to be located at the compartment vents and shall meet the location requirements of 2-2.8.3(a).

2-2.9 LP-Gas System Design and Service Line Pressures.

2-2.9.1 LP-Gas System Design. Systems shall be of the vapor-withdrawal type.

Exception: Liquid withdrawal systems shall be permitted to supply LP-Gas as engine fuel. (See Section 2-11 for engine fuel installations.)

2-2.9.2 LP-Gas Vapor Pressure Maximum. Vapor, at a pressure not over 14 in. water column (3.49 kPa), shall be delivered from the system into the gas appliance supply connection.

Exception: A fuel-burning appliance that operates at a pressure higher than 14 in. water column (3.49 kPa) shall be acceptable provided it meets all of the following:

- (a) *The appliance must provide for a separate fuel supply system or provide a means to prevent high pressure from entering the recreational vehicle's low-pressure system.*
- (b) *The high-pressure fuel system shall be located entirely on the exterior of the vehicle or in a compartment that is vaportight to the vehicle's interior.*

(c) *Exterior rated labels shall be permanently attached to the appliance or appliance compartment and at the fuel source in a visible location indicating the following:*

1. *Operating pressure*
2. *Any special precautions to be taken while servicing*
3. *A statement warning against connecting the appliance to any other fuel system or that fuel system to another appliance*
- (d) *The fuel system shall be tested at six times its working pressure prior to its installation and at its working pressure after installation.*
- (e) *A two-stage regulator system shall not be required for the high-pressure system.*
- (f) *The appliance shall be listed for RV use at the specified operating pressure.*

2-2.9.3 Mounting of LP-Gas Containers. Container openings for vapor withdrawal shall be located in the vapor space when the container is in service or shall be provided with a suitable permanent internal withdrawal tube that communicates with the vapor space in or near the highest point in the container when it is mounted in service position with the vehicle on a level surface. Tanks shall have vapor withdrawal located midway between tank ends. Each cylinder shall be permanently and legibly stamped to show the correct mounting position. Stamping shall be $\frac{1}{4}$ in. (6 mm) minimum letter height. The method of mounting in place shall be such as to minimize the possibility of an incorrect positioning of the cylinder.

2-3 Fuel Oil Supply for Heat-Producing Appliances.

2-3.1 Gravity Flow Oil Tanks. Oil tanks installed for gravity flow of oil to heating equipment shall be installed so that the top of the tank is no higher than 8 ft (2.4 m) above the appliance oil control and the bottom of the tank is no less than 18 in. (457 mm) above the appliance oil control.

2-3.2 Mounting of Automatic Pumps. Listed automatic pumps (oil lifter) shall be mounted no higher than 8 ft (2.4 m) above the appliance oil control and not less than 18 in. (457 mm) above the appliance oil control.

2-3.3 Oil Supply Tank Affixed to Vehicle. Oil supply tanks affixed to a recreational vehicle shall be so located as to require filling and draining on the outside and shall be securely fastened in position in a place readily available for inspection.

2-3.4 Oil Supply Tank Located in Vehicle Compartment. If the oil supply tank is located in a recess or compartment of a recreational vehicle, the compartment shall be vaportight to the inside of the recreational vehicle, ventilated at the bottom to permit diffusion of vapors, and isolated from oil absorption material members. A tank so installed shall be provided with an outside fill and vent pipe and an approved liquid level gauge.

2-3.5 Oil Supply Tank Shutoff Valves. A readily accessible, listed, manual shutoff valve shall be installed at the outlet of an oil supply tank. The valve shall be installed to close against the supply.

2-3.6 Oil Filters. All oil tanks, except for integrally mounted tanks, shall be equipped with a listed oil filter or strainer located downstream from the tank shutoff valve. The fuel oil filter or strainer shall contain a sump with a drain for the entrapment of water.

2-4 Fuel Gas Piping Systems.

2-4.1 General. The requirements of this section shall govern the installation of all fuel gas piping attached to any recre-

ational vehicle intended for carrying gas in the vapor state. None of the requirements listed in this section shall apply to the piping supplied as a part of a listed appliance. Liquid withdrawal piping shall comply with the requirements of NFPA 58, *Liquefied Petroleum Gas Code (Section 2-4 and 3-2.8)*.

2-4.2 Gas Piping System Materials. Materials used for the installation, extension, alteration, or repair of any gas piping system shall be new and free from defects or internal obstructions. The materials shall not be permitted to repair defects in gas piping or fittings. Inferior or defective materials shall be removed and replaced with acceptable material. The system shall be made of materials having a melting point of not less than 1450°F (788°C), except as provided in 2-4.5, 2-4.6, and 2-4.12, or of materials (used in piping or fittings) listed for the specific use intended. They shall be permitted to consist of one or more of the following materials:

(a) Gas pipe shall be steel or wrought-iron pipe complying with ASTM A53, *Specifications for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless*. Threaded copper or brass pipe in iron pipe sizes shall be permitted to be used.

(b) Fittings for gas piping shall be wrought iron, malleable iron, steel, or brass (containing not more than 75 percent copper). Brass flare nuts shall be stress relieved or of the forged type.

(c) Copper tubing shall be annealed Type K or L, conforming to ASTM B 88, *Standard Specifications for Seamless Copper Water Tube*, or shall comply with ASTM B 280, *Specifications for Seamless Copper Tube for Air Conditioning and Refrigeration Field*

Service. Where used on systems designed for natural gas, such tubing shall be internally tinned.

(d) Seamless brass tubing shall be composed of not more than 75 percent copper (cartridge brass 70 percent) and shall have a minimum thickness of 0.030 in. (0.76 mm).

(e) Steel tubing shall be constructed in accordance with ASTM A 539, *Standard Specifications for Electric-Resistance Welded Coiled Steel Tubing for Gas and Fuel Oil Lines*, and shall be externally corrosion-protected.

(f) Flexible nonmetallic tubing or hose shall be either listed and used with listed fittings or part of a listed assembly.

2-4.3 Gas Piping Design. Each recreational vehicle requiring fuel gas for any purpose shall be equipped with a gas piping system that is designed for LP-Gas only or with a natural gas piping system acceptable for LP-Gas.

2-4.4 Gas Pipe Sizing. Gas piping systems shall be sized so that the pressure drop to any appliance inlet connection from the gas supply connection or connections, where all appliances are in operation at maximum capacity, is not more than 0.5 in. water column (0.125 kPa) where used with natural gas if the system is designed for both natural and LP-Gas, or where used with LP-Gas if the system is designed for LP-Gas only. Conformance shall be permitted to be determined on the basis of test, or the gas piping system shall be permitted to be sized in accordance with one of Tables 2-4.4(a) through 2-4.4(d) or other approved method. The natural gas supply connection shall be not less than $\frac{3}{4}$ in. nominal pipe size. (See Appendix B for further guidance on how to calculate gas piping size.)

Table 2-4.4(a) Sizing of Low-Pressure Gas Piping Systems Maximum Capacity of Iron Pipe Sizes in Thousands of Btu per Hour Combination of LP-Gas/Natural Gas System

Nominal Iron Pipe Size (I.D.)		Length of Piping													
		ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
in.	mm	10	3.1	15	4.6	20	6.1	25	7.6	30	9.2	35	10.7	40	12.2
$\frac{1}{4}$	6	43	13.1	33	10	29	8.8	27	8.2	24	7.3	22	6.7	20	6.1
$\frac{3}{8}$	10	95	29	77	23.5	65	19.8	57	17.4	52	15.9	49	14.9	45	13.7
$\frac{1}{2}$	13	175	53	135	41	120	37	108	33	97	29.6	90	27.5	82	25
$\frac{3}{4}$	19	360	110	279	85	250	76	225	69	200	61	186	57	170	52
1	25	680	207	536	163	465	142	404	123	375	114	330	101	320	98

Table 2-4.4(b) Sizing of Low-Pressure Gas Piping Systems Maximum Capacity of Semi-Rigid Tubing in Thousands of Btu per Hour Combination of LP-Gas/Natural Gas System

Tubing Size				Length of Piping											
in.		mm		ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
O.D.	I.D.	O.D.	I.D.	10	3.1	15	4.6	20	6.1	25	7.6	30	9.2	35	10.7
$\frac{3}{8}$	$\frac{1}{4}$	10	6	27	8.2	21	6.4	18	5.5	16	4.9	15	4.6	14	4.3
$\frac{1}{2}$	$\frac{3}{8}$	13	10	56	17.1	42	12.8	38	11.6	34	10.4	31	9.5	28	8.5
$\frac{5}{8}$	$\frac{1}{2}$	16	13	113	34	86	26.2	78	23.8	70	21.3	62	18.9	59	18
$\frac{3}{4}$	$\frac{5}{8}$	19	16	197	60	157	48	136	41	122	37	109	33	99	30
$\frac{7}{8}$	$\frac{3}{4}$	22	19	280	85	227	69	193	59	172	52	155	47	141	43

Table 2-4.4(c) Sizing of Low-Pressure Gas Piping Systems Maximum Capacity of Iron Pipe Sizes in Thousands of Btu per Hour LP-Gas System

Nominal Iron Pipe Size (I.D.)		Length of Piping													
		ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
in.	mm	10	3.1	15	4.6	20	6.1	25	7.6	30	9.2	35	10.7	40	12.2
1/4	6	67	20.4	52	15.9	46	14	41	12.5	37	11.3	34	10.4	31	9.5
3/8	10	147	45	112	34	101	31	87	26.5	81	24.7	74	22.6	70	21.3
1/2	13	275	84	212	65	189	58	166	51	152	46	138	42	129	39
3/4	19	567	173	500	152	393	120	338	103	315	96	276	84	267	81
1	25	1071	326	1005	306	732	223	667	203	590	180	530	162	504	154

Table 2-4.4(d) Sizing of Low-Pressure Gas Piping Systems Maximum Capacity of Semi-Rigid Tubing in Thousands of Btu per Hour LP-Gas System

Tubing Size				Length of Pipe											
in.	mm	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
O.D.	I.D.	O.D.	I.D.	10	3.1	15	4.6	20	6.1	25	7.6	30	9.2	35	10.7
3/8	1/4	10	6	39	11.9	32	9.8	26	7.9	23	7	21	6.4	19.5	5.9
1/2	3/8	13	10	92	28.1	72	21.9	62	18.9	56	17.1	50	15.3	45	13.7
5/8	1/2	16	13	199	61	159	49	131	40	118	36	107	33	94	28.7
3/4	5/8	19	16	329	100	249	76	216	66	193	59	181	55	154	47
7/8	3/4	22	19	501	153	380	116	346	106	300	91	277	84	246	75

2-4.5 Joints for Gas Pipe. Pipe joints in the piping system, unless welded or brazed, shall be screw joints that comply with ANSI B1.20.1, *Pipe Threads, General Purpose (Inch)*. Right and left nipples or couplings shall not be used. Unions, if used, shall be of the ground joint type. The material used for welding or brazing pipe connections shall have a melting temperature in excess of 1000°F (538°C).

2-4.6 Gas Tubing Joints. Tubing joints shall be made with a single or double flare of 45 degrees conforming to SAE J533, *Flares for Tubing, Standard*, as recommended by the tubing manufacturer or by means of listed vibration-resistant fittings, or the joints shall be brazed with a material having a melting point exceeding 1000°F (538°C). Brazing alloys shall not contain phosphorous. Sealants shall not be used on tubing joints. Ball sleeve or one-piece internal compression-type tubing fittings shall not be used. (See 2-5.5.)

2-4.7 Pipe Joint Materials. Threaded joints shall be made up tight with approved pipe joint material, insoluble in liquefied petroleum gas, that shall be applied to the male threads only.

2-4.8 Routing and Protection of Tubing. Tubing shall not be run inside walls, floors, partitions, or roof except that 1/4 in. O.D. tubing shall be permitted to be concealed provided it is enclosed with a metallic covering of thickness equivalent to the thickness of the tubing enclosed. Where tubing passes through walls, floors, partitions, roofs, or similar installations, such tubing shall be protected by the use of weather-resistant grommets that shall fit snugly both the tubing and the hole through which the tubing passes. Tubing shall be routed to be protected from physical damage, sharp edges, and moving parts.

2-4.9 Restrictions on Concealing Joints in Gas Piping or Tubing. Pipe or tubing joints shall not be located in any floor, wall, partition, or concealed construction space. Pipe and tubing joints shall be permitted to be located in storage areas below the floor if they are located within 2 in. (50.8 mm) of the compartment's ceiling with the tubing joints protected from physical damage. Pipe joints shall be permitted to be located below the 2-in. (50.8-mm) requirement if protected from physical damage. Unprotected tubing shall not be located in storage areas below the floor level.

2-4.10 Gas Supply Connection Location. For LP-Gas only systems and for combination LP-Gas and natural gas systems, the supply connection shall be located at the container location. An additional supply connection shall be permitted to be installed, located on the left (road) side or at the rear left of the longitudinal center of the vehicle, within 18 in. (457 mm) of the outside wall. Combination LP-Gas and natural gas additional supply connections shall be within 15 ft (4.6 m) of the rear of the vehicle.

2-4.11 Gas Supply Connections.

2-4.11.1 Natural Gas Supply Connectors. A listed minimum 1/2-in. (12.7-mm) nominal (I.D.) gas supply connector, with 3/4-in. (19-mm) NPT terminal fittings, 6 ft (1.8 m) in length, shall be supplied by the manufacturer where the fuel gas piping system is designed for the use of natural gas.

2-4.11.2 LP-Gas Supply Connectors. Connectors used in LP-Gas systems shall be listed as conforming to UL 569, *Standard for Pigtails and Flexible Hose Connectors for LP-Gas*.

2-4.11.3 High-Pressure LP-Gas Connections. High-pressure LP-Gas connections shall be in accordance with the following:

(a) If the regulator is not directly connected to a permanently mounted container shutoff valve, it shall be connected to the container shutoff valve by a listed high-pressure flexible hose connector or by material conforming to 2-4.2.

(b) The connection between the shutoff valve of a cylinder intended to be removed and mounted on the tongue (A frame) and a regulator mounted on a cylinder support bracket shall be made with a listed high-pressure flexible hose connector.

(c) The connection between the shutoff valve of a cylinder intended to be removed and mounted on the tongue (A frame) and a regulator permanently mounted other than as described in 2-4.11.3(b) shall be made with a listed high-pressure flexible hose connector.

(d) The connection between the shutoff valve of a cylinder intended to be removed and mounted within a compartment shall be made with a listed high-pressure flexible hose connector if the regulator is not directly attached to the shutoff valve.

2-4.11.4 Low-Pressure LP-Gas Connections. Low-pressure LP-Gas connections shall be in accordance with the following:

(a) The connection between a permanently mounted regulator or a regulator directly attached to a permanently mounted container and the gas supply system shall be made with a listed flexible hose connector or with material conforming to 2-4.2.

(b) The connection between a regulator mounted on a cylinder support bracket or a regulator directly attached to the shutoff valve of a cylinder and the gas supply system shall be made with a listed flexible hose connector.

2-4.12 Flexible Nonmetallic Tubing and Hose Connections.

Where nonmetallic tubing or hose is used within the LP-Gas piping system, it shall be permitted to pass directly through any floor, wall, partition, or ceiling provided the entire length of hose is readily available for visual inspection, provision is made to protect against chaffing, and no part of the flexible nonmetallic tubing or hose is concealed in the hollow space of a floor, wall, partition, or ceiling.

2-4.13 Quick Disconnect Devices. Quick disconnect devices used downstream of the LP gas regulator shall be listed for use with LP-Gas and for the specific environment (indoor, outdoor, or both) and shall not be capable of connection to the cylinder portion of a cylinder connection device (CGA 810).

2-4.14 Gas Shutoff Valves. Shutoff valves used in connection with gas piping shall be listed for use with LP-Gas and shall have nondisplaceable rotors.

2-4.15 Gas Inlet Cap.

2-4.15.1 For combination LP-Gas and natural gas systems, suitable cap(s) to effectively close the gas inlet(s) when disconnected from the source of supply and not in use shall be attached to the recreational vehicle. Inlets shall be effectively capped when disconnected from the source of supply.

2-4.15.2 The LP-Gas only supply inlet shall be effectively capped to prevent entrance of water and foreign materials when the recreational vehicle is shipped with the LP-Gas containers disconnected from the system.

2-4.16 Prohibiting Use of Gas Piping as Electrical Ground.

Gas piping shall not be used for a grounding electrode.

2-4.17 Gas Piping Support. All gas piping shall be supported at intervals of not more than 4 ft (1.2 m), except where adequate support and protection is provided by structural members. All pipe shall be rigidly anchored to a structural member within 6 in. (152.4 mm) of the supply connection(s) by galvanized, painted, or equivalently protected metal straps, hangers, or fittings. All pipe shall be anchored within 6 in. (152.4 mm) of tubing connections at the end of pipe runs and within 12 in. (304.8 mm) of tubing connection within pipe runs.

2-4.18 Testing for Gas Leakage.

2-4.18.1 Before Appliances Are Connected. Piping systems shall be proven by test to be leak-free by maintaining an air pressure of at least 6 in. mercury (20.7 kPa) or 3 psi (20.7 kPa) for a period of at least 10 minutes. Before the test is begun, the temperature of the air and of the piping shall be approximately the same, and a uniform temperature shall be maintained throughout the period. Leaks, if observed, shall be located and corrected. Defective material shall be replaced. Tests shall be conducted by either of the following methods:

(a) The source of the air pressure to the piping system shall be shut off. The pressure in the system shall be measured over a period of 10 minutes with a mercury manometer, slope gauge, or equivalent device, calibrated so as to be read in increments of not greater than $1/10$ psi (0.7 kPa). During the 10-minute period a drop in pressure shall not occur.

(b) A bubble-type leak detector shall be installed between the source of air pressure and the piping system. After a 10-minute equalization period, the bubble detector shall not indicate any air flow for a period of 1 minute. Products that contain ammonia or chlorine shall not be used for testing.

2-4.18.2 After Appliances Are Connected. When appliances are connected to the piping system, the entire piping system shall be pressurized to not less than 10 in. water column (2.5 kPa) nor more than 14 in. water column (3.5 kPa) and the appliance connections tested for leakage with either soapy water or bubble solution. Products containing ammonia or chlorine shall not be used. As an alternative procedure a pressure drop test can be conducted in the following manner:

The entire system shall be pressurized to not less than 10 in. water column (2.5 kPa) nor more than 14 in. water column (3.5 kPa), the appliance shutoff valves closed, and the system isolated from all sources of pressure. The temperature of both the air and piping shall be approximately the same, and a uniform temperature shall be maintained throughout the test period. When the test gauge is installed downstream of an appliance regulator, before the test is begun, open one valve and lower the pressure to 8 in. \pm 0.5 in. water column (1.99 kPa \pm 0.5 kPa) so that the appliance regulator is in an open condition. The pressure in the system shall be measured over a period of 3 minutes with a manometer or with a pressure-sensing device designed and calibrated to read, record, or indicate a pressure loss due to leakage during the pressure test period. During the 3-minute period, a drop in pressure shall not occur.

2-5 Fuel Oil Piping System.

2-5.1 General. The requirements of this section shall govern the installation of all fuel oil piping attached to any recreational vehicle. None of the requirements listed in this section shall apply to the piping in the appliance(s).

2-5.2 Oil Piping System Materials. All materials used for the installation, extension, alteration, or repair of any oil piping system shall be new and free from defects or internal obstructions. The system shall be made of materials having a melting point of not less than 1450°F (788°C), except as provided in 2-5.4. They shall be permitted to consist of one or more of the following materials:

- (a) Pipe shall be steel or wrought-iron pipe complying with ANSI/ASME A53, *Welded and Seamless Wrought Steel Pipe*. Threaded copper or brass pipe in iron pipe sizes shall be permitted to be used.
- (b) Fittings for oil piping shall be wrought iron, malleable iron, steel, or brass (containing not more than 75 percent copper).
- (c) Copper tubing shall be annealed Type K or L conforming to ASTM B 88, *Standard Specifications for Seamless Copper Water Tube*, or shall comply with ASTM B 280, *Specifications for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service*.
- (d) Seamless brass tubing shall have a minimum wall thickness of 0.030 in. (0.762 mm).
- (e) Steel tubing shall have a minimum wall thickness of 0.049 in. (1.24 mm), conforming to ASTM A 539, *Standard Specifications for Electric-Resistance Welded Coiled Steel Tubing for Gas and Fuel Oil Lines*, and shall be externally protected from corrosion.

2-5.3 Size of Oil Piping. The minimum size of all fuel oil tank piping connecting outside tanks to the appliance shall be not smaller than $\frac{3}{8}$ in. O.D. copper tubing or $\frac{1}{4}$ in. IPS. In those cases where No. 1 fuel is used with a listed automatic pump (fuel lifter), $\frac{1}{4}$ in. O.D. copper tubing shall be permitted to be used if specified by the pump manufacturer.

2-5.4 Joints for Oil Piping. All pipe joints in the piping system, unless welded or brazed, shall be screw joints that comply with ANSI B1.20.1, *Pipe Threads, General Purpose (Inch)*. The material used for welding or brazing pipe connections shall have a melting temperature in excess of 1000°F (538°C).

2-5.5 General Specifications for Flared Oil Tubing Joints. Flared oil tubing joints shall be in accordance with the following:

- (a) After cutting, tubing ends shall be internally reamed prior to flaring.
- (b) Flares shall be square with the axis of the tubing within one-half degree.
- (c) Flares shall be free from loose scale, burrs, and cracks. Seating surfaces shall be smooth and free from pit marks.

(See also 2-4.6.)

2-5.6 Oil Pipe Joint Compound. Screw joints shall be made up tight with approved pipe joint compound or other approved material that shall be applied to the male threads only.

2-5.7 Couplings for Oil Piping. Where it is necessary to join sections of screw piping, right and left nipples and couplings shall not be used. Ground joint unions shall be permitted to be installed at appliance inlet connections.

2-5.8 Slope of Oil Piping. Fuel oil piping installed in conjunction with gravity feed systems to oil heating equipment shall slope in a gradual rise upward from a central location to both the oil tank and the appliance in order to eliminate air locks.

2-5.9 Strap Hangers for Oil Piping. All oil piping shall be adequately supported by galvanized, painted, or equivalently protected metal straps or hangers at intervals of not more than 4 ft (1.2 m), except where adequate support and protection is provided by structural members. Iron-pipe oil supply connection(s) shall be rigidly anchored to a structural member within 6 in. (152 mm) of the supply connection(s). Iron piping shall be anchored within 6 in. (152 mm) of tubing connections at the end of the pipe runs and within 12 in. (304 mm) of tubing connections within runs.

2-5.10 Testing for Oil System Leakage. Before setting the system in operation, tank installations and piping shall be checked for oil leaks with fuel oil of the same grade as that which will be burned in the appliance. No other material shall be used for testing fuel oil tanks and piping. Tanks shall be filled to a maximum capacity for the final check for oil leakage.

2-6 Fuel-Burning Appliances.

2-6.1 General.

2-6.1.1 Listing Requirements. Fuel-burning appliances and vents necessary for their installation shall be listed for installation in recreational vehicles.

2-6.1.2 Basic Venting Requirements. Fuel-burning, heat-producing, and refrigeration appliances, except ranges and ovens, shall be of the vented type and vented to the outside.

2-6.1.3 Gas Appliance Fuel Utilization. Gas appliances shall be listed for use with LP-Gas only or for use with both natural gas and LP-Gas (convertible from natural gas to LP-Gas and vice versa).

2-6.1.4 Conversion of Appliances. Fuel-burning appliances shall not be converted from one fuel to another unless converted in accordance with the terms of their listings and the appliance manufacturer's instructions.

2-6.2 Installation of Fuel-Burning Appliances.

2-6.2.1 General Installation Requirements. The installation of each appliance shall conform to the terms of its listing and the appliance manufacturer's installation instructions. Floor-mounted fuel-burning appliances shall not be installed on carpeting unless the appliance is listed for such installation. Every appliance shall be secured in place to avoid displacement.

2-6.2.2 Requirement for Direct Vent System Appliances. All fuel-burning appliances, except ranges and ovens, shall be designed and installed to provide for the complete separation of the combustion system from the interior atmosphere of the recreational vehicle. Combustion air inlets and flue gas outlets shall be listed as components of the appliance. The required separation shall be obtained by the installation of direct vent system (sealed combustion system) appliances.

Exception No. 1: A fuel-burning refrigerator shall be permitted to be installed to meet the above requirements using panels supplied by the recreational vehicle manufacturer provided that the refrigerator manufacturer furnishes the necessary vents and grills as specified by the listing requirements and, in addition, the refrigerator is equipped with the necessary means to ensure the integrity of the separation of the combustion system when the refrigerator is removed for field service and reinstalled.

Exception No. 2: A fuel-burning appliance shall not need to be of the direct vent type provided that it conforms to all of the following:

- (a) *It is a vented appliance.*
- (b) *It incorporates provisions for introduction of combustion air from outside the vehicle.*
- (c) *It incorporates a safety control system that will prevent burner operation under any operating conditions that would allow products of combustion to discharge into the interior of the recreational vehicle.*
- (d) *It incorporates provisions either integral to the appliance design or by use of a safety control system(s) to protect against ignition of flammable materials that could come into contact with any heat source or part of the appliance.*
- (e) *It is listed for recreational vehicle installation and is installed with the terms of the listing.*

2-6.2.3 Exterior Appliances. Fuel-burning appliances installed or intended to be used only outside the RV shall be listed but shall not be required to be of the direct vent, sealed combustion type. The installation shall preclude the possibility of appliance operation or gas flow when the appliance is in its storage (travel) position. The appliance manufacturer shall specify clearance to adjacent surfaces as applicable in both the operational and storage positions.

2-6.2.4 Auxiliary Heating Devices. Primary mover engine auxiliary devices for heating interior living or storage space or for heating potable water shall not be required to be listed. Heat exchangers used in the potable water system shall be identified by the device manufacturer as being of a double-wall construction. Exhaust termination of engine block heaters with a gasoline- or diesel-fired source other than the primary mover engine shall comply with 3-4.3.

2-6.2.5 Special Requirement for Forced-Air Heating Appliances. A forced-air heating appliance and its return-air system shall be designed and installed so that negative pressure created by the air-circulating fan cannot affect its, or another appliance's, combustion air supply or act to mix products of combustion with circulating air.

2-6.3 Venting, Ventilation, and Combustion Air.

2-6.3.1 Installation of Venting and Combustion Air Systems. Venting and combustion air systems shall be installed in accordance with the following:

- (a) Components shall be securely assembled and properly aligned using the method shown in the appliance manufacturer's instructions.
- (b) Vent connectors shall be firmly attached to flue collars by sheet metal screws, their equivalent, or as specified in the manufacturer's installation instructions.
- (c) Every joint of a vent, vent connector, exhaust duct, and combustion air intake shall be secure and in alignment.

2-6.3.2 Location of Flue Gas Outlets of Fuel-Burning Heating Appliances. Flue gas outlets from fuel-burning heating appliances shall be not less than 3 ft (0.9 m) from any motor-driven air intake discharging into habitable areas of the recreational vehicle. Flue gas outlets shall not terminate underneath a recreational vehicle.

2-6.3.3 Location of Combustion Air Inlets, Flue Gas Outlets, and Fuel-Burning Heating Appliances. Any portion of a combustion air inlet or a flue gas outlet of a fuel-burning heating appliance shall be located at least 3 ft (0.9 m) from any gasoline filler spout on the vehicle if the inlet or outlet is located above or at the same level. If any portion of such inlet or outlet

is located below the spout, the distance shall be the sum of the vertical distance below the spout plus 3 ft (0.9 m).

2-6.3.4 Ventilation of Areas Accommodating Fuel-Burning Cooking Appliances. The space where any fuel-burning cooking appliance is located shall be ventilated by a gravity or mechanical vent extending through the roof to the outside. Where a combination gravity/mechanical vent is installed, both operations must comply. A gravity vent shall have a free, clear, openable area not less than 1 in.² for every 2000 Btu/hr (11 cm²/1000 W) rated input of the appliance(s). The location of the vent shall be in the roof within 5 ft (1.5 m) of any point directly above and provide unobstructed flow from the cooking appliances. Vent hood ducts shall be designed so that the duct outlet is located at such a point as to preclude the trapping of products of combustion.

Exception No. 1: Vehicles with fabric exterior walls shall be permitted to utilize an opening through the sidewall not more than 15 in. (381 mm) below the highest point of that roof within 5 ft (1.5 m) of any point directly above the appliance.

Exception No. 2: Hooded gravity vents located directly above the appliance are permitted to exhaust through the sidewall. (See 2-6.7.2.)

Exception No. 3: Mechanical vents (exhaust fans) having a flow rating of 2 cfm (0.19 m³/min) for every 1000 Btu/hr (1000 W) rated input of the appliance are permitted to be located on an adjacent wall higher than the appliance within a horizontal distance of not more than 5 ft (1.5 m) from the nearest edge of the appliance.

2-6.4 Marking Appliances (Installation and Operation Features).

2-6.4.1 Clearances, Input Ratings, Lighting, and Shutdown. Information on clearances, input ratings, lighting, and shutdown shall be attached to the appliance with the same permanence as the nameplate and shall be so located that it is easily readable when the appliance is properly installed.

2-6.4.2 Type(s) of Fuel. Each fuel-burning appliance shall bear the appliance manufacturer's permanent marking designating the type(s) of fuel for which it is listed. If listed and installed for use with either LP-Gas or natural gas, the appliance manufacturer's instructions regarding conversion from one fuel to the other shall be attached to the appliance with the same permanence as the nameplate.

2-6.5 Accessibility for Service/Operation. Every appliance shall be accessible for inspection, service, repair, and replacement without removing permanent construction or other fuel-burning appliances. Sufficient room shall be available to enable the operator to operate the controls, start the appliance, and observe the ignition for those appliances where the appliance manufacturer requires such procedure.

2-6.6 Location of Heat-Producing Appliances. Heat-producing appliances shall be so located that doors, drapes, or other such material cannot be placed or swung closer to the appliance than the clearances specified on the labeled appliances.

2-6.7 Clearances of Heat-Producing Appliances.

2-6.7.1 Maintaining Listed Clearances. Clearances between heat-producing appliances and adjacent surfaces shall be not less than as specified in the terms of their listing. Clearance spaces shall be framed in or guarded to prevent creation of storage space within the clearance specified. The only exceptions to framing in or guarding such spaces will be those necessary to allow access to shutoff valves or controls in order to comply with 2-4.9 and 2-6.2.1, in which case the unguarded area must have a warning tag, posted in an easily readable location, as follows:

Table 2-6.7.2 Vertical Clearances to Combustible Material or Metal Cabinets

Type of Protection Provided to Combustible Material or Metal Cabinets Above Range	Top Burner Rating	Oven Burner Rating		Vertical Clearance Required Above Range Top	
		Btu/hr	W	in.	mm
1. No protection provided.	Any combination, number, or input	Any		30	762
2. $\frac{1}{4}$ -in. (6-mm) thick minimum insulating millboard covered with 28 U.S. gauge sheet metal extending 9 in. (229 mm) beyond the sides of the range and covering the entire bottom of the material to be protected extending over the top of range. In lieu of 28 gauge sheet metal, a hood of 28 U.S. gauge sheet metal shall be permitted to be used. Hood shall be not less than the width of the range and shall be centered over the range and cover the entire bottom of the material to be protected.	Any combination, number, or input	Any		24	610
3. Range hood 28 U.S. gauge, with minimum 2-in. (51-mm) vertical sides and provided with a bead or flange around top of hood to provide a minimum $\frac{1}{4}$ -in. (6-mm) dead air space between hood and protected material. Hood shall be not less than the width of the range and shall be installed centered over range and cover the entire bottom of the material to be protected extending over the top of range.	Not more than four top burners — input not to exceed 6000 Btu/hr (1758 W) each — or not more than three top burners — two burners input not to exceed 7000 Btu/hr (2051 W) each and one burner input not to exceed 10,000 Btu/hr (2931 W)	10,000	2931	$19\frac{1}{2}$	495
	Not more than four top burners — input not to exceed 9000 Btu/hr (2638 W) each	24,000	7034	$20\frac{3}{4}$	514
	Two rear burners — input not to exceed 9000 Btu/hr (2638 W) each — and two front burners — input not to exceed 12,000 Btu/hr (3517 W) each	22,000	6448	$23\frac{1}{2}$	597
	Not more than four burners — input not to exceed 9000 Btu/hr (2638 W) each	22,000	6448	23	584
4. Same as No. 3, except no dead air space clearance provided.	Not more than four burners — input not to exceed 9000 Btu/hr (2638 W) each				

WARNING

DO NOT STORE COMBUSTIBLE MATERIAL
IN THIS AREA

2-6.7.2 Vertical Clearances of Ranges. Ranges shall have a vertical clearance between the cooking top and combustible material or metal cabinets in accordance with Table 2-6.7.2 or the terms of their listings.

Exception: Range covers

2-6.8 Clothes Dryers.

2-6.8.1 Exhaust Duct System. All gas and electric clothes dryers shall be exhausted to the outside by a moisture-lint exhaust duct and termination fitting.

Exception: Listed electric clothes dryers that are not required to be vented to the outside.

2-6.8.2 Where the clothes dryer is supplied by the manufacturer, the exhaust duct and termination fittings shall be provided by the manufacturer in accordance with the following:

- (a) A clothes dryer moisture-lint exhaust duct shall not be connected to any other duct, vent, or chimney.
- (b) The exhaust duct shall be of sufficient length so as not to terminate beneath the recreation vehicle.
- (c) Moisture-lint exhaust ducts shall not be connected with sheet metal screws or other fastening devices that extend into the interior of the duct.
- (d) Moisture-lint exhaust duct and termination fittings shall be installed in accordance with the appliance manufacturer's printed instructions.

2-6.8.3 Prevention of Negative Pressure in Recreation Vehicles. Fuel-burning clothes dryers shall receive their combustion air and drying air from outside the vehicle and shall exhaust the combustion products and drying air from inside the vehicle. Any electric dryer that receives drying air from inside the vehicle and exhausts drying air to outside the vehicle shall be provided with a label with the word CAUTION in ³/₈-in. (9-mm) high letters and the body of the text in ¹/₄-in. (6.35-mm) high letters posted on or near the dryer in a conspicuous location that shall read:

CAUTION

OPEN A WINDOW OR VENT WHILE OPERATING
DRYER. IT IS DANGEROUS TO CREATE A
NEGATIVE AIR PRESSURE INSIDE A VEHICLE
CONTAINING FUEL-BURNING APPLIANCES.

2-6.8.4 Provisions for Future Installation of a Gas Clothes Dryer. A recreation vehicle shall be permitted to be provided with gas piping to facilitate a future gas clothes dryer installation by the owner provided it complies with the following provisions:

- (a) Its gas outlet shall be provided with a shutoff valve, the outlet of which is closed by threaded pipe plug or cap.
- (b) Its gas outlet shall be permanently labeled to identify it for use only as the supply connection for a gas clothes dryer.
- (c) The manufacturer shall provide written instructions to the owner on how to complete the exhaust duct installation in accordance with provisions of 2-6.8.2.

2-6.8.5 Provisions for Future Installation of an Electric Clothes Dryer. When wiring is installed to supply an electric clothes dryer for future installation by the owner, the manufacturer shall install a receptacle for future connection of the dryer and provide written instructions on how to complete the

exhaust duct installation in accordance with the provisions of 2-6.8.2.

2-6.8.6 Clothes Dryers Installed in Closets or Alcoves. Each clothes dryer installed in closets or in alcoves shall be listed as suitable for such installation. Closets containing clothes dryers shall have ventilation openings sized in accordance with the appliance manufacturer's installation instructions.

2-7 Circulating Air Systems for Heating (Other than Automotive-Type).

2-7.1 Supply System Ducts. Air supply ducts shall be made of galvanized steel, tin-plated steel, aluminized steel, or aluminum or made of Class 0 or Class 1 listed air ducts or air connectors as tested in accordance with UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors*. A duct system integral with the structure shall be of durable construction that can be demonstrated to be equally resistant to fire and deterioration. Air ducts and plenums constructed of sheet metal shall be in accordance with Table 2-7.1.

2-7.2 Sizing of Supply Ducts. Ducts shall be designed so that where a labeled forced-air furnace is installed and operated continually at its normal input rating in the recreational vehicle, with all registers in full open position, the static pressure measured in the duct plenum shall not exceed that shown on the label of the appliance. Where an air-cooling coil is installed in the system, the total static pressure of the coil and the system shall not exceed that shown on the label of the appliance.

2-7.3 Static Pressure. The internal static pressure of the furnace air delivery system shall comply with the furnace manufacturer's instructions.

2-7.4 Return Air System Air Openings. Provisions shall be made to permit the return of circulating air from all rooms and living spaces to the circulating air supply inlet of the furnace.

Exception: Toilet rooms shall not be required to have return air openings.

2-7.5 Return Air Duct Materials. Return air ducts, if used, shall be in accordance with the following:

- (a) Portions of return air ducts directly above the heating surfaces, or closer than 2 ft (0.6 m) from the outer jacket or casing of the furnace, shall be constructed of metal in accordance with 2-7.1.

Table 2-7.1 Minimum Metal Thickness for Ducts

	Diameter 14 in. (381 mm) or Less		or	Width Over 14 in. (381 mm)	
	in.	mm		in.	mm
Round exposed	0.013	0.33		0.016	0.41
Enclosed rectangular or round	0.013	0.33		0.016	0.41
Exposed rectangular	0.016	0.41		0.019	0.48

Note: When "nominal" thicknesses are specified, 0.003 in. (0.0762 mm) shall be added to these "minimum" metal thicknesses.

(b) Return air ducts, except as required in 2-7.5(a), shall be constructed of 1-in. (25-mm) nominal wood boards (flame spread classification of not more than 200) or other suitable material no more combustible than 1-in. (25-mm) board. The interior of such combustible ducts (ducts of material other than as specified in 2-7.1) shall be lined with noncombustible material at points susceptible to damage from incandescent particles dropped through the register or from the furnace, such as directly under floor registers and bottoms of vertical ducts or directly under furnaces having bottom return.

2-7.6 Sizing of Return Air Ducts. The cross-sectional area of the return air duct shall not be less than 2 in.² for each 1000 Btu/hr (44 cm²/1000 W) input rating of the appliance. A complete ducted heating system need not comply with this return air duct sizing requirement if the numerical total of the static pressure at the inlet and the outlet of the appliance is equal to or less than that shown on the label of the appliance. For example: (supply duct static pressure) + (0.10 in. water column and return air duct static pressure) – (0.04 in. water column). Numerical total is 0.14 in. water column static pressure. Dampers shall not be placed in any return air duct, except that a diverting damper shall be permitted to be placed in a combination fresh air intake and return air duct so arranged that the required cross-sectional area will not be reduced at all possible positions of the damper.

2-7.7 Return Air Duct Permanent Unclosable Openings. Living areas not served by return air ducts and closed off from the return opening of the furnace by doors, sliding partitions, or other means shall be provided with permanent unclosable openings in the doors or separating partitions to allow circulated air to return to the furnace. Such openings shall be permitted to be grilled or louvered. The net free area of each opening shall be equal to or greater than the area of the air supply to the closed-off area but not less than 1 in.² (6.5 cm²) for every 5 ft² (0.46 m²) of total living area closed off from the furnace by the door or partition serviced by that opening. Undercutting doors connecting the closed-off area shall be permitted to be used as a means of providing return air area. However, in the event that doors are undercut, not more than one-half of the free air area provided shall be considered return air area.

2-7.8 Air Duct Joints and Seams. Joints and seams of ducts shall be securely fastened and made substantially airtight. Slip joints shall have a lap of at least 1 in. (25 mm) and shall be individually fastened. Tape or caulking compound shall be permitted to be used for sealing mechanically secure joints. Where used, tape or caulking compound shall not be subject to deterioration under long exposures to temperatures up to 200°F (93.4°C) and to conditions of high humidity, excessive moisture, or mildew.

2-7.9 Air Duct Supports. Ducts shall be securely supported.

2-7.10 Air Duct Registers or Grills. Fittings connecting the registers or grills to the duct system shall be constructed of metal or material that complies with the requirements for Class 0 or Class 1 air ducts under UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors*. Registers or grills shall be constructed of metal or conform with the following:

(a) Registers or grills shall be made of a material classified 94 V-0 or 94 V-2 when tested as described in UL 94, *Standard for Safety Test for Flammability of Plastic Materials for Parts in Devices and Appliances*.

(b) Floor registers or grills shall resist without structural failure a 200-lb (90.7-kg) concentrated load on a 2-in. (51-mm) diameter disc applied to the most critical area of the exposed face of the register or grill. For this test the register or grill is to be at a temperature of not less than 165°F (74°C) and is to be supported in accordance with the manufacturer's instructions.

Exception: This section does not apply to ducted rooftop air conditioning systems with heat strips or heat pumps where the system does not exceed 175°F when tested in accordance with UL 484, Standard for Safety Room Air Conditioners.

2-8 Air Conditioning (Other than Automotive-Type).

2-8.1 General Requirement — Air Conditioning Appliances.

Every air conditioning appliance or combination air conditioning and heating appliance used in a recreational vehicle shall be listed or certified for the application for which the air conditioning appliance is intended and shall be installed in accordance with the terms of its listing.

2-8.2 Air Conditioning Installation and Instructions.

2-8.2.1 Installation of Air Conditioning Appliances. The installation of each appliance shall conform to the terms of its listing and the manufacturer's installation instructions. Appliances shall be secured in place to avoid displacement and movement from vibration and road shock.

2-8.2.2 Rating Plates for Air Conditioning Appliances. The air conditioner rating plate shall be located so that it is easily readable when the appliance is installed.

2-8.2.3 Fuel-Burning Air Conditioners. Each fuel-burning air conditioner shall comply with Section 2-6.

2-8.2.4 Accessibility of Air Conditioners. Each air conditioner shall be accessible for inspection, service, repair, and replacement without removing permanent construction.

2-9 Consumer Information.

2-9.1 Required Information.

2-9.1.1 Instructions for Appliances. Operating instructions shall be provided for each appliance, including air conditioning appliances (other than automotive-type).

2-9.1.2 Owner's Manual. Each recreational vehicle shall be provided with an owner's manual that shall contain the following information as a minimum:

(a)

WARNING

LP-Gas cylinders shall not be placed or stored inside the vehicle. LP-Gas cylinders are equipped with safety devices that relieve excessive pressure by discharging gas to the atmosphere.

(b) The following warning label has been located in the cooking area to remind the user to provide an adequate supply of fresh air for combustion:

WARNING

IT IS NOT SAFE TO USE COOKING APPLIANCES
FOR COMFORT HEATING

Cooking appliances need fresh air for safe operation.

Before operation

1. Open overhead vent or turn on exhaust fan.
2. Open window.

Unlike homes, the amount of oxygen supply is limited due to the size of the recreational vehicle, and proper ventilation when using the cooking appliance(s) will avoid dangers of asphyxiation. It is especially important that cooking appliances not be used for comfort heating, as the danger of asphyxiation is greater when the appliance is used for long periods of time.

(c) A warning label has been located near the LP-Gas container. This label reads as follows:

DO NOT FILL CONTAINER(S) TO MORE THAN 80 PERCENT OF CAPACITY

Overfilling the LP-Gas container can result in uncontrolled gas flow, which can cause fire or explosion. A properly filled container will contain approximately 80 percent of its volume as liquid LP-Gas.

(d) A warning that portable fuel-burning equipment, including wood and charcoal grills and stoves, shall not be used inside the recreational vehicle. The use of this equipment inside the recreational vehicle can cause fires or asphyxiation.

(e) A warning that states not to bring or store LP-Gas cylinders, gasoline, or other flammable liquids inside the vehicle because a fire or explosion can result.

(f) The following label has been placed in the vehicle near the range area:

IF YOU SMELL GAS:

1. Extinguish any open flames, pilot lights, and all smoking materials.
2. Do not touch electrical switches.
3. Shut off the gas supply at the container valve(s) or gas supply connection.
4. Open doors and other ventilating openings.
5. Leave the area until odor clears.
6. Have the gas system checked and leakage source corrected before using again.

(g) LP-Gas regulators must always be installed with the regulator vent facing downward. Regulators that are not in compartments have been equipped with a protective cover. Make sure that the regulator vent faces downward and that the cover is kept in place to minimize vent blockage that could result in excessive gas pressure causing fire or explosion.

2-9.2 Required Markings.

2-9.2.1 Identification of Gas Supply Connections. Each recreational vehicle shall have permanently affixed at or near each gas supply connection or at the end of the piping a plate complying with the requirements for exterior labels (*see Section 1-4*) 3 in. × 1³/₄ in. (76 mm × 44 mm) minimum size that reads (as appropriate) as either of the following:

(a) **THIS GAS PIPING SYSTEM IS DESIGNED FOR USE OF LIQUEFIED PETROLEUM GAS ONLY. DO NOT CONNECT NATURAL GAS TO THIS SYSTEM.** Securely cap inlet(s) when not connected for use. After turning on gas, except after normal cylinder replacement, test gas piping and connections to appliances for leakage with soapy water or bubble solution. Do not use products that contain ammonia or chlorine.

(b) **THIS GAS PIPING SYSTEM IS DESIGNED FOR USE OF EITHER LP-GAS OR NATURAL GAS. BEFORE TURNING ON GAS BE CERTAIN APPLIANCES ARE DESIGNED AND ARRANGED FOR THE GAS CONNECTED. (SEE EACH APPLIANCE INSTRUCTION PLATE.)** Securely cap this inlet when not connected for use. After turning on gas, except after normal cylinder replacement, test gas piping and connections to appliances for leakage with soapy water or bubble solution. Do not use products that contain ammonia or chlorine.

2-9.2.2 Warning Relative to Refueling.

(a) Each vehicle shall have a permanent label adjacent to the LP-Gas container that reads as follows:

DO NOT FILL LP-GAS CONTAINER(S) TO MORE THAN 80 PERCENT OF CAPACITY

(b) Each motor home or truck camper having exterior combustion air inlet(s) at a level below the roof shall have a permanent label that reads as follows:

WARNING

ALL PILOT LIGHTS, APPLIANCES, AND THEIR IGNITORS (SEE OPERATING INSTRUCTIONS) SHALL BE TURNED OFF DURING REFUELING OF MOTOR FUEL TANKS AND/OR LP-GAS CONTAINERS

On truck campers this label shall be placed near the front on both the left and right exterior walls. On motor homes and chassis-mounted truck campers, this label shall be placed by the gasoline filler spout and the LP-Gas container.

The labels shown in 2-9.2.2(a) and 2-9.2.2(b), where required near the LP-Gas containers, shall be permitted to be incorporated in the plates required in 2-9.2.1.

2-9.2.3 Warning If Gas Odor Is Detected. Where LP-Gas fuel-burning equipment is installed by the recreational vehicle manufacturer, a permanent label with ³/₈-in. (9-mm) high title letters and ¹/₈-in. (3-mm) high text letters shall be affixed in a noticeable location near the range. This label shall be permitted to be affixed to the back of a cabinet door providing the cabinet door will be frequently used and shall read as follows:

IF YOU SMELL GAS:

1. Extinguish any open flames, pilot lights, and all smoking materials.
2. Do not touch electrical switches.
3. Shut off the gas supply at the tank valve(s) or gas supply connection.
4. Open doors and other ventilating openings.
5. Leave the area until odor clears.
6. Have the gas system checked and leakage source corrected before using again.

2-9.2.4 Warning Label for Cooking Appliances. A permanent warning label with the word **WARNING** with ³/₈-in. (9-mm) high letters and body text with ¹/₈-in. (3-mm) high letters shall be affixed in a conspicuous manner adjacent to fuel-burning ranges and shall read as follows:

WARNING

IT IS NOT SAFE TO USE COOKING APPLIANCES FOR COMFORT HEATING

Cooking appliances need fresh air for safe operation.

Before operation

1. Open overhead vent or turn on exhaust fan.
2. Open window.

2-10 Gasoline or Diesel Fuel Systems on Travel Trailers and Fifth Wheels.

2-10.1 General. The requirements of this section apply to the installation of gasoline or diesel fuel systems for travel trailers and fifth wheels.

2-10.1.1 The entire fuel system shall be liquidtight and vapor-tight from the interior of the vehicle.

2-10.1.2 Valves, filters, strainers, and similar components shall be accessible for maintenance.

2-10.1.3 Auxiliary outlets for drawing, returning, and venting must be on top of the fuel tank.

2-10.2 Generator Ready.

2-10.2.1 When a fuel system is installed for an electrical generator but the electrical generator is not installed at the recreational vehicle factory, all fuel lines between the fuel tank and the generator compartment shall be routed and plugged.

2-10.2.2 The following information shall appear on a label and shall be located near the fuel filler cap:

CAUTION

DO NOT PUT FUEL IN TANK UNLESS GENERATOR
IS INSTALLED AND FUEL LINES ARE CONNECTED.
CHECK ALL CONNECTIONS FOR LEAKAGE.

2-10.3 Fuel Tank Installation.

2-10.3.1 Location. The fuel tank shall be located under the floor, in a compartment, on a trailer A frame, or forward of the front bulkhead below the overhang of a fifth wheel trailer. Clearances shall be as specified below. All measurements shall be determined from the bottom of the tank, or from the lowest fitting, support, or attachment on the tank or tank housing, whichever is lower, while the vehicle is level and at its maximum gross vehicle weight rating (GVWR).

(a) *Rear Clearance Line.* Above a plane tangent to the line connecting a point that is 8 in. (203 mm) above the ground on the vertical centerline of the wheel spindle and the lowest point on the intersection of the rear wall and floor lines (skid bars are excluded).

(b) *Front Clearance Line.* Above a plane tangent to the line connecting a point that is 8 in. (203 mm) above the ground on the vertical centerline of the wheel spindle and the lowest point of the frame's front cross member. It is not the intent to prohibit the fuel tank from being located in the A frame area providing neither the fuel tank nor the tank connections extend below the bottom of the trailer frame.

(c) The fuel tank shall be permitted to be located in a compartment provided the following:

1. A compartment containing a fuel tank with filler opening, vent, or any combination thereof, within the compartment, shall have no floor.
2. A compartment containing a fuel tank that is filled and vented to the exterior is permitted to have a floor provided that the compartment side walls and floor are resistant and nonabsorbent to fuel, that the floor has a minimum $\frac{1}{2}$ -in. (12.7-mm) diameter drainage hole at each potential low

point, and that the joints between compartment side walls and floor are sealed to prevent fuel entry.

3. The fuel tank compartment shall be vaportight to the vehicle interior and sealed so that vapors cannot travel through concealed spaces between the exterior-interior surfaces of the recreational vehicle. Sealing compounds used to seal the compartment shall be fuel resistant.

4. The fuel tank compartment shall not contain flame- or spark-producing equipment.

2-10.3.2 Securing of Fuel Tanks. The fuel tank shall be secured by fastenings that hold it in place when a force equal to 8 times the tank's filled weight is applied through the fuel tank in any direction.

2-10.4 Fill System.

2-10.4.1 The filler subsystem shall run as directly as possible from the filler cap to the tank. The filler cap end shall be completely above the top of the fuel tank. The fill opening shall not be within 36 in. of any heat source.

2-10.4.2 The area surrounding fuel filler pipes and vents shall be sealed so that vapors cannot travel through concealed spaces between the exterior-interior surfaces of the recreational vehicle. The sidewall surface below the filler cap and extending at least 12 in. (304.8 mm) to each side of the cap's vertical centerline shall be constructed of fuel-resistant nonabsorbent materials. Sealing compounds used around the filler pipe and in this area shall be fuel resistant.

2-10.4.3 A marking indicating the type of fuel to be used shall be provided on or near the filler cap.

2-10.5 Fuel Distribution System.

2-10.5.1 Tubing shall be constructed of prime aluminized steel or material suitable for use with fuel.

2-10.5.2 Hose shall conform to SAE Standard J30, *Fuel and Oil Hoses*, J30R7 or better.

2-10.5.3 Hose-to-tube joints shall remain leak free when subjected to a 20-lb (9.0-kg) axial pull test applied for 1 minute. Hose-to-tube joints shall remain leak free when subjected to an internal pressure of 10 psig.

2-10.5.4 The distribution system shall be supported to minimize chafing and to maintain at least a 6-in. (152.4-mm) clearance from any unshielded exhaust system component.

2-10.5.5 The fuel system shall not be in contact with electrical wiring except as required for component operation.

2-10.5.6 The fuel system shall be designed so that leakage from fuel tanks or joints will not contact electrical or exhaust system components. (Drain troughs shall be permitted to be used as required.)

2-10.5.7 Rollover vent valves identified as complying with the 49 *CFR* 393.67, parts (c)(1) through (5) and (d)(2), shall be used, as applicable, for gasoline or diesel systems.

2-10.6 Fuel Transfer/Dispensing Systems.

2-10.6.1 Systems for transferring/dispensing fuel to other vehicles or containers shall be permitted when constructed in accordance with these requirements and other state and federal laws or regulations as applicable.

2-10.6.2 All transferring/dispensing system attachments including supply, return, and vent lines for fuel shall be accom-

plished from attachments located at the top of the fuel tank. Fill nozzles and hose shall be protected during transporting.

2-10.6.3 Nozzles used for the dispensing of fuel shall be designed for use with unleaded fuel, of a trigger and handle type, made with an aluminum cast body, and identified by its manufacturer as capable of withstanding moderate abuse. Nozzles shall be compatible with pumps, if provided.

2-10.6.4 Fuel pumps shall be of the manual or 12-V electrical type. The pump shall be identified by its manufacturer as being compatible with the fuel type to be used.

2-10.6.5 Clamps used in the fuel system shall be of the constant tension type — Chrysler screw clamps or equal. Clamps shall be matched with the type and size of the fuel lines used. Worm gear clamps shall not be used other than at the fill and vent locations at the fuel tank.

2-10.6.6 In-line fuel filters shall be permitted. When installed, they shall be located in readily accessible locations for service.

2-11 LP-Gas Engine Fuel Installations.

2-11.1 LP-Gas Vehicle Propulsion Engine Fuel Installations. Systems supplying both vapor and liquid withdrawal shall comply with Section 8-2 of NFPA 58, *Liquefied Petroleum Gas Code*, except as provided for in 2-11.2.

2-11.2 Permanently mounted tanks shall be mounted in accordance with 2-2.3(b)3 and secured in accordance with 2-2.4.

Chapter 3 Fire and Life Safety Provisions

3-1 Interior Finish and Textile or Film Materials.

3-1.1 Interior Finish Flame Spread Limitation. Interior finish (as defined in Section 1-3) of walls, partitions, ceilings, exterior passage doors, cabinets, habitable areas, hallways, and bath or toilet rooms, including shower/tub walls, of recreational vehicles shall be of materials with a flame spread classification that does not exceed 200 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

An alternate method of testing for cabinet door and drawer faces, exposed cabinet bottoms and end panels, and tub/shower walls shall be permitted to use ASTM E 162, *Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source*, to establish the flame spread rating not to exceed 200.

Exception: These flame spread limitations do not apply to moldings; trim; furnishings; windows, door, or skylight frames and casings; interior passage doors; countertops; cabinet rails; stiles; mullions; toe kicks; and padded cabinet ends.

3-1.2 Combustibility of Textile or Film Materials. Where the walls, partitions, or ceilings consist of textile or film materials, such as tent fabric, insect screening, flexible plastic weather protection, and so forth, they shall conform to the requirements of 49 CFR 571.302, paragraphs S4.3 and S5 of *Federal Motor Vehicle Safety Standard No. 302*, "Flammability of Interior Materials."

3-1.3 Use of Cellular Foam or Foamed Plastic Materials. Cellular foam or foamed plastic materials shall not be used for interior finish (as defined in Section 1-3) in recreational vehicles.

Exception No. 1: Cellular or foamed plastic materials shall be permitted on the basis of fire tests that substantiate on a reasonable basis their combustibility characteristics, for the use intended, in actual fire conditions.

Exception No. 2: Incidental use of such materials for molding, trim, splash panels, and on doors shall be permitted.

3-1.4 Mirrors. All interior mirrors with an exposed area exceeding 431 in.² (278,064 mm²) shall comply with ANSI Z97.1, *Safety Glazing Materials Used in Buildings — Safety Performance Specifications and Methods of Test*, or equal requirements and shall be so identified by the manufacturer of the mirror.

3-2 Recreational Vehicle Exit Facilities.

3-2.1* Minimum Exit Facilities. Recreational vehicles shall have a minimum of two exits located remote from each other and so arranged as to provide a means of unobstructed travel to the outside of the vehicle. Each bedroom or area designed for sleeping shall have at least two unobstructed paths to exit. The path to exit must not require passing any designated exit to gain use of another designated exit except where any part of a bed in its normal sleeping configuration is within 24 in. (610 mm) of the plane of the nearest designated exit as projected across the vehicle. (See Figure A-3-2.1.)

3-2.2 Alternate Means in Motor Homes and Truck Campers.

The alternate exits in motor homes and truck campers shall be located on a wall other than that wall where the main vehicle exit door is located or shall be located in the roof. Use of the driver's door as an alternate exit shall be permitted provided that the driver's seat locks only in the forward position and arm rests, if any, are retractable and nonlockable when in the arm rest position. The distance between the upright portion of the seat in its extreme forward position and the nearest point of the steering wheel shall be not less than 12 in. (305 mm).

3-2.3 Access to Alternate Exits. The path leading to an alternate exit, other than that stated in 3-2.2, shall be not less than 13 in. (330 mm) wide at the narrowest point and as a minimum shall extend vertically from the supporting surface below the alternate exit to the top of the alternate exit. The supporting surface shall be not more than 3 ft (0.9 m) below the bottom of the alternate exit and shall be capable of supporting a weight of 300 lb (136 kg). Recreational vehicles that contain a designated roof alternate exit shall be provided with a ladder or equivalent device for descending from the roof.

3-2.4 Operation of Exits. The latch mechanism of any required exit facility shall be operable by hand and shall not require the use of a key or tool for operation from the inside. No more than 20 lb of force (89 N) shall be required to open a required exit.

3-2.5* Size of Alternate Exits. The alternate exit, if not an exterior passage door, shall provide an opening of sufficient size to permit unobstructed passage, keeping a major axis parallel to the plane of the opening and horizontal at all times, of an ellipsoid generated by rotating about its minor axis an ellipse having a major axis of 24 in. (610 mm) and a minor axis of 17 in. (432 mm). (See Figure A-3-2.5.) An exterior passage door if used for an alternate exit shall provide an unobstructed opening with a minimum horizontal dimension of 18 in. (457 mm) and a minimum vertical dimension of 48 in. (1.2 m).

3-2.6 Marking of Exits. Alternate exits other than exterior passage doors shall be identified by a waterproof label with the

word EXIT in 1-in. (25.4-mm) minimum red letters on a contrasting background. The label shall be placed on the interior wall surface above or below the exit or on the interior ceiling surface, within 8 in. (203 mm) of the opening in an unobscured visible location or shall be installed on the interior of the exit frame or the moveable portion of the exit approximately midway between the sides.

3-2.7 Identification of Exit Handles. Handles that must be operated to open alternate exits shall be colored red.

Exception: Exterior and interior passage door handles shall not need to be colored.

3-3 Fire Detection Equipment.

3-3.1 Smoke Detector. At least one integral battery-operated smoke detector shall be installed in each fifth wheel, travel trailer, or motor home.

Exception: A fifth wheel or travel trailer that has only interior lighting capable of being powered only by a 120-V or 120-V/240-V external power supply shall be permitted to be equipped with a 120-V operated smoke detector with battery back up that shall be on a branch-circuit supplying lighting and receptacle outlets that shall not have ground-fault protection.

3-3.2* Smoke Detector Listing Requirement. The smoke detector shall be listed and marked on the device as being suitable for installation in recreational vehicles under the requirements of UL 217, *Standard for Single and Multiple Station Smoke Alarms*.

3-3.3 Installation of Smoke Detector. The required smoke detector shall be installed in accordance with its listing, but not within the separate sleeping areas, a minimum of 6 in. (152 mm) from all exterior walls measured edge to edge and away from the direct flow of air from heat and air conditioning outlets.

3-3.4 Operational Check Warning Label. A permanent label shall be installed in a visible location on or within 24 in. (610 mm) of the smoke detector with the following text in contrasting letters at least $\frac{1}{8}$ in. (3.2 mm) high:

WARNING

TEST SMOKE DETECTOR OPERATION AFTER
VEHICLE HAS BEEN IN STORAGE, BEFORE
EACH TRIP, AND AT LEAST ONCE PER
WEEK DURING USE

3-4 Other Considerations.

3-4.1 Provisions for Portable Fire Extinguishers. Each motor home shall be equipped with a listed portable fire extinguisher with a minimum rating of 10-B:C. Each recreational vehicle equipped with fuel-burning equipment (other than the prime mover engine) or 120-/240-V electrical system shall be provided with a listed portable fire extinguisher with a minimum rating of 5-B:C as defined in NFPA 10, *Standard for Portable Fire Extinguishers*.

The fire extinguisher shall be installed in accordance with its listing and Section 1-6 of NFPA 10 and shall be located within the recreational vehicle interior as near as practical to the primary means of exit.

3-4.2 Fuel Spout Installation. The area surrounding liquid fuel filler pipes and vent tubing shall be sealed so that fuel vapors cannot travel into concealed spaces between exterior and interior surfaces of the recreational vehicle nor to the

interior of the vehicle (*see also Chapter 2*). Materials and sealants used to seal the fill pipe and vent tubing location shall be nonabsorbent and resistant to intermittent contact (splashing) with fuel.

3-4.3 Internal Combustion Engine Exhausts. Exhausts from internal combustion engines shall not terminate under the vehicle. Exhausts shall extend beyond the periphery of the vehicle so that exhaust gases discharge away from the vehicle. Internal combustion engine exhaust components installed by the RV manufacturer shall not extend or protrude in a manner where they could be unduly subject to road damage. Internal combustion engine exhaust shall not terminate so that a communicable air passage exists into the living area within an area defined as a distance of 6 in. (152 mm) as measured from the tailpipe termination perimeter as projected onto the vehicle side. Regardless of location of vehicle exhaust, vents or windows that can be opened shall not be installed in the rear wall of motor home and truck campers.

Exception No. 1: Normally unopenable alternate exit windows shall be permitted to be installed in rear walls.

Exception No. 2: Rear entry doors with fixed windows shall be permitted to be installed in truck campers.

Exception No. 3: Rear entry doors with fixed windows shall be permitted to be installed in motor homes provided that no combustion engine exhausts discharge from the rear of the vehicle.

3-4.4 Floor Penetrations. No uncovered hole(s) shall be permitted in or through the floor of a recreational vehicle that is equipped with, or designed for future installation of, an internal combustion engine(s). Holes or other penetrations provided for piping, wiring, or other similar components for systems addressed by this standard shall be sealed.

3-4.5 Installation of Internal Combustion Engine Generators.

Internal combustion engine-driven generator units (subject to the provisions of this standard) shall be secured in place to avoid displacement in accordance with manufacturer's instructions and shall be installed in a compartment that is vaportight to the interior of the vehicle.

Where generator compartments are used to isolate the generator from the vehicle's interior, generator compartments shall be lined with galvanized steel not less than 26 MSG thick. Seams and joints shall be lapped, mechanically secured, and made vaportight to the interior of the vehicle. Alternate materials and methods of construction shall be permitted to be used if they provide equivalent quality, strength, effectiveness, fire resistance, durability, and safety. Liquid fuel lines and exhaust systems shall not penetrate into the living area. Holes into the living area shall be sealed vaportight.

3-4.6 Carbon Monoxide (CO) Detectors. All RVs equipped with an internal combustion engine or designed with features to accommodate future installation of an internal combustion engine and all truck campers shall be equipped with a CO detector listed as suitable for use in recreational vehicles under the requirements of UL 2034, *Standard for Safety Single and Multiple Station Carbon Monoxide Detectors*, and installed according to the terms of its listing.

3-4.7 Special Transportation Provisions. All recreational vehicles providing any entrance door greater than 36 in. (914 mm) in width and an access ramp for that door or that are promoted as providing the ability for transporting or storing internal combustion engine vehicles shall provide the following:

(a) A minimum of one opening or window on each side of the vehicle's longitudinal centerline having a minimum of 200 in.² (0.13 m²) of free area openable during transit. This venting shall be permitted to be located on sidewalls, endwalls, or through the floor where permitted (*see 3-4.4*). The top of sidewall and endwall openings or windows shall not be more than 18 in. above the vehicle's interior floor level. As an alternate, a passive ram air ventilation system shall be permitted. This passive ram air ventilation system shall require a minimum of 10 in.² of free openable area in the forward upper end of the transportation area pointing forward and a minimum of 10 in.² of free openable area in the lower rear area pointing aft, out, or down.

(b) The floor of the transportation area shall be nonabsorbent and resistant to the intermittent contact (splashing) with fuel. If a floor covering or coating is used to accomplish this, it shall be seamless. Where flooring in the transport area meets a wall it shall be sealed to the sidewalls and endwall with sealant that is nonabsorbent and resistant to the intermittent contact (splashing) with fuel.

(c) Electrical equipment and lighting installed in accordance with Sections 511-6(d) and 511-7(b) of NFPA 70, *National Electrical Code*.

(d) A listed portable fire extinguisher with a minimum rating of 10-B:C, as defined in NFPA 10, *Standard for Portable Fire Extinguishers*.

(e) LP-Gas ranges and ovens, if provided, shall not contain pilot lights or shall be equipped with a pilot light shutoff.

(f) A warning label placed inside of the RV adjacent to each entry and visible to anyone entering the RV. This label(s) shall be printed with red letters on a white background with the word WARNING a minimum of $\frac{3}{4}$ in. (19 mm) high, text that shall be a minimum of $\frac{1}{4}$ in. (6 mm) high, and shall read as follows:

WARNING

Any motorized vehicle or any motorized equipment powered with flammable liquid can cause fire, explosion, or asphyxiation if stored or transported within the recreational vehicle. To reduce the risk of fire, explosion, or asphyxiation

1. Do not allow passengers to ride inside internal combustion engine vehicle storage area while vehicles are present.
2. Doors and windows in walls of separation are to be closed while the vehicles are present.
3. Run fuel out of engine after shutting off fuel at the tank.
4. Do not store or transport supplementary motor fuel within this vehicle.
5. Ventilate the interior of the vehicle to reduce the risk of fire, explosion, or asphyxiation.
6. Do not operate gas appliances, pilot lights, or electrical equipment when motorized vehicles or motorized equipment are inside vehicle.

(g) For vehicles that contain a special transportation area with a wall of separation and openings in the floor, a warning label visible to anyone entering the special transportation area. The label shall have text a minimum $\frac{3}{8}$ in. (9.525 mm) high and shall read as follows:

THIS AREA IS NOT A DESIGNATED SLEEPING AREA

(h) A statement in the owner's manual warning of the hazards of transporting, storing, or cohabiting with internal combustion engines inside the vehicle.

(i) A label affixed to the interior of the vehicle and a statement in the owner's manual explaining the proper weight distribution for the transportation of internal combustion engine vehicles.

Exception No. 1: Recreational vehicles designed and promoted for the physically impaired are not required to comply with the requirements of 3-4.7.

Exception No. 2: Portions of recreational vehicles designed to transport livestock, having a permanent wall of separation (passage doors and windows permitted) from the living section, are not required to comply with 3-4.7.

3-4.8 LP-Gas Detectors. All recreational vehicles equipped with an LP-Gas appliance and electrical system shall be equipped with an LP-Gas detector listed as suitable for use in recreational vehicles under the requirements of UL 1484, *Standard for Safety Residential Gas Detectors*, and installed according to the terms of its listing.

Chapter 4 Plumbing Systems

4-1 Requirements for plumbing are developed by the ANSI A119 Committee of which the Recreational Vehicle Industry Association is Secretariat. Those requirements and the fire safety requirements in this standard are published and distributed under one cover as ANSI A119.2/ NFPA 1192.

Chapter 5 Referenced Publications

5-1 The following documents or portions thereof are referenced within this standard as mandatory requirements and shall be considered part of the requirements of this standard. The edition indicated for each referenced mandatory document is the current edition as of the date of the NFPA issuance of this standard. Some of these mandatory documents might also be referenced in this standard for specific informational purposes and, therefore, are also listed in Appendix C.

5-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 10, *Standard for Portable Fire Extinguishers*, 1998 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 1998 edition.

NFPA 70, *National Electrical Code*[®], 1999 edition.

NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*, 1996 edition.

5-1.2 Other Publications.

5-1.2.1 ANSI Publications. American National Standards Institute, 11 West 42nd Street, 13th floor, New York, NY 10036.

ANSI A119.5, *Standard for Park Trailers*, 1993.

ANSI B1.20.1, *Pipe Threads, General Purpose (Inch)*, 1983.

ANSI Z97.1, *Safety Glazing Materials Used in Buildings — Safety Performance Specifications and Methods of Test*, 1984.

5-1.2.2 ASME Publication. American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.

ASME *Boiler and Pressure Vessel Code*, Section VIII, Division I, Rules for Construction of Pressure Vessels.