NFPA 1192

Standard on Recreational Vehicles

2005 Edition

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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NFPA 1192

Standard on

Recreational Vehicles

2005 Edition

This edition of NFPA 1192, *Standard on Recreational Vehicles*, was prepared by the Technical Committee on Recreational Vehicles and acted on by NFPA at its November Association Technical Meeting held November 13–17, 2004, in Miami Beach, FL. It was issued by the Standards Council on January 14, 2005, with an effective date of February 7, 2005, and supersedes all previous editions.

This edition of NFPA 1192 was approved as an American National Standard on February 7, 2005.

Origin and Development of NFPA 1192

1937–1970. The earliest activity of 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 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 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 NFPA 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, 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 was 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 was renumbered as NFPA 1192. Chapter 2 requirements on LP-Gas containers and connectors were updated. Changes also included modifications to Chapter 3 requirements for exit facilities and special transportation provisions.

The 2002 edition consisted of a major editorial reorganization of the document in accordance with the NFPA *Manual of Style*, 2000 edition. Other changes occurred in the language of caution and warning labels.

In this 2005 edition the committee completed the editorial revision to the *Manual of Style for NFPA Technical Committee Documents* and merged the requirements from ANSI A1192.2 into NFPA 1192. ANSI A1192.2 will no longer be published.

NFPA 1192 now contains minimum requirements for the installation of plumbing, fuel burning, electrical, and other safety-related systems in recreational vehicles.

Technical changes to the standard include clarification of requirements for location and securing of propane containers, requirements for high pressure piping, revision of requirements for fuel tank installation, and the inclusion of requirements for automatic generator starting systems.

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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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2005 Edition

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

Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for mandatory extracts are given in Chapter 2 and those for nonmandatory extracts are given in Annex C. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced documents can be found in Chapter 2 and Annex C.

Chapter 1 Administration

1.1* Scope. This standard shall cover fire and life safety criteria for recreational vehicles.

1.2 Purpose. The purpose of this standard shall be to provide the minimum criteria for recreational vehicles that are considered necessary to provide protection from loss of life from fire and explosion.

1.3 Application.

1.3.1* The requirements of this standard shall be applied to all new recreational vehicles.

1.3.2 This standard shall not be applied as a stand-alone design specification or instruction manual.

1.3.3 This standard shall apply to new recreational vehicles manufactured on or after September 1, 2005.

1.4 Retroactivity. This standard shall not be applied retroactively.

1.5 Equivalency. 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.

1.6* Use of International System of Units (SI). In some cases SI equivalents to U.S. customary 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 *Manual of Style for NFPA Technical Committee Documents.* Alternating usage of U.S. and SI units to determine distance, size (capacity), or dimensions shall not be used. Where SI equivalents are not given, it is because the U.S. units shall be employed by anyone enforcing this standard.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 10, *Standard for Portable Fire Extinguishers,* 2002 edition.
NFPA 58, *Liquefied Petroleum Gas Code,* 2004 edition.
NFPA 70, *National Electrical Code®,* 2005 edition.
NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials,* 2000 edition.

2.3 Other Publications.

2.3.1 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI A119.5, *Standard for Park Trailers,* 1998.

ANSI B1.20.1, *Pipe Threads, General Purpose (Inch),* 2001.

ANSI Z97.1, *Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test,* 1994.

ANSI/RVIA 12V, *Low Voltage Systems in Conversion and Recreational Vehicles,* 2002.

2.3.2 ASME Publication. American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

ASME *Boiler and Pressure Vessel Code,* Section VIII, Division I, Rules for Construction of Unfired Pressure Vessels, 2004.

2.3.3 ASTM Publications. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A 53, *Specifications for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless,* 2004.

ASTM A 539, *Standard Specifications for Electric-Resistance Welded Coiled Steel Tubing for Gas and Fuel Oil Lines,* 1999.

ASTM B 88, *Standard Specifications for Seamless Copper Water Tube,* 2003.

ASTM B 280, *Specifications for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service,* 2003.

ASTM E 162, *Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source,* 2002.

2.3.4 CGA Publication. Compressed Gas Association, 4221 Walney Road, 5th Floor, Chantilly, VA 20151-2923.

CGA V-1, *Compressed Gas Cylinder Valve Outlet and Inlet Connections*, 2003.

2.3.5 SAE Publications. Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

SAE J30, *Fuel and Oil Hoses*, Standard, 1998.

SAE J533, *Flares for Tubing*, Standard, 1999.

SAE J1508, *Hose Clamp Specifications*, 1997.

2.3.6 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 94, *Standard for Safety Test for Flammability of Plastic Materials for Parts in Devices and Appliances*, 2003.

UL 125, *Standard for Valves for Anhydrous Ammonia and LP-Gas (Other than Safety Relief),* 2001.

UL 144, *Standard for LP-Gas Regulators*, 2001.

UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors*, 1996.

UL 217, *Standard for Single and Multiple Station Smoke Alarms*, 2003.

UL 330, *Standard for Hose and Hose Assemblies for Dispensing Flammable Liquids*, 1999.

UL 484, *Standard for Room Air Conditioners*, 2002.

UL 569, *Standard for Pigtails and Flexible Hose Connectors for LP-Gas*, 2000.

UL 842, *Standard for Valves for Flammable Liquids*, 1999.

UL 1484, *Standard for Residential Gas Detectors*, 2000.

UL 2061, *Standard for Adapters and Cylinder Connection Devices for Portable LP-Gas Cylinder Assemblies,* 2001.

2.3.7 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Title 49, Code of Federal Regulations, Part 393.67, *Liquid Fuel Tanks.*

Title 49, Code of Federal Regulations, Part 571.302, paragraphs S4.3 and S5, *Federal Motor Vehicle Safety Standard No. 302*, Flammability of Interior Materials.

Chapter 3 Definitions

3.1* General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary,* 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 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.

3.2.4* 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 appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.3 General Definitions.

3.3.1 Accessible. Having access to but which first may require the removal of a panel, door, or similar covering of the item described. [**54,** 2002]

3.3.2 Air Gap. The unobstructed vertical distance through the free atmosphere between the opening from any pipe or faucet supplying potable water to a tank, plumbing fixture, or other device and the flood-level rim of the receptacle.

3.3.3 Anti-Siphon Trap Vent Device. A device that automatically opens to admit air to a fixture drain above the connection of the trap arm so as to prevent siphonage and closes tightly when the pressure within the drainage system is equal to or greater than atmospheric pressure so as to prevent the escape of gases from the drainage system into the recreational vehicle.

3.3.4 Appliance.

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

3.3.4.2 ***Heat-Producing Appliance.*** An appliance that produces heat by utilizing electric energy or by burning fuel. [**211,** 2003]

3.3.5 (Reserved).

3.3.6* 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.

3.3.7 Backflow. The flow of water or other liquids, mixtures, or substances into the distributing pipes of a potable supply of water from any source or sources other than its intended source.

3.3.8 Backflow Preventer. A device or means to prevent backflow.

3.3.9 Branch. Any part of the piping system other than a riser, main, or vent stack.

3.3.9.1 ***Horizontal Branch.*** A drain pipe extending laterally that receives the discharge from one or more fixture drains and connects to the main drain.

3.3.10 Center. The midpoint between the right and left sides of a recreational vehicle.

3.3.11 Clearance Line.

3.3.11.1 ***Front Clearance Line.*** The plane extending between lines on each side of the vehicle that connect a point that is 8 in. (203 mm) above the ground on the vertical center line of the forwardmost wheel spindle to the lowest point of the front chassis cross member.

3.3.11.2 ***Rear Clearance Line.*** The plane extending between lines on each side of the vehicle that connect a point that is 8 in. (203 mm) above the ground on the vertical center line of the rearmost wheel spindle to the lowest point on the intersection of the rear wall and floor lines.

3.3.12 Combination Compartment. A shower stall or recess that provides for or includes the installation of a toilet and is of such size and proportions that it may not be occupied by more than one person.

3.3.13 Compartment. An enclosed volumetric space designed to provide for a separate area.

3.3.14 Connection.

3.3.14.1 ***Cross Connection.*** Any physical connection or arrangement between two otherwise separate systems or sources, one of which contains potable water and the other either water, steam, gas, or chemical of unknown or questionable safety, whereby there may be a flow from one system or source to the other, the direction of flow depending on the pressure differential between the two systems.

3.3.14.2 ***Water Service Connection.*** The fitting or point of connection of the vehicle water distribution system designed for connection to a potable water supply.

3.3.15 Continuous Waste. A drain connecting the compartments of a set of fixtures to a trap or connecting other permitted fixtures to a common trap.

3.3.16 Developed Length. That length of pipe measured along the center line of the pipe and fittings.

3.3.17 Diameter. The nominal inside diameter designated commercially.

3.3.18 Dispensing. As applied to gasoline or diesel fuel systems, withdrawing fuel from applicable recreational vehicle fuel tank(s) to other motorized vehicles or approved containers by means of a hose and hose nozzle valve.

3.3.19 Distribution. As applied to gasoline or diesel fuel systems, the flow of fuel from the recreational vehicle fuel tank(s) to an onboard fuel-burning generator by means of a closed system of tubing or hoses.

3.3.20 Drain. A pipe that carries waste, water, or liquid-borne wastes in a drainage system.

3.3.20.1 ***Fixture Drain.*** The drain from a fixtures trap to the drain outlet or to the junction of that drain with any other drain pipe.

3.3.20.2 ***Main Drain(s).*** The lowest piping of a drainage system that receives the liquid or body waste discharge from all the fixtures within the system and conducts these wastes to the drain outlet(s).

3.3.21 Drain Hose. A hose used for connecting the liquid or body waste drain outlet to a sewer inlet connection.

3.3.22 Drain Outlet. The lowest end of a main or secondary drain to which a sewer connection is made.

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

3.3.24 Fixture Supply. The water supply pipe connecting a fixture to a branch water supply pipe or directly to a main water supply pipe.

3.3.25 Fixtures (Plumbing). Receptacles, devices, or appliances that are supplied with water or that receive liquid or liquid-borne wastes for discharge into the drainage system.

3.3.26 Flexible Drainage Connector. A bendable tube or hose for conveying liquid waste between two drain, waste, vent (DWV) fitting components in a recreational vehicle drainage system.

3.3.27 Flood Level. The level in the receptacle over which water would overflow to the outside of the receptacle.

3.3.28 Flooded. The condition that results when the liquid in a container or receptacle rises to the flood level.

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

3.3.30 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.

3.3.31 Grade. See 3.3.51, Slope.

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

3.3.33 Hose Nozzle Valve. The terminal output end of a dispensing system hose.

3.3.34 Identified. As applied to equipment, recognizable as suitable for the specific purpose, function, use, environment, application, and so forth, where described in a particular code or standard requirement. [**79,** 2002]

3.3.35* Interior Finish. The exposed interior surface in combination with the substrate to which it is applied.

3.3.36 Main. The principal artery of the system to which branches may be connected.

3.3.37 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. [**58,** 2004]

3.3.38* Pipe. Rigid conduit of iron, steel, copper, brass, aluminum, or plastic. [**54,** 2002]

3.3.38.1 ***Horizontal Pipe.*** A pipe or fitting that forms an angle of 45 degrees or less with the horizontal.

3.3.38.2 ***Vertical Pipe.*** Any pipe or fitting that makes an angle of 45 degrees or less with the vertical.

3.3.39* Piping. The tubing or rigid conduit of the system.

3.3.40 Pitch (or Grade). See 3.3.51, Slope.

3.3.41 Plumbing Vent. Any pipe provided to ventilate a plumbing system, to prevent trap siphonage and back pressure, or to equalize the air pressure within the drainage system.

3.3.41.1 ***Branch Vent.*** A vent connecting one or more individual vents with a vent stack.

3.3.41.2 ***Common Vent.*** A vent connecting at the junction of fixture drains and serving as a vent for more than one fixture.

3.3.41.3 ***Continuous Vent.*** A vertical vent that is a continuation of the drain to which it connects.

3.3.41.4 ***Individual Vent.*** A pipe or anti-siphon trap vent device installed to vent a single fixture drain.

3.3.41.5 ***Primary Vent.*** The main vent of the vent system, which is open to the outside atmosphere.

3.3.41.6 ***Secondary Vent.*** Any vent other than the primary vent or those serving toilet or holding tanks.

3.3.41.7 ***Wet Vent.*** A vent that also serves as a drain for one or more fixtures.

3.3.42 Potable Water Storage Tank. A tank installed in a recreational vehicle for the purpose of storing potable water.

3.3.43* Pressure Relief Valve. A type of pressure relief device designed to both open and close to maintain internal fluid pressure. [**58,** 2004]

3.3.44 Propane (Liquefied Petroleum Gas, LP-Gas, 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.

3.3.45 Propane Container. A tank or cylinder.

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

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

3.3.46 Propane Supply Connection. The terminal end or connection where a propane supply connector is attached.

3.3.47 Propane Supply Connector. Tubing or pipe connecting the recreational vehicle to the propane supply source.

3.3.48 Readily Accessible. Able to be located, reached, serviced, or removed without removing other components or parts of the apparatus and without the need to use special tools to open enclosures.

3.3.49 Recreational Park Trailer. See ANSI A119.5.

3.3.50* Recreational Vehicle (RV). A vehicular-type unit primarily designed to provide 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. [**1194,** 2005]

3.3.51* Slope. A grade or fall of a line of pipe in reference to a horizontal plane.

3.3.52 System.

3.3.52.1 ***Drainage System.*** All piping within or attached to the structure that conveys body or liquid waste to the drain outlet or outlets.

3.3.52.2* ***Flexible Drain System.*** An assembly that consists of a trap, strainer, hose, and connectors for use as a liquid waste drainage system.

3.3.52.3 ***Water Distribution System.*** The potable water piping within or attached to the recreational vehicle.

3.3.53 Toilet.

3.3.53.1 ***Flush Toilet (Water Closet).*** A toilet that conforms with ANSI/ASME A112.19.2 or ANSI/IAPMO Z124.4.

3.3.53.2 ***Mechanical Seal Toilet.*** A toilet fitted with a water flushing device and mechanically sealed trap.

3.3.53.3 ***Recirculating Chemical Toilet.*** A self-contained, recirculating toilet in which the waste is chemically treated.

3.3.54 Toilet Trap Arm. The piping between the toilet and its vent that receives the discharge from each toilet.

3.3.55 Trap. A fitting or device designed and constructed to provide a liquid seal that will prevent the back passage of air without materially affecting the flow of liquid waste through it.

3.3.56 Trap Arm. That portion of a fixture drain between a trap and its vent.

3.3.57 Trap Seal. The vertical depth of liquid that a trap will retain.

3.3.58* Tubing. A semirigid conduit of copper, steel, aluminum, or plastic. [**54,** 2002]

3.3.59 Vacuum Breaker. A device that prevents back siphonage by allowing atmosphere air pressure into the system.

3.3.60 Valve.

3.3.60.1 ***Backflow Check Valve.*** A mechanical valve that permits the flow of liquid or vapor in only one direction.

3.3.60.2 ***Fullway Termination Valve.*** A valve that when fully opened has a non-fouling passageway not less than the inside diameter of connected piping.

3.3.61* Vapor Resistant. Constructed so that gas or air is inhibited from entering or leaving except through vents or piping provided for the purpose.

3.3.62 Vent System (Waste). A pipe or pipes installed to provide a flow of air to or from a waste drainage system to protect trap seals from siphonage and back pressure and to equalize the air pressure within the drainage system.

3.3.63 Waste.

3.3.63.1 ***Body Waste.*** The discharge from any fixture, appliance, or appurtenance containing fecal matter or urine.

3.3.63.2 ***Liquid Waste.*** The discharge from any fixture, appliance, area, or appurtenance that does not contain body waste.

3.3.64 Waste Holding Tank. A liquid-tight tank for the temporary retention of body or liquid waste.

Chapter 4 General Requirements

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

4.2 U.S. Federal Regulations. Where federal regulations under the National Highway Traffic Safety Administration supersede all or part of this standard as applied to any category of regulated motor vehicles, the federal regulations shall apply.

4.3 Exterior Labels.

4.3.1 Exterior labels required by Chapters 5 and 6 shall be made of etched, metal-stamped, or embossed brass, stainless steel, or plastic laminates 0.005 in. (0.13 mm) minimum, or anodized or alclad aluminum not less than 0.020 in. (0.5 mm) thick.

4.3.2 These exterior labels shall be mounted by permanent attachment methods compatible with the surface to which they are applied.

4.3.3 Other types of exterior labels shall be permitted to be approved if there is proof of permanency and comparable life expectancy to those types specified herein.

4.4 Electrical Requirements. All electrical installations, systems, and equipment shall comply with Article 551, Parts I and III through VI, of NFPA 70. All low voltage electrical installations, systems, and equipment shall comply with ANSI/RVIA 12V.

Chapter 5 Fuel Systems and Equipment

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

5.2 Propane Systems.

5.2.1 Maximum Container Capacities. Where propane utilization equipment is installed by the recreational vehicle manufacturer, the recreational vehicle shall be provided with one of the following:

(1) One but not more than three cylinders having individual water capacities of 105 lb (47.6 kg) maximum [approximately 45 lb (20.4 kg) propane capacity]
(2) One or more tanks having a maximum aggregate water capacity of 200 gal (0.8 m^3)

5.2.2 Construction of Propane Containers.

5.2.2.1 Cylinders shall be constructed and marked in accordance with the specifications for propane cylinders of the U.S. Department of Transportation (DOT).

5.2.2.2 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 Pressure Vessel Code*, and shall have a design gauge pressure of at least 312 psi (2155 kPa).

5.2.3 Location of Propane Containers.

5.2.3.1 Propane containers that do not meet the provisions of 5.2.3.2 shall not be installed nor shall provisions be made for installing or storing any propane containers, even temporarily, inside any recreational vehicle.

5.2.3.2 New propane cylinders that have never contained propane and are supplied as original equipment shall be permitted to be transported inside the vehicle.

5.2.3.3 Propane containers with their control valves shall be installed in compliance with one of the following:

(1) Mounted in a recess or compartment other than on the roof that is vapor resistant 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 trailer and not lower than the bottom of the trailer frame
(3) 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 in front of the front axle, as follows:
   (a) Tanks mounted between the front and rear axles shall be installed not lower than the front axle height.
   (b) 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.
   (c) 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) Mounted on the chassis or to the floor of a travel trailer or fifth wheel trailer as follows:
   (a) Tanks mounted behind the rear axle of a travel trailer or fifth wheel trailer 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 higher.
   (b) 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.

5.2.3.4 Containers shall not be mounted on the exterior of the rear wall or the rear bumper of the vehicle.

5.2.4 Securing of Propane Containers.

5.2.4.1 Containers shall be secured in place so they do 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.

5.2.4.2 Where the recreational vehicle is supplied with cylinders not in place, the recreational vehicle manufacturer shall provide mounting instructions and required materials with the vehicle.

5.2.5 Heat Shielding of Propane Containers and Piping. Propane containers located less than 18 in. (457 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.

5.2.6 Ventilation of Compartments Containing Propane Containers.

5.2.6.1 Compartments shall be ventilated at or near the top and at the extreme bottom to facilitate diffusion of vapors.

5.2.6.2 The compartment shall be ventilated with at least two vents, each having an aggregate free area equal to at least 0.5 $in.^2$ for each 7 lb (3.23 cm^2 per 500 g) of the total propane fuel capacity of the maximum number of the largest cylinders the compartment can hold.

5.2.6.3 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.

5.2.6.4 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.

5.2.6.5 Vents shall have an unrestricted discharge to the outside atmosphere.

5.2.6.6 Doors or panels providing access to valves shall not be equipped with locks or require special tools to open.

5.2.7 Securing Propane Cylinder Housings.

5.2.7.1 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 in place to prevent them from working loose during transit.

5.2.7.2 Hoods or housings covering valves shall not be equipped with locks or require special tools to open.

5.2.8 Fastenings for Propane Cylinders in Compartments. Cylinder compartments or carriers shall be provided with hold-down fastenings complying with 5.2.4 for as many cylinders as the carriers or compartments are capable of holding.

5.2.9 Elimination of Ignition Sources. Propane containers shall not be installed in compartments or under hoods or housings that contain flame- or spark-producing equipment.

5.2.10 Propane Container Appurtenances and Location.

5.2.10.1 Pressure relief valves, container shutoff valves, overfilling prevention devices, backflow check valves, excess flow valves, and fixed maximum liquid level gauges shall be listed.

5.2.10.2 The manual control of the tank shutoff valve, the propane fill connection, and the fixed maximum liquid level gauge of tanks shall be located not more than 18 in. (457 mm) from the vehicles outside wall.

5.2.11 Location of Remotely Controlled Appurtenances.

5.2.11.1 Vehicles shall be permitted to be equipped with a remotely controlled, normally closed, electrically operated shutoff valve installed within 9 in. (228 mm) of the outlet of the tank shutoff valve using piping or tubing.

5.2.11.2 A double check filler valve shall be installed in the tank fill opening, and a backflow check valve shall be installed at the remote fill valve location.

5.2.11.3 The remote fill connection, fixed maximum liquid level gauge, and electrically operated shutoff valve control shall be located within 18 in. (457 mm) of the vehicle's outside wall.

5.2.12* Valves for Multiple Propane Cylinder Assembly System. Valves in a multiple propane cylinder assembly system shall be arranged so that replacement of cylinders can be made without shutting off the flow of propane to the appliance(s).

5.2.13 Overfilling Prevention Devices.

5.2.13.1 Containers shall be equipped with a listed overfilling prevention device.

5.2.13.2 Cylinders shall be equipped with a CGA 791 (Type 1, 1⅝ in. Acme) outlet as described in CGA V-1.

5.2.14 Protection of Propane Cylinder's Shutoff Valves.

5.2.14.1 Cylinder shutoff valves shall be protected by a ventilated cap or collar fastened to the cylinder, 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).

5.2.14.2 Construction of the ventilated cap or collar shall be such that the blow is not transmitted to the valve.

5.2.15 Propane Regulators.

5.2.15.1 First-stage regulators shall have an outlet gauge pressure setting up to 10.0 psi (69 kPa) in accordance with UL 144.

5.2.15.2 A two-stage regulator system or an integral two-stage regulator shall be listed to the requirements of UL 144.

5.2.15.3 The regulator(s) shall have a capacity that is not less than the total input of all propane appliances installed in the recreational vehicle.

5.2.15.4 The regulator(s) shall be installed with the pressure relief valve 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.

5.2.15.5 A regulator(s) installed below floor level shall be installed in a compartment that provides protection against the weather and wheel spray.

5.2.15.6 The compartment shall be of sufficient size to permit tool operation for connection to and replacement of the regulator(s), shall be vapor resistant to the interior of the vehicle, shall have a 1 $in.^2$ (6.5 cm^2) minimum and 2 $in.^2$ (12.9 cm^2) maximum 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.

5.2.15.7 The regulator vent outlet shall be at least 2 in. (51 mm) above the compartment vent opening.

5.2.15.8 Regulators installed elsewhere and not installed in compartments as specified in 5.2.15.5 shall be equipped with a durable cover [that does 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.

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

5.2.16 Propane Shutoff Valves, Excess Flow Valves, and Backflow Check Valves.

5.2.16.1 A listed propane excess flow valve shall be provided in accordance with 5.2.16.1(A) and 5.2.16.1(B).

(A) Tanks shall require a manual shutoff valve equipped with a listed internal excess flow valve listed to the requirements of UL 125 that is designed to close automatically at the rated closing flow of vapor or liquid specified by the manufacturer.

(B) 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.

5.2.16.2 Cylinders shall require a manual shutoff valve for vapor service that does not allow propane to flow until a positive seal is achieved between that valve and its mating connection.

5.2.16.3 In multiple cylinder systems a backflow check valve shall be provided anywhere from the cylinder outlet to the automatic changeover regulator inlet.

5.2.16.4 The mating connection shall be listed to the requirements of UL 2061 and installed with the regulator and vehicle as follows:

(1) The mating connection to the cylinder valve shall be furnished with a thermal element that activates at a temperature range of 240°F to 300°F (116°C to 149°C) and positively shuts off the flow of propane from the cylinder valve.
(2) The mating connection to the cylinder valve shall also incorporate a listed excess flow valve that closes at a flow not greater than 200 ft^3/hr at a gauge pressure of 100 psi (5.66 m^3/hr at 689 kPa) and has a bypass area that does not allow a flow greater than 10 ft^3/hr at a gauge pressure of 100 psi (0.28 m^3/hr at 689 kPa).
(3) The mating connection to the cylinder valve shall be provided with a CGA 791 female connection that does not attach to a CGA 510 female POL connector.

5.2.17 Propane Container Pressure Relief Valves.

5.2.17.1 Cylinders shall be provided with pressure relief valves as required by the regulations of the U.S. Department of Transportation.

5.2.17.2 Tanks for recreational vehicle use shall be provided with full internal or flush-type full internal pressure relief valves in accordance with NFPA 58.

5.2.17.3 Containers shall have pressure relief valves in direct communication with the vapor space of the container.

5.2.18 Regulator Pressure Relief Valves.

5.2.18.1 A separate first stage of a two-stage regulator system shall incorporate an integral pressure relief valve having a start-to-discharge setting within the limits specified in UL 144.

5.2.18.2 The second stage of a two-stage regulator system shall be equipped with one or both of the following:

(1) An integral pressure relief valve on the outlet pressure side having a start-to-discharge pressure setting with the limits specified in UL 144 and shall limit the outlet gauge 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 gauge pressure to the regulator is 10.0 psi (69 kPa) or less as specified in UL 144.
(2) An integral overpressure shutoff device that shuts off the flow of propane vapor when the outlet pressure of the regulator reaches the overpressure limits specified in UL 144 and shall not open to permit flow of propane until it has been manually reset.

5.2.19* Discharge from Propane Container Pressure Relief Valves.

5.2.19.1 Propane 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 such discharge:

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

5.2.19.2 Unventilated compartment doors containing either door or body side seals and entry doors not containing screens or openable windows below the level of the propane discharge outlet(s) are exempt from the requirements of 5.2.19.1.

5.2.19.3 The propane tank pressure relief valve discharge system(s) shall be installed in accordance with 5.2.19.3(A) through 5.2.19.3(N).

(A) The pressure relief valve discharge shall be directed upward or downward within 45 degrees of vertical so that its discharge does not directly impinge on the prime mover engine or is not directed into the interior of the vehicle.

(B) 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.

(C) No portion of the pipeaway system shall have an internal diameter less than the internal diameter of the recommended breakaway adapter.

(D) 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.

(E) The breakaway adapter shall be installed so that it breaks away without impairing the function of the pressure relief valve; however, the breakaway adapter shall be permitted to be an integral part of the pressure relief valve.

(F) The breakaway adapter shall have a melting point of not less than 1450°F (788°C).

(G) 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.

(H) The terminal discharge end of the pipeaway system shall be directed upward or downward within 45 degrees of vertical.

(I) Metallic pipe or nonmetallic hose used in the pipeaway system shall be fabricated of materials resistant to the action of propane.

(J) Nonmetallic hose, where used, shall be able to withstand the downstream pressure from the pressure relief valve when in the full open position.

(K) Where hose is used to pipe away the pressure relief valve discharge from propane 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 5.2.19.2. All fittings shall have a melting point of not less than 1450°F (788°C).

(L) The pipeaway system connections shall be mechanically fastened and shall not depend on adhesives or sealing compounds.

(M) Where a pipeaway system is not required, the pressure relief valve shall have a protective cover in accordance with 5.2.19.3(B).

(N) Where the pressure relief valve outlets on cylinders are located in a compartment vapor resistant 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 5.2.19.1.

5.2.20 Propane System Design.

5.2.20.1 Systems shall be of the vapor withdrawal type.

5.2.20.2 Liquid withdrawal systems shall be permitted to supply propane as engine fuel.

5.2.21 Propane Vapor Pressure Maximum.

5.2.21.1 Vapor, at a pressure not over 14 in. water column (3.49 kPa), shall be delivered from the system into the propane appliance supply connection.

5.2.21.2 A propane-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 criteria:

(1) The appliance shall provide for a separate propane supply system or provide a means to prevent high pressure from entering the recreational vehicle's low-pressure system.
(2) The high-pressure propane system shall be located entirely on the exterior of the vehicle or in a compartment that is vaportight to the vehicle's interior.
(3) Permanent exterior warning labels with the word "Warning" with a minimum ¼ in. (6 mm) high letters and body text with minimum ⅛ in. (3 mm) high letters on contrasting background shall be affixed to the appliance or appliance compartment and at the propane source in a visible location indicating the following:
   (a) Operating pressure
   (b) Any special precautions to be taken while servicing
   (c) A statement warning against connecting the appliance to any other fuel system or that fuel system to another appliance

5.2.21.3 The propane system shall be tested at six times its working pressure prior to its installation and at its working pressure after installation.

5.2.21.4 A two-stage regulator system shall not be required for the high-pressure system.

5.2.21.5 The appliance shall be listed for recreational vehicle use at the specified operating pressure.

5.2.22 Mounting of Propane Containers.

5.2.22.1 Container openings for vapor withdrawal shall be located in the vapor space when the container is in service or shall be provided with a permanent internal withdrawal tube that communicates with the vapor space in or near the highest point in the container when it is mounted in the service position with the vehicle on a level surface.

5.2.22.2 Tanks shall have vapor withdrawal located midway between tank ends.

5.2.22.3 Each cylinder shall be permanently and legibly stamped to show the correct mounting position.

5.2.22.4 Stamping shall be ¼ in. (6 mm) minimum letter height.

5.2.22.5 The cylinder shall incorporate a method of mounting that keeps the cylinder in the position for its designed use.

5.3 Propane Piping Systems.

5.3.1 General.

5.3.1.1 The requirements of this section shall govern the installation of all propane piping attached to any recreational vehicle intended for carrying propane in the vapor state.

5.3.1.2 None of the requirements listed in this section shall apply to the piping supplied as a part of a listed appliance.

5.3.1.3 Liquid withdrawal piping shall comply with the requirements of NFPA 58, Section 5.8 and 6.8.1.

5.3.2 Propane Piping System Materials.

5.3.2.1 Materials used for the installation, extension, alteration, or repair of any propane piping system shall be new and free from defects or internal obstructions.

5.3.2.2 Inferior or defective materials in propane piping or fittings shall be replaced and shall not be repaired.

5.3.2.3 Inferior or defective materials shall be removed and replaced with acceptable material.

5.3.2.4 The system shall be made of materials having a melting point of not less than 1450°F (788°C), except as provided in 5.3.2.5(11), 5.3.4, 5.3.6.1, 5.3.12, and 5.3.13, or of materials (used in piping or fittings) listed for the specific use intended.

5.3.2.5 Propane piping system materials shall be permitted to consist of one or more of the following materials:

(1) Propane pipe shall be steel or wrought-iron pipe and comply with ASTM A 53.
(2) Schedule 40 steel or wrought-iron pipe shall be permitted to be used where system gauge pressure is less than 125 psi (862 kPa).
(3) Schedule 80 steel or wrought-iron pipe shall be used where system gauge pressure is 125 psi (862 kPa) or greater.
(4) Threaded copper or brass pipe in iron pipe sizes shall be permitted to be used.
(5) Fittings for propane piping shall be wrought-iron, malleable iron, steel, or brass (containing not more than 75 percent copper).
(6) Brass flare nuts shall be stress relieved or of the forged type.
(7) Copper tubing shall be annealed Type K or L, conforming to ASTM B 88, or shall comply with ASTM B 280.
(8) Copper tubing shall be internally tinned where used on systems designed for natural gas.
(9) 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).
(10) Steel tubing shall be constructed in accordance with ASTM A 539 and shall be externally corrosion protected.
(11) Flexible nonmetallic tubing or hose shall be either listed and used with listed fittings or part of a listed assembly.

5.3.3 Propane Piping Design. Each recreational vehicle requiring propane for any purpose shall be equipped with a propane piping system that is designed for propane only or with a natural gas piping system acceptable for propane.

5.3.4 Propane Pipe Sizing.

5.3.4.1 Propane piping systems shall be sized so that the pressure drop to any appliance inlet connection from the propane 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 gas and propane, or where used with propane if the system is designed for propane only.

5.3.4.2 Conformance shall be permitted to be determined on the basis of test, or the propane piping system shall be permitted to be sized in accordance with Table 5.3.4.2(a) through Table 5.3.4.2(d) or other approved method.

Table 5.3.4.2(a) Sizing of Low-Pressure Propane Piping Systems: Maximum Capacity of Iron Pipe Sizes in Thousands of Btu per Hour, Combination of Propane/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
¼	6	43	13.1	33	10	29	8.8	27	8.2	24	7.3	22	6.7	20	6.1
⅜	10	95	29	77	23.5	65	19.8	57	17.4	52	15.9	49	14.9	45	13.7
½	13	175	53	135	41	120	37	108	33	97	29.6	90	27.5	82	25
¾	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 5.3.4.2(b) Sizing of Low-Pressure Propane Piping Systems: Maximum Capacity of Semi-Rigid Tubing in Thousands of Btu per Hour, Combination of Propane/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	40	12.2
⅜	¼	10	6	27	8.2	21	6.4	18	5.5	16	4.9	15	4.6	14	4.3	13	4
½	⅜	13	10	56	17.1	42	12.8	38	11.6	34	10.4	31	9.5	28	8.5	26	7.9
⅝	½	16	13	113	34	86	26.2	78	23.8	70	21.3	62	18.9	59	18	53	16.2
¾	⅝	19	16	197	60	157	48	136	41	122	37	109	33	99	30	93	28.4
⅞	¾	22	19	280	85	227	69	193	59	172	52	155	47	141	43	132	40

Table 5.3.4.2(c) Sizing of Low-Pressure Propane Piping Systems: Maximum Capacity of Iron Pipe Sizes in Thousands of Btu per Hour, Propane 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
¼	6	67	20.4	52	15.9	46	14	41	12.5	37	11.3	34	10.4	31	9.5
⅜	10	147	45	112	34	101	31	87	26.5	81	24.7	74	22.6	70	21.3
½	13	275	84	212	65	189	58	166	51	152	46	138	42	129	39
¾	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 5.3.4.2(d) Sizing of Low-Pressure Propane Piping Systems: Maximum Capacity of Semi-Rigid Tubing in Thousands of Btu per Hour, Propane 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	40	12.2
⅜	¼	10	6	39	11.9	32	9.8	26	7.9	23	7	21	6.4	19.5	5.9	19	5.8
½	⅜	13	10	92	28.1	72	21.9	62	18.9	56	17.1	50	15.3	45	13.7	41	12.5
⅝	½	16	13	199	61	159	49	131	40	118	36	107	33	94	28.7	90	27.5
¾	⅝	19	16	329	100	249	76	216	66	193	59	181	55	154	47	145	44
⅞	¾	22	19	501	153	380	116	346	106	300	91	277	84	246	75	233	71

5.3.4.3 The natural gas supply connection shall be not less than ¾ in. (19 mm) nominal pipe size. *(See Annex B for further guidance on how to calculate propane piping size.)*

5.3.5 Joints for Propane Pipe.

5.3.5.1 Pipe joints in the piping system, unless welded or brazed, shall be screw joints that comply with ANSI B1.20.1.

5.3.5.2 Right and left nipples or couplings shall not be used.

5.3.5.3 Unions, if used, shall be of the ground joint type.

5.3.5.4 The material used for welding or brazing pipe connections shall have a melting temperature in excess of 1000°F (538°C).

5.3.6 Propane Tubing Joints.

5.3.6.1 Propane tubing joints shall be permitted to be made with a single or double flare of 45 degrees conforming to SAE J533, 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).

5.3.6.2 Brazing alloys shall not contain phosphorus.

5.3.6.3 Sealants shall not be used on tubing joints.

5.3.6.4 Ball sleeve or one-piece internal compression-type tubing fittings shall not be used.

5.3.7 Pipe Joint Materials.

5.3.7.1 Threaded joints shall be made up tight with approved pipe joint material that is insoluble in propane.

5.3.7.2 Pipe joint material shall be applied only to the male threads.

5.3.8 Routing and Protection of Tubing.

5.3.8.1 Tubing shall not be run inside walls, floors, partitions, or ceilings.

5.3.8.2 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.

5.3.8.3 Tubing shall be routed to be protected from physical damage, sharp edges, and moving parts.

5.3.9 Restrictions on Concealing Joints in Propane Piping or Tubing.

5.3.9.1 Pipe or tubing joints shall not be located in any floor, wall, partition, or concealed construction space.

5.3.9.2 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.

5.3.9.3 Pipe joints shall be permitted to be located below the 2 in. (50.8 mm) requirement if protected from physical damage.

5.3.9.4 Unprotected tubing shall not be located in storage areas below the floor level.

5.3.10 Propane Supply Connection Location.

5.3.10.1 For propane-only systems and for combination propane and natural gas systems, the supply connection shall be located at the container location.

5.3.10.2 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.

5.3.10.3 Combination propane and natural gas additional supply connections shall be within 15 ft (4.6 m) of the rear of the vehicle.

5.3.11 Special Requirement for High-Pressure Piping.

5.3.11.1 The high-pressure piping shall be located entirely on the exterior of the vehicle or in a compartment vapor resistant to the vehicle interior.

5.3.11.2 Propane system pressure shall be regulated to a pressure of 30 psi (206.8 kPa) or less within 60 in. (125.4 cm) of the container outlet.

5.3.12 Propane and Natural Gas Supply Connections.

5.3.12.1 A listed minimum ½ in. (12.7 mm) nominal (I.D.) gas supply connector, with ¾ 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.

5.3.12.2 Connectors used in propane systems shall be listed as conforming to UL 569.

5.3.12.3 High-pressure propane connections shall be in accordance with 5.3.12.3(A) through 5.3.12.3(E).

(A) If the regulator is not directly connected to a 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 5.3.2.

(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 mounted other than as described in 5.3.12.3(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.

(E) A regulator shall not be permitted to be directly attached to the shutoff valve of a cylinder.

5.3.12.4 Low-pressure propane connections shall be in accordance with 5.3.12.4(A) through 5.3.12.4(C).

(A) The connection between a regulator fixed in place and the propane supply system shall be made with a listed flexible hose connector or with material conforming to 5.3.2.

(B) The connection between a regulator not fixed in place and the propane supply system shall be made with a listed flexible hose connector.

(C) A two-stage regulator shall not be directly attached to the shutoff valve of a cylinder.

5.3.13 Flexible Nonmetallic Tubing and Hose Connections.

5.3.13.1 Where nonmetallic tubing or hose is used within the propane 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 chafing, and no part of the flexible nonmetallic tubing or hose is concealed in the hollow space of a floor, wall, partition, or ceiling.

5.3.13.2 Flexible nonmetallic tubing or hose shall not be permitted to enter the body of a listed range or cooktop as the final connection.

5.3.14 Quick Disconnect Devices.

5.3.14.1 Quick disconnect devices used downstream of the propane regulator shall be listed for use with propane and for the specific environment (indoor, outdoor, or both).

5.3.14.2 Quick disconnect devices shall not be capable of connection to the cylinder portion of a cylinder connection device.

5.3.14.3 Quick disconnect devices shall either have integral shutoff or shall have a manual shutoff upstream, capable of operation from the same user position as the quick disconnect device.

5.3.15 Propane Shutoff Valves. Shutoff valves used in connection with propane piping shall be listed for use with propane and shall have non-displaceable rotors.

5.3.16 Propane Inlet Cap.

5.3.16.1 For combination propane and natural gas systems, suitable cap(s) to effectively close the propane inlet(s) when disconnected from the source of supply and not in use shall be attached to the recreational vehicle.

5.3.16.2 Inlets shall be effectively capped when disconnected from the source of supply.

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

5.3.17 Prohibiting Use of Propane Piping as Electrical Ground. Propane piping shall not be used for a grounding electrode.

5.3.18 Propane Piping Support.

5.3.18.1 All propane piping shall be supported at intervals of not more than 4 ft (1.2 m), except where adequate support and protection are provided by structural members.

5.3.18.2 All piping 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.

5.3.18.3 All piping shall be anchored within 6 in. (152.4 mm) of tubing connections at the end of piping runs and within 12 in. (304.8 mm) of tubing connection within piping runs.

5.3.19 Testing Low-Pressure Piping Systems for Propane Leakage Before Appliances Are Connected.

5.3.19.1 The 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 a pressure of 3 psi (20.7 kPa) for a period of at least 10 minutes.

5.3.19.2 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.

5.3.19.3 Leaks, if observed, shall be located and corrected.

5.3.19.4 Defective material shall be replaced.

5.3.19.5 Products that contain ammonia or chlorine shall not be used for testing.

5.3.19.6 Tests shall be conducted by either of the following methods:

(1) Air pressure as follows:
   (a) The source of the air pressure to the piping system shall be shut off.
   (b) 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 a pressure of ⅒ psi (0.7 kPa).
   (c) During the 10-minute period a drop in pressure shall not occur.

(2) Bubble-type leak detector as follows:
   (a) A bubble-type leak detector shall be installed between the source of air pressure and the piping system.
   (b) The bubble detector shall not indicate any air flow for a period of 1 minute.

5.3.20 Testing Low-Pressure Piping Systems for Propane Leakage After Appliances Are Connected.

5.3.20.1 After appliances are connected to the piping system, the entire piping system shall be proven by test to be leak-free by maintaining an air pressure of not less than 10 in. water column (2.5 kPa) or more than 14 in. water column (3.5 kPa).

5.3.20.2 Before the test is begun, the temperature of both air and piping shall be approximately the same, and a uniform temperature shall be maintained throughout the test period.

5.3.20.3 Leaks if observed shall be located and corrected.

5.3.20.4 Products containing ammonia or chlorine shall not be used for locating leaks.

5.3.20.5 Defective material shall be replaced.

5.3.20.6 A pressure drop test shall be permitted to be conducted by any of the following methods:

(1) Air pressure as follows:
   (a) The entire system shall be pressurized to not less than 8 in. water column (1.99 kPa) or more than 14 in. water column (3.5 kPa), the appliance shutoff valves shall be closed, and the system shall be isolated from all sources of pressure.
   (b) 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. ± 0.5 in. water column (1.99 kPa ± 0.125 kPa) so that the appliance regulator is in an open condition.
   (c) 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.
   (d) During the 3-minute period, a drop in pressure shall not occur.

(2) Bubble-type leak detector as follows:
   (a) A bubble-type leak detector shall be installed between the source of air pressure and the piping system.
   (b) The bubble detector shall not indicate any air flow for a period of 1 minute.

(3) As an alternate test the appliance and regulator connections not tested in 5.3.20.1 shall be tested for leakage with either soapy water or bubble solution.

5.4 Fuel-Burning Appliances.

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

5.4.2 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.

5.4.3 Propane Appliance Utilization. Propane appliances shall be listed for use with propane only or for use with both natural gas and propane where convertible from natural gas to propane and vice versa.

5.4.4 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.

5.4.5 Installation of Fuel-Burning Appliances.

5.4.5.1 The installation of each appliance shall conform to the terms of its listing and the appliance manufacturer's installation instructions.

5.4.5.2 Floor-mounted fuel-burning appliances shall not be installed on carpeting unless the appliance is listed for such installation.

5.4.5.3 Every appliance shall be mounted in place to avoid displacement.

5.4.6 Requirement for Direct Vent System Appliances.

5.4.6.1 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.

5.4.6.2 Combustion air inlets and flue gas outlets shall be listed as components of the appliance.

5.4.6.3 The required separation shall be obtained by the installation of direct vent system (sealed combustion system) appliances.

5.4.6.4 A fuel-burning refrigerator shall be permitted to be installed to meet the requirements of 5.4.6 using panels supplied by the recreational vehicle manufacturer provided that the refrigerator manufacturer furnishes the necessary vents and grilles 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.

5.4.6.5 A fuel-burning appliance shall not need to be of the direct vent type provided that it conforms to all of the following:

(1) It is a vented appliance.
(2) It incorporates provisions for introduction of combustion air from outside the vehicle.
(3) It incorporates a safety control system that prevents burner operation under any operating conditions that allow products of combustion to discharge into the interior of the recreational vehicle.
(4) 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.
(5) It is listed for recreational vehicle installation and is installed with the terms of the listing.

5.4.7 Exterior Appliances.

5.4.7.1 Fuel-burning appliances installed or intended to be used only outside the recreational vehicle shall be listed but shall not be required to be of the direct vent, sealed combustion type.

5.4.7.2 The installation shall preclude the possibility of appliance operation or propane flow when the appliance is in its storage (travel) position.

5.4.7.3 The appliance manufacturer shall specify clearance to adjacent surfaces as applicable in both the operational and storage positions.

5.4.7.4 Fuel-burning appliances shall be so installed as to not obstruct any path to exit(s).

5.4.8 Auxiliary Heating Devices.

5.4.8.1 Primary mover engine auxiliary devices for heating interior living or storage space or for heating potable water shall not be required to be listed.

5.4.8.2 Heat exchangers used in the potable water system shall be identified by the device manufacturer as being of a double-wall construction.

5.4.8.3 Exhaust termination of engine block heaters with a gasoline- or diesel-fired source other than the primary mover engine shall comply with 6.4.3.

5.4.9 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.

5.5 Venting, Ventilation, and Combustion Air.

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

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

5.5.2 Location of Flue Gas Outlets of Fuel-Burning Heating Appliances.

5.5.2.1 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.

5.5.2.2 Flue gas outlets shall not terminate underneath a recreational vehicle.

5.5.3 Location of Combustion Air Inlets, Flue Gas Outlets, and Fuel-Burning Appliances.

5.5.3.1 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.

5.5.3.2 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).

5.5.4 Ventilation of Areas Accommodating Fuel-Burning Cooking Appliances.

5.5.4.1 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.

5.5.4.2 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.

5.5.4.3 Where a combination gravity/mechanical vent is installed, both operations shall comply.

5.5.4.4 A gravity vent shall have a free, clear, openable area not less than 1 $in.^2$ for every 2000 Btu/hr (11 cm^2/1000 W) rated input of the appliance(s).

5.5.4.5 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.

5.5.4.6 Hooded gravity vents located directly above the appliance shall be permitted to exhaust through the sidewall. *(See 5.6.6.5.)*

5.5.4.7 Mechanical vents (exhaust fans) having a flow rating of 2 ft^3/min (0.19 m^3/min) for every 1000 Btu/hr (1000 W) rated input of the appliance shall be 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.

5.5.4.8 Vent hood ducts shall be designed so that the duct outlet precludes the trapping of products of combustion.

5.6 Marking Appliances (Installation and Operation Features).

5.6.1 Clearances, Input Ratings, Lighting, and Shutdown.

5.6.1.1 Information on clearances, input ratings, lighting, and shutdown shall be attached to the appliance.

5.6.1.2 Appliances that require manual lighting of pilot lights shall have lighting and shutdown requirements located so that it is easily readable after the appliance is installed.

5.6.2 Type(s) of Fuel.

5.6.2.1 Each fuel-burning appliance shall bear the appliance manufacturer's permanent marking designating the type(s) of fuel for which it is listed.

5.6.2.2 If listed and installed for use with either propane 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.

5.6.3 Accessibility for Service and Operation.

5.6.3.1 Every appliance shall be accessible for inspection, service, repair, and replacement.

5.6.3.2 Room shall be provided 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.

5.6.4 Doors and Window Treatments. Doors and window treatments shall be installed so that they cannot be placed or swung closer to a heat-producing appliance than the clearances specified on the labeled appliance.

5.6.5 Location of Privacy Curtains. When used, privacy curtains that can be placed or swung closer to a cooktop/range or wall furnace than the clearances specified on the labeled appliance shall be in accordance with 5.6.5.1 and 5.6.5.2.

5.6.5.1 The privacy curtains shall be installed so that they can be secured outside the defined clearance area(s).

5.6.5.2 A permanent warning label with the word "Warning" with minimum ¼ in. (6 mm) high letters and body text with minimum ⅛ in. (3 mm) high letters on a contrasting background shall be affixed in a visible location adjacent to the applicable appliance(s) and shall read as follows:

⚠ WARNING
DO NOT OPERATE THIS APPLIANCE UNLESS THE PRIVACY CURTAIN IS SECURED.
FAILURE TO COMPLY COULD RESULT IN A FIRE OR SERIOUS INJURY.

5.6.6 Clearances of Heat-Producing Appliances.

5.6.6.1 Clearances between heat-producing appliances and adjacent surfaces shall be not less than as specified in the terms of their listing.

5.6.6.2 Clearance spaces shall be framed in or guarded to prevent creation of storage space within the clearance specified.

5.6.6.3 The only exception to framing in or guarding such spaces shall be where such spaces are necessary to allow access to shutoff valves or controls in order to comply with 5.3.9 and 5.4.5.1, in which case the unguarded area shall have a warning label posted in a readable location.

5.6.6.4 A permanent warning label with the word "Warning" with a minimum ¼ in. (6 mm) high letters and body text with a minimum ⅛ in. (3 mm) high letters on a contrasting background shall be affixed in a visible location adjacent to the applicable appliance(s) and shall read as follows:

⚠ WARNING
DO NOT STORE COMBUSTIBLE MATERIAL IN THIS AREA.
FAILURE TO COMPLY COULD RESULT IN A FIRE OR PERSONAL INJURY.

5.6.6.5 Ranges and cooktops, not including covers, shall have a vertical clearance between the cooking top and combustible material or metal cabinets in accordance with Table 5.6.6.5 or the terms of their listings.

5.6.7 Clothes Dryers.

5.6.7.1 General. All propane and electric clothes dryers shall be exhausted to the outside by a moisture-lint exhaust duct and termination fitting.

5.6.7.2 Electric Clothes Dryers. Listed electric clothes dryers that are not required to be vented to the outside are exempt from compliance with 5.6.7.1.

5.6.7.3 Exhaust Duct Installation. 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:

(1) A clothes dryer moisture-lint exhaust duct shall not be connected to any other duct, vent, or chimney.

Table 5.6.6.5 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	Any	30	762
2. ¼ in. (6.4 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 the range. In lieu of 28 U.S. 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	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 ¼ in. (6.4 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	19½	495
	Not more than four top burners — input not to exceed 9000 Btu/hr (2638 W) each	24,000	7034	20¾	527
	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	23½	597
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)	22,000	6448	23	584

(2) The exhaust duct shall be of sufficient length so as not to terminate beneath the recreational vehicle.
(3) Moisture-lint exhaust ducts shall not be connected with sheet metal screws or other fastening devices that extend into the interior of the duct.
(4) Moisture-lint exhaust duct and termination fittings shall be installed in accordance with the appliance manufacturer's printed instructions.

5.6.7.4 Fuel-Burning Clothes Dryers. 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.

5.6.7.5 Future Installations. A recreational vehicle shall be permitted to be provided with propane piping to facilitate a future propane clothes dryer installation by the owner, provided it complies with the following provisions:

(1) Its propane outlet shall be provided with a shutoff valve, the outlet of which is closed by threaded pipe plug or cap.
(2) Its propane outlet shall be permanently labeled to identify it for use only as the supply connection for a propane clothes dryer.
(3) The manufacturer shall provide written instructions to the owner on how to complete the exhaust duct installation in accordance with the provisions of 5.6.7.3.

5.6.7.6 Wiring. 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 shall provide written instructions on how to complete the exhaust duct installation in accordance with the provisions of 5.6.7.3.

5.6.7.7 Closets or Alcoves. Clothes dryers installed in closets or in alcoves shall be listed for such installation.

5.6.7.8 Closets containing clothes dryers shall have ventilation openings sized in accordance with the appliance manufacturer's installation instructions.

5.7 Circulating Air Systems for Heating (Other than Automotive Type).

5.7.1 Supply System Ducts.

5.7.1.1 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.

5.7.1.2 A duct system integral with the structure shall be of durable construction that can be demonstrated to be equally resistant to fire and deterioration.

5.7.1.3 Air ducts and plenums constructed of sheet metal shall be in accordance with Table 5.7.1.3.

Table 5.7.1.3 Minimum Metal Thickness for Duct's Diameter 14 in. (381 mm) or Less or Width over 14 in. (381 mm)

	Diameter 14 in. (381 mm) or Less		*or*	Width over 14 in. (381 mm)	
	in.	mm		in.	mm
Exposed round	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

5.7.1.4 When nominal thicknesses are specified, 0.003 in. (0.0762 mm) shall be added to the minimum metal thicknesses of Table 5.7.1.3.

5.7.2 Sizing of Supply Ducts.

5.7.2.1 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.

5.7.2.2 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.

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

5.7.4 Return Air System Air Openings.

5.7.4.1 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.

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

5.7.5 Return Air Duct Materials. Return air ducts shall be in accordance with the following:

(1) 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 5.7.1.
(2) Return air ducts, except as required in 5.7.5(1), shall be constructed of 1 in. (25 mm) nominal wood boards (flame spread classification of not more than 200) or other material no more combustible than 1 in. (25 mm) board.
(3) The interior of such combustible ducts (ducts of material other than as specified in 5.7.1) 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.

5.7.6 Sizing of Return Air Ducts.

5.7.6.1 The cross-sectional area of the return air duct shall not be less than 2 $in.^2$ for each 1000 Btu/hr (44 cm^2/1000 W) input rating of the appliance.

5.7.6.2* A complete ducted heating system shall not be required to comply with the return air duct sizing requirement in 5.7.6.1 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.

5.7.6.3 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.

5.7.7 Return Air Duct Unclosable Openings.

5.7.7.1 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 unclosable openings in the doors or separating partitions to allow circulated air to return to the furnace.

5.7.7.2 Such openings shall be permitted to be grilled or louvered.

5.7.7.3 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 cm^2) for every 5 ft^2 (0.46 m^2) of total living area closed off from the furnace by the door or partition serviced by that opening.

5.7.7.4 Undercutting doors connecting the closed-off area shall be permitted to be used as a means of providing return air area.

5.7.7.5 Where doors are undercut, not more than one-half of the free air area provided shall be considered return air area.

5.7.8 Air Duct Joints and Seams.

5.7.8.1 Joints and seams of ducts shall be securely fastened and made substantially airtight.

5.7.8.2 Slip joints shall have a lap of at least 1 in. (25 mm) and shall be individually fastened.

5.7.8.3 Tape or caulking compound shall be permitted to be used for sealing mechanically secure joints.

5.7.8.4 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.

5.7.9 Air Duct Supports. Ducts shall be securely supported.

5.7.10* Air Duct Registers or Grilles.

5.7.10.1 Fittings connecting the registers or grilles 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.

5.7.10.2* Registers or grilles shall be constructed of metal or conform with 5.7.10.2(A) and 5.7.10.2(B).

(A) Registers or grilles shall be made of a material classified 94 V-0 or 94 V-2 when tested as described in UL 94.

(B) Floor registers or grilles shall resist without structural failure a 200 lb (90.7 kg) concentrated load on a 2 in. (51 mm) diameter disc applied to the weakest area of the exposed face of the register or grille at a temperature of not less than 165°F (74°C).

5.7.11 Air Conditioners with Heat Strips or Heat Pumps. Section 5.7 shall not apply to ducted rooftop air-conditioning systems with heat strips or heat pumps where the system does not exceed 175°F (80°C) when tested in accordance with UL 484.

5.8 Air Conditioning (Other than Automotive Type).

5.8.1 General. Every air-conditioning appliance or combination air-conditioning and heating appliance used in a recreational vehicle shall be listed and shall be installed in accordance with the terms of its listing and the manufacturer's instructions.

5.8.2 Air-Conditioning Installation and Instructions.

5.8.2.1 The installation of each appliance shall conform to the terms of its listing and the manufacturer's installation instructions.

5.8.2.2 Appliances shall be secured in place to avoid displacement and movement from vibration and road shock.

5.8.2.3 The air conditioner rating plate shall be located so that it is easily readable when the appliance is installed.

5.8.2.4 Fuel-burning air conditioners shall comply with Section 5.4.

5.8.2.5 Air conditioners shall be accessible for inspection, service, repair, and replacement.

5.9 Consumer Information.

5.9.1 Required Information.

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

5.9.1.2 Each recreational vehicle shall be provided with an owner's manual that shall contain as a minimum the information contained in 5.9.1.2(A) through 5.9.1.2(G).

(A) The following warning:

⚠ WARNING

Propane cylinders shall not be placed or stored inside the vehicle. Propane cylinders are equipped with safety devices that relieve excessive pressure by discharging propane to the atmosphere.
FAILURE TO COMPLY COULD RESULT IN DEATH OR SERIOUS INJURY.

(B) The following warning label, located in the cooking area to remind the user to provide a 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

FAILURE TO COMPLY COULD RESULT IN DEATH OR SERIOUS INJURY.
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) avoids 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.
FAILURE TO COMPLY COULD RESULT IN DEATH OR SERIOUS INJURY.

(C) A warning label located near the propane container that reads as follows:

DO NOT FILL CONTAINER(S) TO MORE THAN 80 PERCENT OF CAPACITY.
FAILURE TO COMPLY COULD RESULT IN DEATH OR SERIOUS INJURY.
Overfilling the propane container can result in uncontrolled propane flow, which can cause fire or explosion.
A properly filled container contains approximately 80 percent of its volume as liquid propane.

(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 propane cylinders, gasoline, or other flammable liquids inside the vehicle because a fire or explosion can result.

(F) The following label, placed in the vehicle near the range area:

IF YOU SMELL PROPANE:

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

FAILURE TO COMPLY COULD RESULT IN EXPLOSION RESULTING IN DEATH OR SERIOUS INJURY.

(G) Propane 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 propane pressure causing fire or explosion.

5.9.2 Required Markings.

5.9.2.1 Each recreational vehicle shall have a label affixed, in a visible location at or near each propane supply connection, or at the end of the piping. The label shall contain the word "Caution" with minimum ¼ in. (6 mm) high letters and body text with minimum ⅛ in. (3 mm) high letters on a contrasting background that reads (as appropriate) either:

⚠ CAUTION
THIS PROPANE PIPING SYSTEM IS DESIGNED FOR USE WITH PROPANE ONLY.
DO NOT CONNECT NATURAL GAS TO THIS SYSTEM.
Securely cap this inlet when not connected for use.
After turning on propane, except after normal cylinder replacement, test propane piping and connections to appliance for leakage with soapy water or bubble solution. Do not use products that contain ammonia or chlorine.

or

⚠ CAUTION
THIS GAS PIPING SYSTEM IS DESIGNED FOR USE WITH EITHER PROPANE 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 appliance for leakage with soapy water or bubble solution. Do not use products that contain ammonia or chlorine.

5.9.2.2 The labels in 5.9.2.2(A) through 5.9.2.2(C), where required near the propane containers, shall be permitted to be incorporated in the labels required by 5.9.2.1.

(A) Each vehicle shall have a warning label in accordance with Section 4.3. The label shall contain the word "Warning" with minimum ¼ in. (6 mm) high letters and body text with minimum ⅛ in. (3 mm) high letters on a contrasting background. The label shall be affixed in a visible location near the propane container and shall read as follows:

⚠ WARNING
DO NOT FILL PROPANE CONTAINER(S) TO MORE THAN 80 PERCENT OF CAPACITY.
FAILURE TO COMPLY COULD RESULT IN A FIRE OR PERSONAL INJURY.

(B) Each motor home or truck camper having exterior combustion air inlet(s) at a level below the roof shall have a permanent exterior danger label in accordance with Section 4.3. The label shall contain the word "Danger" with minimum ¼ in. (6 mm) high letters and body text with minimum ⅛ in. (3 mm) high letters on a contrasting background. The label shall be affixed in a visible location near the gasoline filler spout and the propane container and shall read as follows:

⚠ DANGER
ALL PILOT LIGHTS, APPLIANCES, AND THEIR IGNITORS (SEE OPERATING INSTRUCTIONS) SHALL BE TURNED OFF BEFORE REFUELING OF MOTOR FUEL TANKS AND/OR PROPANE CONTAINERS. FAILURE TO COMPLY COULD RESULT IN DEATH OR SERIOUS INJURY.

(C) On truck campers the label in 5.9.2.2(B) 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 propane container.

5.9.2.3 When fuel-burning equipment is installed by the recreational vehicle manufacturer, a permanent danger label with the word "Danger" with minimum ¼ in. (6 mm) high letters and body text with minimum ⅛ in. (3 mm) high letters on a contrasting background shall be affixed in a visible location near the range. This label, which shall be permitted to be affixed to the back of a cabinet door providing the door is frequently used, shall read as follows:

⚠ DANGER
IF YOU SMELL PROPANE

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

FAILURE TO COMPLY COULD RESULT IN EXPLOSION RESULTING IN DEATH OR SERIOUS INJURY.

5.9.2.4 A permanent warning label with the word "Warning" with minimum ¼ in. (6 mm) high letters and body text with minimum ⅛ in. (3 mm) high letters on a contrasting background shall be affixed in a visible location 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

FAILURE TO COMPLY COULD RESULT IN DEATH OR SERIOUS INJURY.

5.10 Gasoline or Diesel Fuel Systems.

5.10.1 General. The requirements of this section shall apply to the installation of gasoline or diesel fuel systems for nonprimary mover engine applications in recreational vehicles.

5.10.1.1 The entire fuel system shall be liquidtight and vaportight to the interior of the vehicle.

5.10.1.2 Valves, filters, strainers, and similar components shall be accessible for maintenance.

5.10.1.3 Fittings for withdrawing fuel from the fuel tank shall be located above the normal level of the fuel in the tank when the tank is full.

5.10.2 Electric Generator. 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 at the open end.

5.10.3 Fuel Tank Installation.

5.10.3.1 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.

5.10.3.2 The fuel tank and any of its attachments and fittings shall be located above rear and front clearance lines.

5.10.3.3 All measurements shall be determined from the bottom of the fuel tank, or from the lowest fitting, support, or attachment on the fuel tank or fuel tank housing, whichever is lower, while the vehicle is level and loaded to its maximum gross vehicle weight rating (GVWR).

5.10.3.4 The installation shall comply with 5.10.3.4(A) through 5.10.3.4(C).

(A) Where the fuel tank is located between the chassis main rails, the rear point shall be permitted to be taken at the bottom of the main rail. Skid bars shall not be used to lower this point.

(B) The fuel tank shall be permitted to be located on a trailer A-frame if no part extends below the bottom of the A-frame members.

(C) The fuel tank shall be permitted to be located in a compartment under the following conditions:

(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 sidewalls and floor are resistant and nonabsorbent to fuel, that the floor has a minimum ½ in. (12.7 mm) diameter drainage hole at each low point, and that the joints between compartment sidewalls and floor are sealed to prevent fuel entry.
(3) The fuel tank compartment shall be vapor resistant to the vehicle interior and sealed so that vapors cannot travel into the interior 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.

5.10.3.5 The fuel tank shall be secured by fastenings that hold it in place when a force equal to eight times the fuel tank's filled weight is applied through the filled fuel tank's center of gravity in any direction.

5.10.3.6 Metallic fuel tanks shall be electrically bonded to the vehicle chassis.

5.10.4 Fill System.

5.10.4.1 The filler cap end shall be completely above the top of the fuel tank. The fill opening shall be located in accordance with 5.5.3.

5.10.4.2 The area surrounding fuel filler pipes and vents shall be sealed so that vapors cannot travel between the exterior interior surfaces of the recreational vehicle.

5.10.4.3 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.

5.10.4.4 Sealing compounds used around the filler pipe and in the area described in 5.10.4.3 shall be fuel resistant.

5.10.4.5 A marking indicating the type of fuel to be used shall be provided on or adjacent to the filler cap.

5.10.5 Fuel Distribution System.

5.10.5.1 All fuel distribution equipment, including but not limited to tanks, pumps, hoses, and valves, shall be protected from road impact damage.

5.10.5.2 Equipment located above the clearance lines specified in 5.10.3.4(B) shall be considered protected.

5.10.5.3 Tubing shall be constructed of prime aluminized steel or material approved for use with fuel.

5.10.5.4 Hose shall conform to SAE J30, SAE J30R7, or better.

5.10.5.5 Hose-to-tube joints shall remain leak free when subjected to an internal gauge pressure of 10 psi (69 kPa).

5.10.5.6 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.

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

5.10.5.8 The fuel system shall be designed so that leakage from fuel tanks or joints does not contact electrical or exhaust system components.

5.10.5.9 Drain troughs shall be permitted to be used as required.

5.10.5.10 Rollover vent valves identified as complying with 49 CFR 393.67, (c)(10), shall be used, as applicable, for gasoline or diesel systems.

5.10.6 Fuel-Dispensing Systems.

5.10.6.1 Systems for 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.

5.10.6.2 All fuel-dispensing systems shall have a readily accessible emergency manual shutoff located on the exterior not more than 18 in. (457 mm) from the vehicle's outside wall, or be equipped with a remotely controlled, normally closed electronic shutoff valve that has the electronic shutoff valve control located within 18 in. (457 mm) of the vehicle's outside wall.

5.10.6.3 All fuel-dispensing equipment, including but not limited to tanks, pumps, hoses, and valves, shall be protected from road impact damage.

5.10.6.4 Equipment located above the clearance lines specified in 5.10.3.4(B) shall be considered protected.

5.10.6.5 All fuel-transfer-dispensing equipment shall only be accessible from the exterior of the vehicle.

5.10.7 Fuel-Dispensing Compartments.

5.10.7.1 Compartments or enclosures that house dispensing systems shall be made of nonporous and noncombustible material, sealed from the interior atmosphere of the recreational vehicle and vented.

5.10.7.2 These compartments shall be ventilated with openings having a minimum area of 1.7 in.^{2} (1100 mm^2) within 2 in. (51 mm) of both the top and bottom.

5.10.7.3 These compartments shall not contain flame- or spark-producing equipment.

5.10.8 Other Fuel-Dispensing System Requirements.

5.10.8.1 Fuel tanks with dispensing capabilities shall be provided with a method of venting while fuel is being dispensed.

5.10.8.2 Nozzles shall be used for the dispensing of fuel and shall be listed to UL 842, designed for use with unleaded fuel, of a trigger and handle type, and made with a nonferrous body.

5.10.8.3 A fuel-dispensing system shall have provisions to prevent unauthorized use.

5.10.8.4 The fuel-dispensing system shall be designed and installed to prevent fuel from siphoning due to hose failure.

5.10.8.5 The fuel-dispensing hose between the nozzle and its first connection on the vehicle shall be a hose assembly listed to UL 330.

5.10.8.6 Fuel-dispensing hoses shall be limited in length to a maximum of 5 ft (1.5 m) from the side of the recreational vehicle.

5.10.8.7 Tanks, pumps, and changeover valves used in fuel-dispensing systems shall be identified for use with flammable liquids.

5.10.8.8 All pressurized fuel-dispensing components shall be rated to at least the output pressure of the pump.

5.10.8.9 All 120/120-240-V electrical equipment located on the exterior of the vehicle and within 3 ft (0.9 m) of the fully extended distribution hose, measured from the outlet of the hose nozzle valve, shall meet the requirements of Articles 500 and 501 of NFPA 70 for Class I, Group D, Division 2 locations.

5.10.8.10 Fuel-burning appliance intake and exhaust vents shall be located at least 3 ft (0.9 m) from any point the fuel-dispensing hose nozzle valve outlet can reach.

5.10.8.11 Manufacturers shall be permitted to make provisions for future installations of fuel-dispensing systems only when instructions for doing so are provided in the owner's manual of the recreational vehicle.

5.10.8.12 Fuel-dispensing systems shall be provided with a minimum 14 AWG bonding jumper wire or equivalent for connection to the vehicle receiving fuel to protect against any potential electrical static discharge as follows:

(1) The bonding jumper wire shall be attached to the frame of the recreational vehicle.
(2) The bonding jumper wire shall be capable of reaching 3 ft (0.9 m) beyond the reach of the exposed usable length of the fueling hose.
(3) The bonding jumper wire shall be equipped with a spring-loaded metal connector for attachment to the vehicle receiving fuel.

5.10.8.13 All recreational vehicles equipped with fuel-dispensing systems shall have a label with the word "Danger" in minimum ⅝ in. (16 mm) high red block letters and body text in minimum ⅜ in. (9.5 mm) high red block letters on a contrasting background visible to the operator during dispensing of fuel from the recreational vehicle.

5.10.8.14 The fuel-dispensing system label shall be made of material that does not deteriorate when in contact with petroleum-based products and shall read as follows:

⚠ DANGER
NO SMOKING.
BEFORE DISPENSING FUEL, TURN OFF ALL ENGINES, FUEL-BURNING APPLIANCES, AND THEIR IGNITORS.
CONNECT THE BONDING JUMPER WIRE TO THE VEHICLE RECEIVING FUEL.
DO NOT DISPENSE FUEL WITHIN 20 FEET OF AN IGNITION SOURCE.
FAILURE TO COMPLY COULD RESULT IN FIRE, DEATH, OR SERIOUS INJURY.

5.10.8.15 Clamps used in the fuel-dispensing system shall be in accordance with the following:

(1) Clamps shall be of the constant tension type, screw and nut type (with nonperforated band meeting specifications of SAE J1508 type D clamp), or equal.
(2) Clamps shall be matched with the type and size of the fuel lines used.
(3) Worm gear clamps shall not be used other than at the fill and vent locations at the fuel tank.

5.10.8.16 In-line fuel filters shall be permitted provided they are located in readily accessible locations for service and mounted in such a way that removal does not allow fuel to drip onto electrical or exhaust system components.

5.11 Propane Vehicle Propulsion Engine Installations.

5.11.1 Propane systems supplying both vapor and liquid withdrawal shall comply with Section 11.3 of NFPA 58, except as provided for in 5.11.2.

5.11.2 Tanks shall be mounted in accordance with 5.2.3.3 and secured in accordance with 5.2.4.

Chapter 6 Fire and Life Safety Provisions

6.1 Interior Finish and Textile or Film Materials.

6.1.1 Interior Finish Flame Spread Limitation.

6.1.1.1 Interior finish (as defined in 3.3.35) 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.

6.1.1.2 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 to establish the flame spread rating not to exceed 200.

6.1.1.3 The flame spread limitations shall 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.

6.1.2 Combustibility of Textile or Film Materials. Where the walls, partitions, or ceilings consist of textile or film materials, such as tent fabric, insect screening, and flexible plastic weather protection, 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*.

6.1.3 Use of Cellular Foam or Foamed Plastic Materials. Cellular foam or foamed plastic materials shall not be used for interior finish (as defined in 3.3.35) in recreational vehicles.

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

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

6.1.4 Glazing Materials. All interior glazing materials with an exposed area exceeding 431 in.^{2} (278,064 mm^2) shall comply with ANSI Z97.1 or equal requirements and shall be so identified by the manufacturer of the glazing material.

6.2 Recreational Vehicle Exit Facilities.

6.2.1* Minimum Exit Facilities.

6.2.1.1 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.

6.2.1.2 Each bedroom or area designed for sleeping shall have at least two unobstructed paths to exit.

6.2.1.3 The path to exit shall 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.6.2.1.)*

6.2.2 Alternate Exits in Motor Homes and Truck Campers.

6.2.2.1 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.

6.2.2.2 Use of the driver's door as an alternate exit shall be permitted provided that the seat locks only in the forward position and arm rests, if any, are retractable and nonlockable when in the arm rest position.

6.2.2.3 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).

6.2.3 Access to Alternate Exits.

6.2.3.1 The path leading to an alternate exit, other than that stated in 6.2.2, 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.

6.2.3.2 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).

6.2.3.3 Recreational vehicles that contain a designated roof alternate exit shall be provided with a ladder or equivalent device for descending from the roof.

6.2.4 Operation of Exits.

6.2.4.1 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.

6.2.4.2 No more than 20 lb of force (89 N) shall be required to open a required exit.

6.2.5* Size of Alternate Exits.

6.2.5.1 The alternate exit, if not an exterior passage door, shall provide an opening of sufficient size to permit unobstructed passage, keeping the major axis parallel to the plane of the opening and horizontal at all times, of an ellipsoid generated by rotating about the 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.6.2.5.)*

6.2.5.2 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).

6.2.6 Marking of Alternate Exits.

6.2.6.1 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.

6.2.6.2 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 movable portion of the exit approximately midway between the sides.

6.2.7 Identification of Alternate Exit Handles. Other than exterior and interior passage doors, all other handles that must be operated to open alternate exits shall be colored red.

6.3 Fire Detection Equipment.

6.3.1 Smoke Alarms.

6.3.1.1 At least one integral battery-operated smoke alarm shall be installed in each fifth wheel, travel trailer, truck camper, or motor home.

6.3.1.2 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 alarm with battery backup that shall be on a branch circuit supplying lighting and receptacle outlets that shall not have ground-fault protection.

6.3.2* Smoke Alarm Listing Requirement. The smoke alarm shall be listed and marked on the device as being suitable for installation in recreational vehicles under the requirements of UL 217.

6.3.3 Installation of Smoke Alarm. The required smoke alarm shall be installed in accordance with its listing but not within the separate sleeping areas.

6.3.4 Operational Check Warning Label. A permanent warning label with the word "Warning" with minimum ¼ in. (6 mm) high letters and body text with minimum ⅛ in. (3 mm) high letters on a contrasting background shall be

affixed in a visible location on or within 24 in. (610 mm) of the smoke alarm and shall read as follows:

⚠ WARNING
TEST SMOKE ALARM OPERATION AFTER VEHICLE HAS BEEN IN STORAGE, BEFORE EACH TRIP, AND AT LEAST ONCE PER WEEK DURING USE.
FAILURE TO COMPLY MAY RESULT IN SERIOUS INJURY.

6.4 Other Considerations.

6.4.1 Provisions for Portable Fire Extinguishers.

6.4.1.1 Each motor home shall be equipped with a listed portable fire extinguisher with a minimum rating of 10-B:C.

6.4.1.2 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.

6.4.1.3 The fire extinguisher shall be installed in accordance with its listing and Section 1.5 of NFPA 10 and shall be located in the recreational vehicle interior within 24 in. (610 mm) of the opening of the primary means of exit.

6.4.2 Liquid Fuel Filler Installation Provisions.

6.4.2.1 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 or to the interior of the vehicle.

6.4.2.2 Materials and sealants used to seal the fill pipe and vent tubing location shall be nonabsorbent and resistant to intermittent contact (splashing) with fuel.

6.4.3 Internal Combustion Engine Exhausts and Vehicle Wall Openings.

6.4.3.1 The terminus of engine exhausts shall extend beyond the periphery of the vehicle and discharge exhaust gases away from the vehicle.

6.4.3.2 Engine exhaust components installed by the recreational vehicle manufacturer shall not extend or protrude in a manner that could subject them to road damage.

6.4.3.3 Engine exhaust shall not terminate so that a communicable air passage exists into the living area within an area defined by a distance of 6 in. (152 mm) measured from the tailpipe terminus perimeter as projected onto the vehicle side.

6.4.3.4 Vents or windows that can be opened for ventilation shall not be installed in the rear wall of motor home and truck campers.

6.4.3.5 Normally unopenable alternate exit windows shall be permitted in rear walls.

6.4.3.6 Rear entry doors with fixed windows shall be permitted in truck campers.

6.4.3.7 Rear entry doors with fixed windows shall be permitted in motor homes provided that no combustion engine exhausts discharge from the rear of the vehicle.

6.4.4 Floor Penetrations for Recreational Vehicles Equipped with or Designed for Future Installation of an Internal Combustion Engine(s).

6.4.4.1 No uncovered hole(s) shall be permitted in or through the floor.

6.4.4.2 Holes or other penetrations provided or made for piping, wiring, or other similar components for systems addressed by this standard shall be filled or sealed.

6.4.5 Installation of Internal Combustion Engine Generators.

6.4.5.1 Internal combustion engine-driven generator units (subject to the provisions of this standard) shall be listed and installed in accordance with manufacturer's instructions and shall be vapor resistant to the interior of the vehicle.

6.4.5.2 Where a generator compartment is used to isolate the generator from the vehicle's interior, the generator compartment shall be lined with galvanized steel not less than 26 MSG thick.

(A) Seams and joints shall be lapped, mechanically secured, and made vapor resistant to the interior of the vehicle.

(B) Alternate materials and methods of construction shall be permitted in accordance with Section 1.5.

(C) Liquid fuel lines and exhaust systems shall not penetrate into the living area.

(D) Holes into the living area shall be sealed.

6.4.6 Carbon Monoxide (CO) Detectors. All recreational vehicles 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 and installed according to the terms of its listing.

6.4.7 Special Transportation Provisions.

6.4.7.1 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 to transport and store internal combustion engine vehicles shall be constructed in accordance with 6.4.7.2 through 6.4.7.9.

6.4.7.2 Venting by openings, windows, or passive ram air ventilation systems shall be provided in accordance with 6.4.7.2(A) through 6.4.7.2(D).

(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 m^2) of free area openable during transit and any set-up mode shall be provided.

(B) Venting shall be permitted to be located on sidewalls, endwalls, or through the floor where permitted *(see 6.4.4)*.

(C) The top of sidewall and endwall openings or windows shall not be more than 18 in. (457 mm) above the vehicle's interior floor level.

(D) Passive ram air ventilation systems shall require a minimum of 10 $in.^2$ (65 cm^2) of free openable area in the forward upper end of the transportation area pointing forward and a minimum of 10 $in.^2$ (65 cm^2) of free openable area in the lower rear area pointing aft, out, or down.

6.4.7.3 Flooring of the transportation area shall be in accordance with 6.4.7.3(A) through 6.4.7.3(C).

(A) The floor shall be nonabsorbent and resistant to intermittent contact with flammable liquids.

(B) If a floor covering or coating is used, it shall be seamless.

(C) 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 intermittent contact with flammable liquids.

6.4.7.4 A listed portable fire extinguisher with a minimum rating of 10-B:C, as defined in NFPA 10, shall be provided in the recreational vehicle.

6.4.7.5 Propane ranges and ovens containing a pilot light shall be equipped with a pilot light shutoff.

6.4.7.6 A danger label shall be placed inside of the recreational vehicle adjacent to each entry and visible to anyone entering the recreational vehicle. This label(s) shall be printed with red letters on a white background with the word "Danger" a minimum of ¾ in. (19 mm) high letters and body text that shall be a minimum of ¼ in. (6 mm) high, and shall read as follows:

⚠ DANGER

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) Passengers shall not ride in the vehicle storage area while vehicles are present.
(2) Occupants shall not sleep in the vehicle storage area while vehicles are present.
(3) Doors and windows in walls of separation (if installed) shall be closed while the vehicles are present.
(4) Fuel shall be run out of engines of stored vehicles after shutting off fuel at the tank.
(5) Motor fuel shall not be stored or transported inside this vehicle.
(6) The vehicle storage area shall be ventilated.
(7) Propane appliances, pilot lights, or electrical equipment shall not be operated when motorized vehicles or motorized equipment are inside vehicle.

FAILURE TO COMPLY COULD RESULT IN AN INCREASED RISK OF FIRE, EXPLOSION, OR ASPHYXIATION, DEATH, OR SERIOUS INJURY.

6.4.7.7 For vehicles that contain a special transportation area with a wall of separation and openings in the floor, no provisions for sleeping shall be in this special transportation area, and a warning label with the word "Warning" with minimum ⅝ in. (16 mm) high text and minimum ⅜ in. (9.5 mm) body text shall be visible to anyone entering the special transportation area and shall read as follows:

⚠ WARNING

DO NOT SLEEP IN THIS AREA. FAILURE TO COMPLY MAY RESULT IN DEATH OR SERIOUS INJURY.

6.4.7.8 The owner's manual shall contain a statement warning of the hazards of transporting, storing, or cohabiting with internal combustion engines inside the vehicle. The following label has been placed inside the recreational vehicle adjacent to each entry:

⚠ DANGER

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) Passengers shall not ride in the vehicle storage area while vehicles are present.
(2) Occupants shall not sleep in the vehicle storage area while vehicles are present.
(3) Doors and windows in walls of separation (if installed) shall be closed while the vehicles are present.
(4) Fuel shall be run out of engines of stored vehicles after shutting off fuel at the tank.
(5) Motor fuel shall not be stored or transported inside this vehicle.
(6) The vehicle storage area shall be ventilated.
(7) Gas appliances, pilot lights, or electrical equipment shall not be operated when motorized vehicles or motorized equipment are inside vehicle.

FAILURE TO COMPLY COULD RESULT IN AN INCREASED RISK OF FIRE, EXPLOSION, ASPHYXIATION, DEATH, OR SERIOUS INJURY.

6.4.7.9 A label with "Warning" in ¼ in. (6 mm) high text and body text in ⅛ in. (3 mm) high text 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 shall be provided.

6.4.7.10 Recreational vehicles designed and promoted for the physically impaired shall not be required to comply with the requirements of 6.4.7.

6.4.7.11 Portions of recreational vehicles designed to transport livestock, having a permanent wall of separation (passage doors and windows permitted) from the living section, shall not be required to comply with 6.4.7.

6.4.8 Propane Detectors. All recreational vehicles equipped with a propane appliance and electrical system shall be equipped with a propane detector listed as suitable for use in recreational vehicles under the requirements of UL 1484 and installed according to the terms of its listing.

6.4.9 Slide-Out Room Activation. Slide-out room activation shall use only momentary switching with nonlatching circuitry or equivalent.

Chapter 7 Plumbing Systems

7.1 Plumbing System.

7.1.1 General Requirements.

7.1.1.1 Any plumbing system installed in a recreational vehicle shall conform with the provisions of this standard.

7.1.1.2 Requirements for any size, weight, or quality of material modified by the terms *minimum, not less than, at least,* and similar expressions shall be minimum standards.

7.1.1.3 All plumbing fixtures, drains, appurtenances, and appliances designed or used to receive or discharge liquid waste or body waste shall be connected to the recreational vehicle drainage system in a manner provided by this standard.

7.1.2 Components.

7.1.2.1 Plumbing materials, devices, fixtures, fittings, equipment, appliances, accessories, and appurtenances installed in or attached to a recreational vehicle shall be listed and conform to minimum performance standards or shall be specifically approved by the authority having jurisdiction when listing by an approved listing agency is not available.

7.1.2.2 All listed components shall be installed in accordance with terms of their listing.

7.1.2.3 All design, construction, and workmanship shall be in conformance with accepted engineering practices.

7.1.2.4 All valves, pipes, and fittings shall be installed in correct relationship to the direction of flow.

7.1.3 Assembling of Pipe.

7.1.3.1 All joints and connections shall be correctly assembled for tightness.

7.1.3.2 Pipe threads shall be fully engaged with the threads of the fittings.

7.1.3.3 Pipe threads and slip joints shall not be wrapped with string, paper, putty, or similar fillers.

7.1.3.4 Plastic pipe and copper tubing shall be inserted to the full depth of the fitting sockets.

7.1.4 Solder Fittings and Joints.

7.1.4.1 Solder joints for copper tubing shall be made with approved or listed sweat-solder-type fittings.

7.1.4.2 Surfaces to be soldered shall be cleaned bright.

7.1.4.3 The joints shall be properly fluxed with noncorrosive-paste-type flux and made with approved solder that contains less than two-tenths of one percent of lead.

7.1.4.4 The use of self-cleaning fluxes shall not be permitted.

7.1.5 Prohibited Practices.

7.1.5.1 Piping, fixtures, or equipment shall be located so as not to interfere with the normal use or operation of windows, doors, or other required facilities.

7.1.5.2 Fittings, connections, devices, or methods of installation that obstruct or retard the flow of liquid waste, body waste, or air in the drainage or venting systems in an amount greater than the normal frictional resistance to flow shall not be used unless their use is approved or acceptable in the standard.

7.1.5.3 Drainage or vent piping shall not be drilled and tapped for the purpose of making connections.

7.1.5.4 Cracks, holes, or other imperfections in piping and fittings shall not be concealed by welding, brazing, or soldering or by paint, wax, tar, or other leak-sealing or repairing agents.

7.1.5.5 Galvanized pipe shall not be bent or welded.

7.1.6 Protective Requirements.

7.1.6.1 Pipes, supports, drains, outlets, or drain hoses shall not extend or protrude where they could be subjected to road hazard.

7.1.6.2 Drain terminations and other plumbing components protruding below the plane formed by the rear axle tire to road interface and the rear bumper and frame shall be protected from contact with the road.

7.1.6.3* Pipe and hoses shall be installed so they cannot be subject to dislocation, strain, or damage by extendable components.

7.1.6.4 All exterior openings around piping shall be sealed to prevent the entrance of rodents.

7.1.6.5 Piping in a plumbing system shall be installed with provision for expansion and contraction.

7.1.6.6 Piping shall be securely attached to the structure by proper hangers, clamps, or brackets that provide protection against damage from motion, vibration, road shock, torque in the chassis, or other unusual conditions.

7.1.6.7 Hangers and anchors shall support the pipe.

7.2 Plumbing Fixtures.

7.2.1 General Requirements.

7.2.1.1 Plumbing fixtures shall have smooth impervious finishes, be free from defects and concealed fouling surfaces, be capable of resisting road shock and vibration, and conform in quality and design to approved or listed standards.

7.2.1.2 The waste outlet of all plumbing fixtures, other than toilets, shall be equipped with a drain fitting that provides an unobstructed waterway.

7.2.2 Fixture Connections.

7.2.2.1 Fixture tailpieces and continuous wastes in exposed or accessible locations shall be not less than No. 20 Brown and Sharpe gauge seamless drawn-brass tubing or other approved pipe or tubing.

7.2.2.2 Fixture connections shall be constructed according to the requirements for drainage piping.

7.2.2.3 Each fixture tailpiece, continuous waste, or waste and overflow shall be not less than 1¼ in. (31.8 mm) for a single fixture having a 2 in. (50.8 mm) maximum drain opening.

7.2.2.4 The vertical distance from the fixture outlet to the trap shall not exceed 24 in. (609.6 mm).

7.2.2.5 The horizontal distance from the fixture's outlet to the trap shall not exceed 30 in. (762 mm).

7.2.2.6 Concealed slip joint connections shall be provided with unobstructed access panels and shall be accessible for inspection and repair.

7.2.2.7 Each plumbing fixture shall be located and installed in a manner to provide access for cleaning and repair.

7.2.2.8 Fixtures shall be set level.

7.2.2.9 Fixtures shall be rigidly supported without any strain being transmitted to the piping connections.

7.2.3 Toilets.

7.2.3.1 Recirculating or mechanical seal toilets shall be permitted to provide for storage of liquid waste and body waste as an integral part of the unit.

7.2.3.2 When a mechanical seal toilet does not contain storage for the retention of liquid waste and body waste, it shall be connected to an approved waste holding tank.

7.2.3.3 Flush toilets shall not be installed in a system that incorporates a body waste holding tank.

7.2.3.4 Toilets, when directly connected to a waste holding tank or drainage system, shall be bolted to either the tank or other approved fitting.

7.2.3.5 Bolts used to attach the toilet to the flange shall be of brass or equally corrosion-resistant material and shall not be less than ¼ in. (6.4 mm) in diameter.

7.2.3.6 Screws or bolts used to attach the flange to the floor shall be of brass, zinc, or cadmium-plated steel or other approved corrosion-resistant material and shall not be less than ¼ in. (6.4 mm) in diameter.

7.2.3.7 A watertight seal shall be made between the toilet and flange or other approved fittings by the use of a gasket or sealing compound.

7.2.4 Shower Stalls.

7.2.4.1 Each shower stall shall be provided with an approved watertight receptor with sides and back extending 1 in. (25.4 mm) above the finished dam or threshold.

7.2.4.2 In no case shall the depth of a shower receptor be less than 2 in. (50.8 mm) or more than 9 in. (228.6 mm), measured from the top of the finished dam or threshold to the top of the drain.

7.2.4.3 The wall area shall be constructed of smooth, noncorrosive, and nonabsorbent waterproof materials to a height not less than 70 in. (177.8 cm) above the top of the drain, or to the ceiling if less than 70 in. (177.8 cm) above the top of the drain. Such walls shall form a watertight joint with each other, as well as with the receptor or shower floor.

7.2.4.4 Fabric wall portions of folding camper trailers and folding truck campers shall be permitted to be protected by a shower curtain.

7.2.4.5 The joint around the drain connection and around the toilet outlet in combination compartments shall be made watertight by a flange, clamping ring, or other approved or listed means.

7.2.4.6 Shower doors and tub and shower enclosures shall be constructed so as to be waterproof.

7.2.4.7 Shower doors and tubs and shower enclosures, if glazed, shall conform to ANSI Z97.1.

7.2.4.8 Hinged, swinging shower doors shall open outward.

7.3 Water Distribution Systems.

7.3.1 Materials. Water pipe shall be of standard weight brass; galvanized wrought iron; galvanized steel; Type K, L, or M copper tubing; listed plastic; or other approved or listed material.

7.3.2 Fittings.

7.3.2.1 Appropriate fittings shall be used for all changes in size and where pipes are joined.

7.3.2.2 The material and design of fittings shall conform to the type of piping used.

7.3.2.3 Fittings for screw piping shall be standard weight galvanized iron for galvanized iron and steel pipe, and brass for brass piping.

7.3.2.4 Fittings shall be installed where required for change in direction or reduction of size, or where pipes are joined together.

7.3.2.5 Fittings for copper tubing shall be cast brass or drawn copper sweat solder pattern or flare type.

7.3.2.6 Faucet fittings shall be accessible for removal and repair.

7.3.3 Prohibited Practices.

7.3.3.1 Used piping materials shall not be permitted.

7.3.3.2 Plastic pipe, tubing, and fittings shall not be used in water systems containing water heating devices unless such pipe and fittings are listed for use in hot water systems.

7.3.3.3 When any substance other than potable water is added to the water distribution system, that substance shall be identified for use in a potable water system.

7.3.3.4 Ethylene glycol, methanol-based antifreeze, or other poisonous chemicals shall not be used.

7.3.4 Demand Pressure Pump Installation.

7.3.4.1 An 18 in. (457 mm) length of listed cold water flexible tubing shall be installed on the outlet side of a demand pressure pump.

7.3.4.2 A minimum 24 in. (610 mm) length of separation shall be provided between the hot water heater and the flexible hose.

7.3.4.3 When provisions for a city water connection are installed in the water distribution system and a pressure regulator is not installed, the cold water flexible hose shall be approved for the maximum test pressure specified in 7.7.2.

7.3.5 Installation of Piping.

7.3.5.1 Iron pipe-size brass or galvanized iron or steel pipe and fittings shall be joined with standard pipe threads fully engaged in the fittings.

7.3.5.2 Threads for pipe and fittings shall conform to the approved or applicable standard.

7.3.5.3 Pipe ends shall be reamed out to size of bore, and all chips and cutting oil shall be removed.

7.3.5.4 Pipe joint compound or thread lubricant shall be insoluble in water, shall be nontoxic, and shall be applied to male threads only.

7.3.5.5 A flaring tool shall be used to shape the ends of flared tubing to match the flare of fittings.

7.3.6 Water Supply Requirements.

7.3.6.1 Valves other than those controlling a single fixture, when installed in the water supply distribution system and when fully opened, shall have a nominal size at least equal to the nominal size of the pipe in which the valve is installed.

7.3.6.2 The water distribution system shall be installed to provide for gravity drainage of the system and water storage tank.

7.3.6.3 Piping systems shall be sized to provide a quantity of water to each plumbing fixture at a flow rate to keep the fixture in a clean and sanitary condition without backflow or siphonage.

Table 7.3.6.4 Minimum Size Tubing and Pipe for Water Distribution Systems[a]

Number of Fixtures	Tubing I.D. (in.)	Tubing O.D. (in.)	Iron Pipe Size (in.)
1	¼[b]	⅜[b]	⅜
2	¼[c]	⅜[c]	⅜
3	⅜	½	½
4	⅜	½	½
5 or more	½	⅝	½

[a]Minimum size for toilet water supply line shall not be less than the size recommended by the manufacturer.
[b]12 ft (3.7 m) maximum length allowable only from water service connection to a single fixture.
[c]6 ft (1.8 m) maximum length.

7.3.6.4 The size of water supply piping and branch lines shall not be less than shown in Table 7.3.6.4.

7.3.6.5 A water heater or ice maker shall not be counted as a water-using fixture when computing pipe sizes.

7.3.7 Potable Water Storage Tanks.

7.3.7.1 Potable water tanks shall be installed to be removable for service, repair, or replacement without removing structural members.

7.3.7.2 Tanks shall be installed so they are not subject to road damage.

7.3.7.3 Each nonpressure or gravity tank shall be equipped with a vent at the top of the tank to assist in filling and drainage.

7.3.7.4 Each inlet to a potable water tank shall have affixed a warning label with the word "Warning" with minimum ¼ in. (6 mm) high letters and body text with minimum ⅛ in. (3 mm) high letters on a contrasting background that shall read as follows:

⚠ WARNING
POTABLE WATER ONLY. SANITIZE, FLUSH, AND DRAIN BEFORE USING. SEE INSTRUCTION MANUAL.
FAILURE TO COMPLY COULD RESULT IN DEATH OR SERIOUS INJURY.

7.3.7.5* Instructions for proper sanitizing of water distribution systems shall be furnished with each vehicle.

7.3.8 Water Service Connections, Outlets, and Backflow Prevention.

7.3.8.1 Each recreational vehicle with a water distribution system sized as required in Table 7.3.6.4, that can be connected to an outside source, shall be equipped with a ¾ in. (19 mm) swivel female hose water service connection.

7.3.8.2 A matching cap or plug shall be provided to close the water inlet when it is not in use and shall be attached to the recreational vehicle.

7.3.8.3 The water service connection, if provided, shall be located on the left road side or at the rear of the recreational vehicle within 18 in. (457 mm) of the outside wall.

7.3.8.4 A location other than that specified in 7.3.8.3 shall be permitted provided that a length of listed cold water flexible hose connected to the water distribution system and equipped with a ¾ in. (19 mm) swivel female hose water service connection with matching cap or plug extends to the required location.

7.3.8.5 Recreational vehicles designed to transport livestock shall be permitted to have the water service connection located on either side or at the rear within 18 in. (457 mm) of the outside wall.

7.3.8.6 Potable water supply piping or fixture or appliance connections shall be installed to prevent backflow *(see 7.3.10)*.

7.3.8.7 No part of the water system shall be connected to any drainage or vent piping.

7.3.9 Water Outlets.

7.3.9.1 Unless they are individually protected by a listed backflow preventer or anti-siphon device, the outlets of faucets, spouts, and similar devices shall be spaced at least 1 in. (25.4 mm) above the flood level of the fixture.

7.3.9.2 Valved hose outlets shall be installed to prevent a cross connection.

7.3.9.3 Vacuum breakers, hose length, or an installed retaining device to prevent cross connections shall be permitted to be used.

7.3.9.4 When using hose length or a retaining device, the extreme end of the assembly shall be a minimum of 2 in. (50.8 mm) above the flood plane of the closest fixture.

7.3.9.5 An outside shower hose assembly shall have a vacuum breaker to preclude cross connection unless the extreme end of the assembly is more than 12 in. (304.8 mm) above the ground in its free hanging position.

7.3.10 Backflow Prevention Device. When nonpressurized water storage tank(s) (reservoirs) [except water heater(s)] for storing potable water are connected to the water distribution system of recreational vehicles that have a water service connection for an outside source of supply, they shall have an approved or listed backflow check valve or other approved or listed type backflow prevention device installed in the water supply piping adjacent to the water service connection.

7.3.11 Temperature and Pressure Relief Valve.

7.3.11.1 Every water heater shall be protected against overtemperature and overpressure by an approved or listed and adequately sized temperature and pressure relief valve.

7.3.11.2 Valves rated at not more than 150 psi (1034 kPa) and 210°F (98.9°C) shall be acceptable for the protection of systems constructed of materials authorized by 7.3.1 and 7.3.2.

7.3.12 Pressure Relief Valve and Drain.

7.3.12.1 The pressure relief valve, if located inside the recreational vehicle, shall be equipped with a full size drain able to withstand 225°F (107°C), which shall extend outside with the end directed downward, except that no drain shall be required if the pressure relief valve discharges into an area sealed off from the inside of the vehicle and drained and ventilated to the outside.

7.3.12.2 The discharge end of the drain shall not be equipped with a thread or other means of capping or plugging.

7.3.12.3 The threaded discharge of a pressure relief valve not equipped with a drain shall be provided with a means to make capping or plugging difficult.

7.3.13 Air-Pressurized Water Storage Tanks.

7.3.13.1 Water storage tanks, except water heaters, which can be pressurized by air, shall be equipped with a listed air pressure relief valve set to open at not more than 125 psi (862 kPa) or the tank manufacturer's recommended working pressure, whichever is lower.

7.3.13.2 The air pressure relief valve shall be located above the maximum water level of the tank.

7.4 Drainage Systems.

7.4.1 Pipe and Fittings.

7.4.1.1 Drainage piping shall be standard weight, galvanized steel, galvanized wrought iron, brass, copper tube DWV, listed DWV plastic, or other approved or listed material.

7.4.1.2 Drainage fittings shall have a recessed drainage pattern with smooth interior waterways of the same diameter as the piping and shall be of a material conforming to the type of piping used.

7.4.1.3 Drainage fittings shall be designed to provide for ¼ in./ft (20.8 mm/m) grade in horizontal piping.

7.4.1.4 Fittings for threaded pipe shall be cast iron, malleable iron, brass, or approved or listed plastic with standard pipe threads.

7.4.1.5 Fittings for copper tubing shall be cast brass or wrought copper.

7.4.1.6 Fittings for plastic piping shall be made to approved or applicable standards.

7.4.1.7 Brass adapter or wrought copper fittings shall be used to join copper tubing to threaded pipe.

7.4.2 Drainage Piping.

7.4.2.1 Drain pipe sizes shall be determined by the type of fixtures and the total number connected to each drain.

7.4.2.2 One and one-quarter inch (31.8 mm) minimum diameter piping shall be required for one and not more than three individually vented fixtures.

7.4.2.3 Nominal 3 in. (76.2 mm) minimum diameter piping shall be required for toilets or sized in accordance with the listed toilet system installation instructions.

7.4.2.4 Horizontal drainage piping, except fixture connections on the inlet side of the trap, shall have a uniform slope of not less than ⅛ in./ft (10.4 mm/m) toward the recreational vehicle main drain outlet.

7.4.2.5 Drain piping shall be secured at not more than 4 ft (121.9 cm) intervals, unless different spacing is recommended by the piping manufacturer, to keep the pipe in alignment and carry the weight of the pipe and contents.

7.4.2.6 Changes in direction of drainage piping shall be made by the appropriate use of approved or listed fittings and angle shall be either 11¼ degrees, 22½ degrees, 45 degrees, 60 degrees, or 90 degrees; or other approved or listed fittings, or combination of fittings with equivalent radius or sweep.

7.4.3 Connections.

7.4.3.1 Horizontal drainage lines, connecting with vertical pipes, shall enter through 45-degree "Y" branches, sanitary "T" branches, or other approved or listed fittings or combination of fittings having equivalent sweep.

7.4.3.2 No fitting having more than one branch at the same level shall be used unless the fitting is constructed so that the discharge from any one branch cannot readily enter any other branch.

7.4.3.3 Horizontal drainage lines connecting with other horizontal drainage lines or vertical drainage lines connected with horizontal drainage lines shall enter through 45-degree "Y" branches, long-turn "TY" branches, or other approved or listed fittings or combination of fittings having the equivalent sweep.

7.4.3.4 A single-entry, short-turn "TY" shall be permitted to be used as a horizontal-to-horizontal drainage fitting providing final termination if it is mounted directly to the fullway termination valve on one side and has a manual disconnect on the other.

7.4.3.5 A double-entry, short-turn "TY" shall be permitted to be used as a horizontal-to-horizontal drainage fitting provided it is a final termination collector fitting and provided it is approved as a component part of a listed waste valve termination assembly.

7.4.4 Traps.

7.4.4.1 Each plumbing fixture, except listed toilets and fixtures utilizing listed detachable waste holding tanks with integral traps, shall be separately trapped by approved or listed water seal traps.

7.4.4.2 A two-compartment sink, two single sinks, two lavatories, or a single sink and a single lavatory, with waste outlets not more than 30 in. (762 mm) apart and flood level rims at same level, shall be permitted to be connected to one trap and thereby considered as a single fixture for the purpose of drainage and vent requirements.

7.4.4.3 Traps and connected tailpieces or continuous wastes shall be designed and installed so they can be separated without the removal of the strainer by the use of two or more mechanical joints.

7.4.4.4 Full "S" traps, bell traps, drum traps, and crown-vented traps shall be prohibited.

7.4.4.5 A trap that depends for its seal upon concealed interior partitions shall not be used except for listed flexible drain systems.

7.4.4.6 Fixtures shall not be double trapped.

7.4.4.7 Listed flexible drain systems and listed systems utilizing a detachable waste holding tank with integral trap shall be permitted.

7.4.4.8 Each trap shall have a water seal of not less than 2 in. (50.8 mm) and not more than 4 in. (101.6 mm) and shall be set true to its seal.

7.4.4.9 Traps shall not be less than 1¼ in. (31.8 mm) in diameter.

7.4.4.10 A trap shall not be larger than the waste pipe to which it is connected.

7.4.4.11 Traps shall be accessible.

7.4.5 Trap Arms.

7.4.5.1 The piping between a trap and the fixture tee or the vented waste line shall be graded ¼ in./ft (20.8 mm/m) and in no event shall have a slope greater than its diameter.

7.4.5.2 The vent opening at fixture tees shall not be below the weir of the trap outlet.

7.4.5.3 The piping between the trap and vent shall be permitted to change direction or be offset horizontally with the equivalent of no more than 180 degrees.

7.4.5.4 The distance between a trap and its vent or vented waste line shall be in accordance with Table 7.4.5.4.

Table 7.4.5.4 Distance of Fixture Trap from Vent

Size of Trap Arm		Distance from Trap to Vent	
in.	**mm**	**ft**	**m**
1¼	32	4½	1.37
1½	38	4½	1.37
2	51	5	1.52
3	76	6	1.83

7.4.5.5 Not more than one trap shall connect to a trap arm.

7.4.6 Wet-Vented Drainage System.

7.4.6.1 All parts of a wet-vented drainage system, including the connected fixture drains, shall be horizontal except for the wet-vented vertical riser and the final section consisting of an appropriate horizontal-to-vertical fitting with a connecting pipe that shall be permitted to turn vertically to enter the top of the waste holding tank.

7.4.6.2 Where required by structural design, wet-vented drain piping shall be permitted to be offset vertically when other vented drains or relief vents are connected to the drain piping below the vertical offsets.

7.4.6.3 Except as permitted in 7.6.4, a wet-vented drain pipe shall be at least one pipe size larger than the largest required trap.

7.4.6.4 Not more than three fixtures shall be permitted to connect to a wet-vented drain system.

7.4.7 Side-Vented Drainage Systems and Flexible Drain Systems.

7.4.7.1 A side-vented liquid waste drainage system shall be permitted to be utilized in conjunction with a one- or two-compartment sink, lavatory fixture, or shower with no more than a 2 in. (50.8 mm) drain opening and including the trap, strainer, pipe, and vent connections in accordance with the following:

(1) The side-vented drainage system shall be constructed of approved or listed components.
(2) The side-vented drainage system installation shall have the following features:
   (a) The baffle or diverter tee shall be used to connect the trap arm to the highest fixture to the side-vented drain system.
   (b) The trap shall be 1¼ in. (31.8 mm) minimum diameter installed as close to the fixture as possible with the center of the outlet not more than 6 in. (152.4 mm) from the bottom of the fixture or other approved trap system.
   (c) The drain shall be permitted to terminate through the outside wall above the floor or extend vertically through the floor to the exterior or shall be permitted to discharge into a liquid waste holding tank.
   (d) The horizontal vent offset center shall be located not less than 2¼ in. (57.2 mm) above the bottom of the highest fixture and shall be permitted to terminate through the outside wall at a level lower than the offset.
   (e) The vent termination through the outside wall shall be at least 3 ft (0.9 m) away from any fuel-burning appliance intake that is above the level of the vent.
   (f) The vent offset shall be permitted to terminate through the sidewall horizontally without change in direction when the drain discharges into a liquid waste holding tank.
   (g) A connection between liquid and body waste drainage systems shall be prohibited.

7.4.7.2 Flexible drain systems shall be permitted to be used on single-compartment sinks and showers.

7.4.7.3 A flexible drain system shall not be used on a tub drain.

7.4.7.4 Each flexible drain system shall be a listed assembly.

7.4.7.5 A flexible drain system shall be permitted to be connected to the fixed drain piping of a side-vented drainage system with approved fittings below the vent offset through the wall or be installed as provided in 7.5.7.4. *(See 7.5.7.5 and 7.5.7.7 for related information on drain outlets.)*

7.4.7.6 A flexible drainage connector shall conform to the following:

(1) Maintain a minimum inside nominal diameter equal to the diameter of the DWV fittings to which it is connected
(2) Provide a minimum slope of ⅛ in./ft (10.4 mm/m) throughout its range of movement
(3) Be securely attached to the mating DWV fitting components
(4) Be anchored at each mating attachment for strain relief
(5) Have a smooth, nonfouling interior

7.4.8 Cleanouts.

7.4.8.1 Cleanouts shall be installed if the drainage system cannot be cleaned through fixtures or vent openings.

7.4.8.2 A cleaning tool shall not be required to pass through more than 360 degrees of fittings, excluding all parts of removable traps and the first fitting used to gain system access, to reach any part of the drainage system.

7.4.8.3 Cleanouts shall be accessible through an unobstructed minimum clearance of 6 in. (152.4 mm) directly in front of the opening.

7.4.8.4 Each cleanout fitting shall open in a direction opposite to the flow or at right angles to the pipe.

7.4.8.5 Cleanouts that are not provided with access covers shall be extended to a point above the floor or outside the recreational vehicle, with pipe and directional fittings installed, as required, for drainage piping.

7.4.8.6 Plugs and caps shall be brass or approved or listed plastic, with screw pipe threads.

7.4.8.7 Cleanout plugs shall have raised heads except that plugs at floor level shall have countersunk slots.

7.5 Waste Holding Tanks.

7.5.1 Installation of Waste Holding Tanks. Waste holding tanks shall be securely installed in such locations as to be removable for service, repair, or replacement without the necessity of removing structural members.

7.5.2 Liquid Waste Holding Tank.

7.5.2.1 Minimum size of inlet connections shall be determined by the total number of connected fixtures in accordance with 7.4.2.

7.5.2.2 Neither the inlet nor vent fitting shall extend downward into the tank more than ½ in. (12.7 mm).

7.5.2.3 The drain opening shall be 1½ in. (38.1 mm) minimum pipe size located at the lowest point in the tank.

7.5.2.4 A listed fullway termination valve shall be directly connected to the tank or installed in the drain pipe of the tank.

7.5.2.5 Except as otherwise permitted in 7.4.7, the tank shall be vented at the highest point in the top of the tank by one of the following methods:

(1) A 1¼ in. (31.8 mm) minimum diameter individual vent pipe extending undiminished in size through the roof
(2) A continuous vent serving as a drain for not more than three fixtures provided the drain portion is increased one pipe size larger than the largest required trap

7.5.3 Body Waste Holding Tank.

7.5.3.1 Toilet connections shall be in accordance with 7.4.2.3 and shall extend vertically.

7.5.3.2 The inlet fitting shall not extend downward into the tank more than 1½ in. (38.1 mm).

7.5.3.3 The toilet connection shall be designed to receive or conform in an approved shape to a closet flange of standard dimensions or other approved fitting.

7.5.3.4 The drain opening shall be a 3 in. (76.2 mm) minimum pipe size outlet located at the lowest point in the tank.

7.5.3.5 A listed fullway termination valve shall be directly connected to the tank or installed in the drain pipe of the tank within 36 in. (91.4 cm) of the tank drain outlet.

7.5.3.6 The tank shall be vented at the highest point in the top of the tank by one of the following methods:

(1) A 1¼ in. (31.8 mm) minimum diameter individual vent pipe extending undiminished in size through the roof
(2) A continuous vent serving as a drain from one additional fixture provided the drain portion is increased one pipe size larger than the connected trap arm
(3) Two or more vented drains when at least one is wet-vented and each drain is separately connected to the top of the tank

7.5.4 Connections Between Holding Tanks. No drain connection shall be made between liquid waste and body waste holding tanks upstream of any fullway termination valves.

7.5.5 Operation and Location of Fullway Termination Valves.

7.5.5.1 Fullway termination valves shall be designed for manual operation from outside the recreational vehicle and have no extension or activating device within the vehicle.

7.5.5.2 Remotely operated termination valves shall be permitted to be used under the following conditions:

(1) The remotely operated valves shall be capable of manual operation.
(2) The body waste valve control shall be installed outside the living volume of the vehicle with a security lockout.
(3) The primary liquid waste valve control shall be located outside the living volume of the vehicle with a security lockout.
(4) A secondary liquid waste valve control shall be permitted to be located within the living volume of the vehicle with a means to disable the valve control as follows:
    (a) When the vehicle ignition is activated
    (b) When the vehicle transmission selector is moved from the park position
    (c) When the waste sewer hose is stowed
(5) A secondary liquid waste valve control, if provided, shall be located either in the bathroom or within 5 ft (1.5 m) of the clothes washer.

7.5.6 Detachable Waste Holding System. A recreational vehicle having a sink as its only liquid waste plumbing fixture shall be permitted to have all its liquid waste discharge into a listed detachable waste holding tank.

7.5.7 Drain Outlets.

7.5.7.1 A drain outlet used for the discharge of body waste shall be nominal 3 in. (76.2 mm) pipe size.

7.5.7.2 Except for listed flexible drain systems, a drain outlet used for the discharge of liquid waste shall be 1½ in. (38.1 mm) minimum pipe size.

7.5.7.3 Each recreational vehicle shall have a main drain outlet(s) that shall terminate at any point within 22.5 ft (6.9 m) of the rear, on the left (road) side or at the rear left of the longitudinal center of the vehicle within 18 in. (457.2 mm) of the outside wall.

7.5.7.4 When less than 18 in. (457.2 mm) above the ground, the drain outlet(s) shall be permitted to terminate vertically when it is equipped with a manual-disconnect-type coupler and a companion elbow hose adapter.

7.5.7.5 A recreational vehicle equipped with only a listed flexible drain system or a side-vent drain system, or designed for transporting livestock, shall be permitted to have its drain outlet located on either side or at the rear, within 18 in. (457.2 mm) of the outside wall. *(See also 7.5.7.7.)*

7.5.7.6 A recreational vehicle having a mechanical seal toilet with a waste holding tank or a recirculating chemical toilet shall be permitted to have a separate drain outlet installed in accordance with the location requirements specified in 7.5.7.3 through 7.5.7.8.

7.5.7.7 A recreational vehicle with drainage systems limited to a listed flexible drain system and a side-vent drain system shall be permitted to have separate drain outlets for these systems. *(See also 7.5.7.5.)*

7.5.7.8 Subject to the other requirements in 7.5.7.3 through 7.5.7.7, truck campers shall be permitted to have the main drain(s) located anywhere across the rear of the vehicle.

7.5.7.9 Each drain outlet shall be equipped with a watertight cap that shall be attached to the vehicle or drain piping.

7.5.7.10 Drain outlets shall be provided with a minimum clearance of 1½ in. (38.1 mm) on three sides from all parts of the vehicle and with clearance directly in front of the outlet to permit connection of a drain hose or cap.

7.5.7.11 Where drain outlets are equipped or arranged for hose coupling devices, such devices shall be of the manual disconnect type.

7.6 Vents and Venting.

7.6.1 General.

7.6.1.1 Each plumbing fixture trap shall be protected against siphonage and back pressure.

7.6.1.2 Air circulation shall be ensured throughout all parts of the drainage system by means of vents.

7.6.1.3 Except as specifically provided elsewhere in this chapter, vent pipes shall not be used as waste or drain pipes.

7.6.2 Vent Pipe and Fittings.

7.6.2.1 Vent piping shall be standard weight galvanized steel, galvanized wrought iron, brass, copper tube DWV, listed DWV plastic, or other approved or listed materials.

7.6.2.2 Appropriate fittings shall be used for all changes in direction, size, or shape, and where pipes are joined.

7.6.2.3 The material and design of fittings shall conform to appropriate national standards.

7.6.2.4 Listed rectangular tubing shall be permitted to be used for venting with listed transition fittings.

7.6.3 Sizing of Vent Piping.

7.6.3.1 Unless protected by an anti-siphon trap vent device *(see 7.6.6)*, a 1¼ in. (31.8 mm) minimum diameter vent pipe shall be required for all individually vented fixtures with 1½ in. (38.1 mm) or smaller traps.

7.6.3.2 The continuous vent of wet-vented drainage systems shall be 1¼ in. (31.8 mm) minimum diameter.

7.6.3.3 When two fixture traps located within the distance allowed from their vent have their trap arms connected separately at the same level into an approved double fitting, an individual vent pipe shall be permitted to serve as a common vent without any increase in size.

7.6.3.4 Where two or more vent pipes are joined together, no increase in size shall be required.

7.6.3.4.1 The largest vent pipe shall extend full size through the roof.

7.6.4 Flush Toilet Venting.

7.6.4.1 The trap arm for each flush toilet shall be vented by 1½ in. (38.1 mm) minimum diameter vent or rectangular vent of venting cross section equivalent to or greater than the venting cross section of a 1½ in. (38.1 mm) diameter vent, connected to the trap arm within the distance outlined in Table 7.4.5.4 for 3 in. (76 mm) trap arms.

7.6.4.2 The connection for venting shall be accomplished by one of the following methods:

(1) A 1½ in. (38.1 mm) minimum diameter individual vent pipe connected to the trap arm and extended undiminished in size through the roof
(2) A 1½ in. (38.1 mm) minimum diameter continuous vent indirectly connected to the toilet drain pipe through a 2 in. (50.8 mm) wet-vented drain

7.6.5 Horizontal Vents.

7.6.5.1 Each vent, other than a wet-vented drain, shall extend vertically from its fixture "T" or point of connection with the waste piping, to a point not less than one vent pipe diameter above the flood level of the fixture that is venting before offsetting horizontally or being connected with any other vent pipe.

7.6.5.2 Vents for horizontal drains shall connect to the drain piping downstream of the trap.

7.6.5.3 Vents other than wet-vented drains shall connect above the centerline of horizontal drain piping.

7.6.5.4 Vents shall be level or so designed to drain back to the drainage system by gravity.

7.6.6 Anti-Siphon Trap Vent Devices. An anti-siphon trap vent device shall be permitted to be used only as a secondary vent in accordance with the following:

(1) An anti-siphon trap vent device shall be installed in accordance with the terms of its listing.
(2) One anti-siphon trap vent device shall be permitted to serve not more than two fixtures.
(3) Anti-siphon trap devices shall not be used as a primary vent for toilets or holding tanks.
(4) When a fixture drain or main drain bypasses a holding tank, that drain shall be vented by a primary vent.
(5) Anti-siphon trap vent devices shall not be used on more than two consecutive fixtures before being vented to outside atmosphere.
(6) Two fixtures protected by one anti-siphon trap vent device shall be drained by a common 1½ in. (38.1 mm) minimum drain.
(7) The device shall be installed in an accessible location that permits a free flow of air.

7.6.7 Roof Vent Terminations.

7.6.7.1 Except as otherwise permitted in this standard, each vent pipe shall pass through the roof and terminate vertically, undiminished in size, not less than 2 in. (50.8 mm) above the roof.

7.6.7.2 Vents terminating on curved roof recreation vehicles or recreation vehicles with elevating tops shall pass through the roof or upper side of the recreation vehicle at a point as high as practicable and not less than 6 ft (1.8 m) from the ground level.

7.6.8 Other Vent Termination Requirements.

7.6.8.1 Waste holding tank vent openings shall not be less than 3 ft (0.9 m) away from any motor-driven air intake that opens into habitable areas.

7.6.8.2 The opening around each vent pipe shall be made watertight by flashing or flashing material.

7.6.8.3 Vent caps, if provided, shall be removable without removing the flashing from the roof.

7.7 Plumbing System Tests.

7.7.1 Water Piping System Tests.

7.7.1.1 All pressure water piping in the water distribution system shall be subjected to a pressure test.

7.7.1.2 A pressure gauge or bubble-type leak detector shall be used on all tests.

7.7.1.3 Tests shall be performed in accordance with 7.7.2 through 7.7.5.

7.7.2 Pressurized System Test.

7.7.2.1 The test shall be performed by subjecting the pressure water piping system to either air or water pressure for 10 minutes without leakage or loss of pressure in accordance with 7.7.2.1(A) and 7.7.2.1(B).

(A) The entire piping system shall be filled with water and pressure tested with air or water at 80 psi to 100 psi (551 kPa to 689 kPa). The entire piping system shall include the hot water storage tank and the pressurized potable water storage tank with water and pressure tested with air or water at 80 psi to 100 psi (551 kPa to 689 kPa).

(B) The water heater storage tank and the pressurized potable water storage tank shall be removed from the piping system, and the remaining piping system shall be pressure tested with air at 80 psi to 100 psi (551 kPa to 689 kPa).

7.7.2.2 PVC and CPVC systems shall be permitted to be tested to the manufacturer's recommended test procedure.

7.7.2.3 Vehicles with demand systems that do not have city water connections shall be permitted to be tested by subjecting the system to air or water pressure equivalent to the maximum discharge pressure of the pump for a period of 10 minutes without leakage or loss of pressure.

7.7.3 Tests for Drainage and Vent Systems. The waste and vent system shall be subjected to one of the three tests described in 7.7.3.1 through 7.7.3.3 without evidence of leaks.

7.7.3.1 Before plumbing fixtures are connected, all the openings into the piping shall be plugged and the entire piping system subjected to a static water test for 15 minutes by filling it with water to the top of the highest vent opening.

7.7.3.2 After all fixtures have been installed, the traps filled with water, and the remaining openings securely plugged, the entire system shall be subjected to a 2 in. (50.8 mm) (manometer) water column air pressure test.

7.7.3.3 The recreational vehicle shall be in a level position, all fixtures shall be connected, and the entire system shall be filled with water to the flood level rim of the toilet bowl. Tub and shower drains shall be plugged.

(A) After all trapped air has been released, the test shall be sustained for not less than 15 minutes.

(B) The waste piping above the level of the toilet shall be tested and show no indication of leakage when the high fixtures are filled with water and emptied simultaneously to obtain the maximum possible flow in the drain piping.

7.7.4 Liquid Waste System Tests. When a recreational vehicle is equipped with a liquid waste holding system, it shall be subjected to a static water test for 15 minutes by filling the system with water to the level of the lowest connected trap arm without evidence of leaks.

7.7.5 Flow Tests. The plumbing fixtures and connections shall be subjected to a flow test by filling them with water and checking for leaks and retarded flow while they are being emptied.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

A.1.1 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. 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 2.

A.1.3.1 This standard should not be intended as a design specification or an instruction manual.

A.1.6 SI stands for the International System of Units, which is officially abbreviated SI in all languages. For full explanation, see ANSI SI 10.

A.3.1 Other definitions relating to heat-producing appliances are contained in NFPA 97.

A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.6 Axle Height. A single or dual beam axle is measured at the lowest point of that beam axle at the spring location.

A.3.3.32 Gross Trailer Area. In calculating the square footage, measurements should be taken on the exterior. Square footage includes all siding, corner trims, moldings, storage spaces, and areas enclosed by windows but not the roof overhangs *(see HUD Interpretive Bulletin A-1-88)*. Expandable room sections, regardless of height, should be included. Storage lofts contained within the basic unit should have ceiling heights less than 5 ft (1.5 m) and would not constitute additional square footage.

A.3.3.35 Interior Finish. Interior finish includes any material (e.g., paint, wallpaper, decorative panels) that is affixed to such surfaces.

A.3.3.38 Pipe. An example of pipe is iron pipe.

A.3.3.39 Piping. Examples of piping include iron pipe and copper tubing.

A.3.3.43 Pressure Relief Valve. The term *pressure relief valve* also includes the following:

(1) External Pressure Relief Valve. A pressure relief valve that is used on older domestic containers, on pressure relief valve manifolds, and for piping protection where all the working parts are located entirely outside the container or piping. **[58,** 2004**]**
(2) Flush-Type Full Internal Pressure Relief Valve. An internal pressure relief valve in which the wrenching section is also within the container connection, not including a small portion due to pipe thread tolerances on makeup. **[58,** 2004**]**
(3) Full Internal Pressure Relief Valve. A pressure relief valve for engine fuel and mobile container use in which all working parts are recessed within the container connection and the spring and guiding mechanism are not exposed to the atmosphere. **[58,** 2004**]**
(4) Internal Spring-Type Pressure Relief Valve. The exposed parts of the pressure relief valve have a low profile.

A.3.3.50 Recreational Vehicle (RV). The term *recreational vehicle* also includes the following:

(1) Motor Home. A vehicular unit designed to provide temporary living quarters for recreational, camping, or travel use, built on or attached to a self-propelled motor vehicle chassis or on a chassis cab or van that is an integral part of the completed vehicle.
(2) Camping Trailer. A vehicular unit that is mounted on wheels and constructed with collapsible partial sidewalls that fold for towing by another vehicle and unfold at the campsite to provide temporary living quarters for recreational, camping, or travel use.
(3) 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 ft^2 (37.2 m^2) 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.
(4) Travel 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 permits when towed by a motorized vehicle, and of gross trailer area less than 320 ft^2 (29.7 m^2).
(5) 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.

A.3.3.51 Slope. In drainage, it is usually expressed as the fall in a fraction of an inch (or millimeter) or percentage slope per foot (or meter) length of pipe.

A.3.3.52.2 Flexible Drain System. A liquid waste drainage system (including the trap, strainer, hose, and connectors) with a minimum free waterway of ⅝ in. (15.9 mm) inside diameter (or equivalent passage) used where authorized under 7.4.7.

A.3.3.58 Tubing. An example of tubing is copper tubing.

A.3.3.61 Vapor Resistant. Examples of *vapor resistant* include construction where penetrations, seams, or joints are caulked, sealed, filled, or equivalent.

A.5.2.12 This provision is not to be construed as requiring an automatic changeover device.

A.5.2.19 This section should 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 propane discharge outlet(s).

A.5.7.6.2 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.

A.5.7.10 For this test the register or grille 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.

A.5.7.10.2 This subsection shall not apply to ducted rooftop air-conditioning systems with heat strips or heat pumps where the system does not exceed 175°F (80°C) when tested in accordance with UL 484.

A.6.2.1 See Figure A.6.2.1.

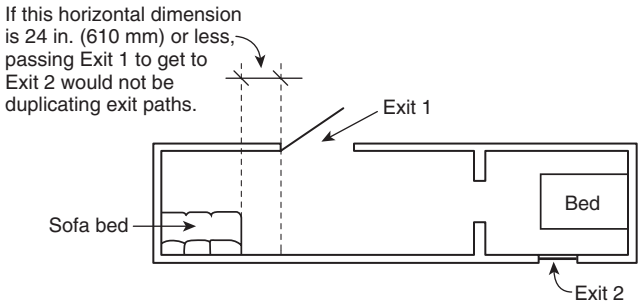

FIGURE A.6.2.1 Bed Within 24 in. (610 mm) of the Plane of the Nearest Designated Exit.

A.6.2.5 Figure A.6.2.5 is useful in explaining the method of measuring the alternate exit in 6.2.5.

A.6.3.2 Because some smoke alarms are activated by the gases released when cooking food and can result in an unwanted alarm, the smoke alarm manufacturer should be consulted regarding the alarm's suitability for operation in close proximity to cooking processes.

A.7.1.6.3 Such as power supply assemblies.

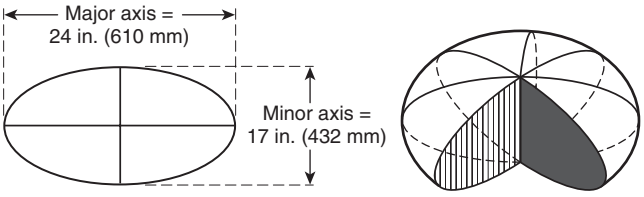

FIGURE A.6.2.5 Ellipsoid of Revolution about a Minor Axis.

A.7.3.7.5 To assure complete disinfection of the potable water system, it is recommended that the following procedures be followed on a new system, one that has not been used for a period of time, or one that could have become contaminated. This procedure is also recommended before long periods of storage such as over winter.

(1) Prepare a chlorine solution using 1 gallon of water and ¼ cup of household bleach (sodium hypochlorite solution). With tank empty, pour chlorine solution into the tank. Use 1 gallon solution for each 15 gallons of tank capacity. This procedure will result in a residual chlorine concentration of 50 ppm in the water system. If a 100 ppm concentration is required as discussed in A.7.3.7.5(3), use ½ cup of household bleach with 1 gallon of water to prepare the chlorine solution. One gallon of the solution should be used for each 15 gallons of tank capacity.
(2) Complete filling of tank with potable water. Open each faucet and run the water until a distinct odor of chlorine can be detected in the water discharged. Do not forget the hot water taps.
(3) Allow the system to stand for at least 4 hours when disinfecting with 50 ppm residual chlorine. If a shorter time period is desired, then a 100 ppm chlorine concentration should be permitted to stand in the system for at least 1 hour.
(4) Drain and flush with potable water.

Annex B Propane Pipe Sizing

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Example of Propane Pipe Sizing. To determine the required propane supply pipe sizes for each piping section (A–J) of the typical example diagrammed in Figure B.1, assuming a combination propane/natural gas supply system, the steps given in Table B.1 should be taken.

Table B.1 Example of Determining Propane Supply Pipe Sizes

Figure Sizing by	Front Propane Supply Connection							Rear Propane Supply Connection						
Step 1. Measure the length of the piping from the propane supply connection to the inlet of the most remote appliance. *Step 2.* In the appropriate Table 5.3.4.2(a) through (d), select the column showing that distance or the next longer distance if the table does not give the exact length. In this example use Table 5.3.4.2(a) since it presumes using a combination propane/natural gas piping system using iron pipe. *Step 3.* Use the vertical column in Table 5.3.4.2(a) selected in Step 2 for all propane pipe sizing. For each section of piping, determine the total demand for that section. In the vertical column selected in Step 2, locate the Btu/hr demand equal to or just greater than the demand for that section of pipe. *Step 4.* Choose the larger size piping required from either the front or rear propane supply connection. If a single propane supply connection is provided, this step is not required.	28 ft (8.5 m) (A + J + C + E + G) [Total: 82,000 Btu/hr (24,026 W)] 30 ft (9.2 m) column [which for 82,000 Btu/hr (24,026 W) means ½ in. (13 mm) iron pipe or ¾ in. (19 mm) tubing] 30 ft (9.2 m) column front connection							19 ft (5.8 m) (F + E + C + H) [Total: 82,000 Btu/hr (24,026 W)] 20 ft (6.1 m) column [which for 82,000 Btu/hr (24,026 W) means ½ in. (13 mm) iron pipe or ¾ in. (19 mm) tubing] 20 ft (6.1 m) column rear connection						
				Nominal I.D. Pipe		Tubing O.D.					Nominal I.D. Pipe		Tubing O.D.	
	Piping Section	Btu/hr Demand (1000s)	W Demand	in.	mm	in.	mm	Piping Section	Btu/hr Demand (1000s)	W Demand	in.	mm	in.	mm
	A	82	24,026	½	13	¾	19	A	—	—	—	—	—	—
	B	30	8,790	⅜	10	½	13	B	30	8,790	⅜	10	½	13
	C	50	14,650	⅜	10	⅝	16	C	32	9,376	⅜	10	½	13
	D	15	4,395	¼	6	⅜	10	D	15	4,395	¼	6	⅜	10
	E	35	10,255	⅜	10	⅝	16	E	47	13,771	⅜	10	⅝	16
	F	—	—	—	—	—	—	F	82	24,026	½	13	¾	19
	G	35	10,255	⅜	10	⅝	16	G	35	10,255	⅜	10	½	13
	H	2	586	¼	6	⅜	10	H	2	586	¼	6	⅜	10
	J	52	15,236	⅜	10	⅝	16	J	30	8,790	⅜	10	½	13

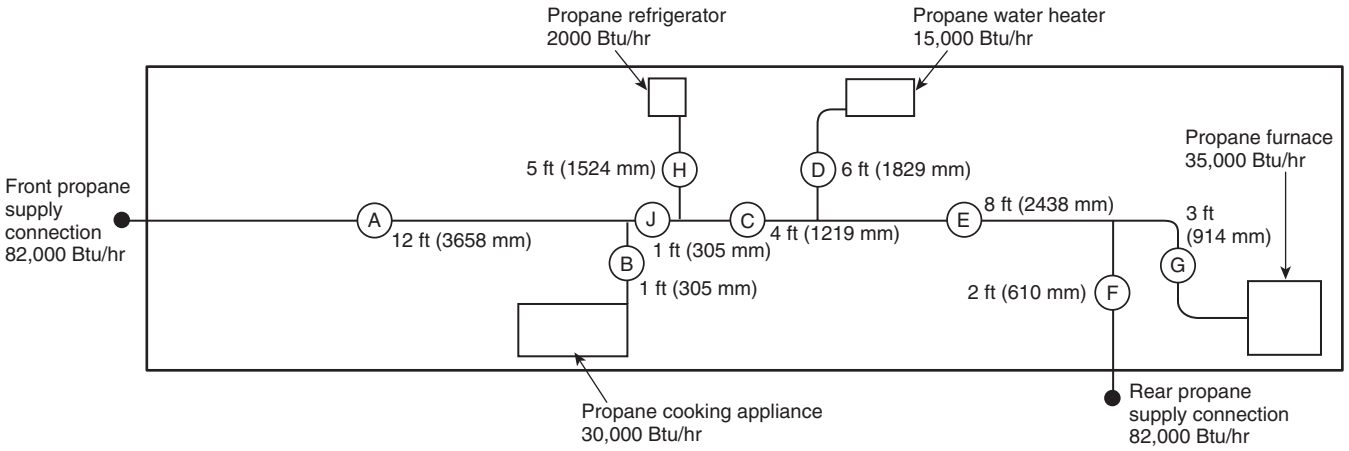

FIGURE B.1 Typical Example of Propane Pipe System Sizing for a Recreational Vehicle.

Annex C Informational References

C.1 Referenced Publications. The following documents or portions thereof are referenced within this standard for informational purposes only and are thus not part of the requirements of this document unless also listed in Chapter 2.

C.1.1 NFPA Publication. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 97, *Standard Glossary of Terms Relating to Chimneys, Vents, and Heat-Producing Appliances*, 2003 edition.

C.1.2 Other Publications.

C.1.2.1 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI A119.5, *Standard for Park Trailers*, 1998.

ANSI SI 10, *Standard for Use of the International System of Units (SI): The Modern Metric System,* 1997.

ANSI/IAPMO Z124.4, *Plastic Water Closet Bowls and Tanks*, 1996.

ANSI/ASME A112.19.2, *Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals*, 2003.

C.1.2.2 ASME Publication. American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

ASME *Boiler and Pressure Vessel Code*, Section VIII, Division I, Rules for Construction of Unfired Pressure Vessels, 2004.

C.1.2.3 UL Publication. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 484, *Standard for Room Air Conditioners*, 2002.

C.1.2.4 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

HUD Interpretive Bulletin A-1-88.

Title 49, Code of Federal Regulations, U.S. Department of Transportation, *Specifications for LP-Gas Containers.*

C.1.2.5 Other Publication. *Merriam-Webster's Collegiate Dictionary*, 11th edition, Merriam Webster, Inc., Springfield, MA, 2003.

C.2 Informational References. The following documents or portions thereof are listed here as informational resources only. They are not a part of the requirements of this document.

C.2.1 UL Publication. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 2034, *Standard for Safety Single and Multiple Station Carbon Monoxide Detectors*, 1996.

C.3 References for Extracts. The following documents are listed here to provide reference information, including title and edition, for extracts given throughout the nonmandatory sections of this standard as indicated by a reference in brackets [ ] following a section or paragraph. These documents are not a part of the requirements of this document unless also listed in Chapter 2 for other reasons.

NFPA 54, *National Fuel Gas Code*, 2002 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2004 edition.

NFPA 79, *Electrical Standard for Industrial Machinery*, 2002 edition.

NFPA 211, *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances*, 2003 edition.

NFPA 1194, *Standard for Recreational Vehicle Parks and Campgrounds*, 2005 edition.

Annex D Cross-Reference Table for 2002–2005 Editions

D.1 Due to the extensive revisions to the 2005 edition of the standard, Table D.1 has been developed to assist the user in finding specific requirements by providing cross-references to the paragraph numbers in the 2002 edition.

Table D.1 NFPA 1192 2002/2005 Cross Reference

Table D.1

2005	2002
1.1	1.1
1.2	1.2
1.3	1.3
1.4	1.4
1.5	1.5
1.6	1.6
2.1	2.1
2.2	2.2
2.3	2.3
3.1	3.1
3.2	3.2
3.3	3.3
4.1	4.1
4.2	4.2
4.3	4.3
4.3.1	4.3.1
4.3.2	4.3.2
4.3.3	4.3.3
4.4	4.4
5.1	5.1
5.2	5.2
5.2.1	5.2.1
(1)	(1)
(2)	(2)
5.2.2	5.2.2
5.2.2.1	5.2.2
5.2.2.2	5.2.2
5.2.3	5.2.3
5.2.3.1	5.2.3(1)
5.2.3.2	Exception
5.2.3.3	5.2.3(2)
(1)	5.2.3(2)(a)
(2)	5.2.3(2)(b)
(3)	5.2.3(2)(c)
(a)	5.2.3(2)(c)
(b)	5.2.3(2)(c)
(c)	5.2.3(2)(c)
(4)	5.2.3(2)(d)
(a)	5.2.3(2)(d)
(b)	5.2.3(2)(d)
5.2.3.4 New	
5.2.4	5.2.4
5.2.4.1	5.2.4
5.2.4.2	5.2.4
5.2.5	5.2.5
5.2.6	5.2.6
5.2.6.1	5.2.6.1
5.2.6.2	5.2.6.1
5.2.6.3	5.2.6.1
5.2.6.4	5.2.6.1
5.2.6.5	5.2.6.1
5.2.6.6	5.2.6.1
5.2.7	5.2.6.2
5.2.7.1	5.2.6.2
5.2.7.2	5.2.6.2
5.2.8	5.2.6.3
5.2.9	5.2.6.4
5.2.10	5.2.7
5.2.10.1	5.2.7.1

Table D.1 *Continued*

2005	2002
5.2.10.2	5.2.7.2
5.2.11	5.2.7.2 Exception
5.2.11.1	5.2.7.2 Exception
5.2.11.2	5.2.7.2 Exception
5.2.11.3	5.2.7.2 Exception
5.2.12	5.2.7.3
5.2.13	5.2.7.4
5.2.13.1	5.2.7.4
5.2.13.2	5.2.7.4
5.2.14	5.2.7.5
5.2.14.1	5.2.7.5
5.2.14.2	5.2.7.5
5.2.15	5.2.7.6
5.2.15.1	5.2.7.6
5.2.15.2	5.2.7.6
5.2.15.3	5.2.7.6
5.2.15.4	5.2.7.6
5.2.15.5	5.2.7.6
5.2.15.6	5.2.7.6
5.2.15.7	5.2.7.6
5.2.15.8	5.2.7.6
5.2.15.9	5.2.7.6
5.2.16	5.2.7.7
5.2.16.1	5.2.7.7
(A)	5.2.7.7(1)
(B)	5.2.7.7(1)
5.2.16.2	5.2.7.7(2)
5.2.16.3 New	
5.2.16.4	5.2.7.7(2)
(1)	5.2.7.7(2)(a)
(2)	5.2.7.7(2)(b)
(3)	5.2.7.7(2)(c)
5.2.17	5.2.8
5.2.17.1	5.2.8.1
5.2.17.2	5.2.8.1
5.2.17.3	5.2.8.1
5.2.18	5.2.8.2
5.2.18.1 New	
5.2.18.2	5.2.8.2
(1)	5.2.8.2(1)
(2)	5.2.8.2(2)
5.2.19	5.2.8.3
5.2.19.1	5.2.8.3 5.2.8.3(1)
(1)	(a)
(2)	(b)
(3)	(c)
5.2.19.2	5.2.8.3(1)Exception
5.2.19.3	5.2.8.3(2)
(A)	(a)
(B)	(b)
(C)	(c)
(D)	(d)
(E)	(e)

Table D.1 *Continued*

2005	2002
(F)	(f)
(G)	(g)
(H)	(h)
(I)	(i)
(J)	(j)
(K)	(k)
(L)	(l)
(M)	(m)
(N)	(n)
5.2.20	5.2.9.1
5.2.20.1	5.2.9.1
5.2.20.2	5.2.9.1 Exception
5.2.21	5.2.9.2
5.2.21.1	5.2.9.2
5.2.21.2	5.2.9.2 Exception
(1)	(1)
(2)	(2)
(3)	(3)
(a)	(a)
(b)	(b)
(c)	(c)
5.2.21.3	(4)
5.2.21.4	(5)
5.2.21.5	(6)
5.2.22	5.2.9.3
5.2.22.1	5.2.9.3
5.2.22.2	5.2.9.3
5.2.22.3	5.2.9.3
5.2.22.4	5.2.9.3
5.2.22.5	5.2.9.3
5.3	5.4
5.3.1	5.4.1
5.3.1.1	5.4.1
5.3.1.2	5.4.1
5.3.1.3	5.4.1
5.3.2	5.4.2
5.3.2.1	5.4.2
5.3.2.2	5.4.2
5.3.2.3	5.4.2
5.3.2.4	5.4.2
5.3.2.5	5.4.2
(1)	(1)
(2) New	
(3) New	
(4)	(1)
(5)	(2)
(6)	(2)
(7)	(3)
(8)	(3)
(9)	(4)
(10)	(5)
(11)	(6)
5.3.3	5.4.3
5.3.4	5.4.4
5.3.4.1	5.4.4
5.3.4.2	5.4.4
5.3.4.3	5.4.4
5.3.5	5.4.5
5.3.5.1	5.4.5

Table D.1 *Continued*

2005	2002
5.3.5.2	5.4.5
5.3.5.3	5.4.5
5.3.5.4	5.4.5
5.3.6	5.4.6
5.3.6.1	5.4.6
5.3.6.2	5.4.6
5.3.6.3	5.4.6
5.3.6.4	5.4.6
5.3.7	5.4.7
5.3.7.1	5.4.7
5.3.7.2	5.4.7
5.3.8	5.4.8
5.3.8.1	5.4.8
5.3.8.2	5.4.8
5.3.8.3	5.4.8
5.3.9	5.4.9
5.3.9.1	5.4.9
5.3.9.2	5.4.9
5.3.9.3	5.4.9
5.3.9.4	5.4.9
5.3.10	5.4.10
5.3.10.1	5.4.10
5.3.10.2	5.4.10
5.3.10.3	5.4.10
5.3.11 New	
5.3.11.1 New	
5.3.11.2 New	
5.3.12	5.4.11
5.3.12.1	5.4.11.1
5.3.12.2	5.4.11.2
5.3.12.3	5.4.11.3
(A)	(1)
(B)	(2)
(C)	(3)
(D)	(4)
(E) New	
5.3.12.4	5.4.11.4
(A)	(1)
(B)	(2)
(C) New	
5.3.13	5.4.12
5.3.13.1	5.4.12
5.3.13.2 New	
5.3.14	5.4.13
5.3.14.1	5.4.13
5.3.14.2	5.4.13
5.3.14.3 New	
5.3.15	5.4.14
5.3.16	5.4.15
5.3.16.1	5.4.15.1
5.3.16.2	5.4.15.1
5.3.16.3	5.4.15.2
5.3.17	5.4.16
5.3.18	5.4.17
5.3.18.1	5.4.17
5.3.18.2	5.4.17
5.3.18.3	5.4.17
5.3.19	5.4.18
5.3.19.1	5.4.18.1
5.3.19.2	5.4.18.1
5.3.19.3	5.4.18.1