

ANSI A119.2 NFPA 1192

Standard on Recreational Vehicles

2002 Edition



NFPA, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

NFPA License Agreement

This document is copyrighted by the National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02269-9101 USA.
All rights reserved.

NFPA grants you a license as follows: The right to download an electronic file of this NFPA document for temporary storage on one computer for purposes of viewing and/or printing one copy of the NFPA document for individual use. Neither the electronic file nor the hard copy print may be reproduced in any way. In addition, the electronic file may not be distributed elsewhere over computer networks or otherwise. The hard copy print may only be used personally or distributed to other employees for their internal use within your organization.

Copyright ©
National Fire Protection Association, Inc.
One Batterymarch Park
Quincy, Massachusetts 02269

IMPORTANT NOTICE ABOUT THIS DOCUMENT

NFPA codes, standards, recommended practices, and guides, of which the document contained herein is one, are developed through a consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on fire and other safety issues. While the NFPA administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in its codes and standards.

The NFPA disclaims liability for any personal injury, property or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this document. The NFPA also makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

In issuing and making this document available, the NFPA is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the NFPA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The NFPA has no power, nor does it undertake, to police or enforce compliance with the contents of this document. Nor does the NFPA list, certify, test or inspect products, designs, or installations for compliance with this document. Any certification or other statement of compliance with the requirements of this document shall not be attributable to the NFPA and is solely the responsibility of the certifier or maker of the statement.

NOTICES

All questions or other communications relating to this document and all requests for information on NFPA procedures governing its codes and standards development process, including information on the procedures for requesting Formal Interpretations, for proposing Tentative Interim Amendments, and for proposing revisions to NFPA documents during regular revision cycles, should be sent to NFPA headquarters, addressed to the attention of the Secretary, Standards Council, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

Users of this document should be aware that this document may be amended from time to time through the issuance of Tentative Interim Amendments, and that an official NFPA document at any point in time consists of the current edition of the document together with any Tentative Interim Amendments then in effect. In order to determine whether this document is the current edition and whether it has been amended through the issuance of Tentative Interim Amendments, consult appropriate NFPA publications such as the *National Fire Codes*[®] Subscription Service, visit the NFPA website at www.nfpa.org, or contact the NFPA at the address listed above.

A statement, written or oral, that is not processed in accordance with Section 5 of the Regulations Governing Committee Projects shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

The NFPA does not take any position with respect to the validity of any patent rights asserted in connection with any items which are mentioned in or are the subject of this document, and the NFPA disclaims liability for the infringement of any patent resulting from the use of or reliance on this document. Users of this document are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Users of this document should consult applicable federal, state, and local laws and regulations. NFPA does not, by the publication of this document, intend to urge action that is not in compliance with applicable laws, and this document may not be construed as doing so.

Licensing Policy

This document is copyrighted by the National Fire Protection Association (NFPA). By making this document available for use and adoption by public authorities and others, the NFPA does not waive any rights in copyright to this document.

1. Adoption by Reference—Public authorities and others are urged to reference this document in laws, ordinances, regulations, administrative orders, or similar instruments. Any deletions, additions, and changes desired by the adopting authority must be noted separately. Those using this method are requested to notify the NFPA (Attention: Secretary, Standards Council) in writing of such use. The term "adoption by reference" means the citing of title and publishing information only.

2. Adoption by Transcription—**A.** Public authorities with lawmaking or rule-making powers only, upon written notice to the NFPA (Attention: Secretary, Standards Council), will be granted a royalty-free license to print and republish this document in whole or in part, with changes and additions, if any, noted separately, in laws, ordinances, regulations, administrative orders, or similar instruments having the force of law, provided that: (1) due notice of NFPA's copyright is contained in each law and in each copy thereof; and (2) that such printing and republication is limited to numbers sufficient to satisfy the jurisdiction's lawmaking or rule-making process. **B.** Once this NFPA Code or Standard has been adopted into law, all printings of this document by public authorities with lawmaking or rule-making powers or any other persons desiring to reproduce this document or its contents as adopted by the jurisdiction in whole or in part, in any form, upon written request to NFPA (Attention: Secretary, Standards Council), will be granted a nonexclusive license to print, republish, and vend this document in whole or in part, with changes and additions, if any, noted separately, provided that due notice of NFPA's copyright is contained in each copy. Such license shall be granted only upon agreement to pay NFPA a royalty. This royalty is required to provide funds for the research and development necessary to continue the work of NFPA and its volunteers in continually updating and revising NFPA standards. Under certain circumstances, public authorities with lawmaking or rule-making powers may apply for and may receive a special royalty where the public interest will be served thereby.

3. Scope of License Grant—The terms and conditions set forth above do not extend to the index of this document.

(For further explanation, see the Policy Concerning the Adoption, Printing, and Publication of NFPA Documents, which is available upon request from the NFPA.)

Chapter 7 Copyright © 2002, RVIA, All Rights Reserved
 Chapters 1, 2, 3, 4, 5, 6, Annexes A and B Copyright © 2002, National Fire Protection
 Association, All Rights Reserved

ANSI A119.2/NFPA 1192

Standard on

Recreational Vehicles

2002 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 10–14, 2001, in Dallas, TX. It was issued by the Standards Council on January 11, 2002, with an effective date of January 31, 2002, and supersedes all previous editions.

This edition of NFPA 1192 was approved as an American National Standard on January 31, 2002.

NOTICE

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

The ANSI A119 Accredited Standards Committee was created to establish minimum requirements for the installation of plumbing, fuel burning, electrical, and other safety-related systems in recreational vehicles. This committee recognized the efforts and expertise of the NFPA in the areas of fuel systems, fire and life safety, and electrical. Therefore, in an effort to limit duplication, the ANSI A119 Accredited Standards Committee decided that the NFPA work could be combined with its work on plumbing to formulate this total document. Thus, NFPA developed Chapters 1, 2, 4, 5, and 6, Annex A, and Annex B, and the ANSI A119 Accredited Standards Committee developed Chapter 7. Chapter 3 was a joint effort between the ANSI A119 Accredited Standards Committee and the NFPA Technical Committee on Recreational Vehicles. All chapters were approved by the ANSI A119 Accredited Standards Committee.

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 that approved by NFPA in 1970 and by ANSI in 1971. This replaced ASA Standard A119.2-1963.

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

1970–1977. Previous editions of the *Standard on Recreational Vehicles* were published in 1970 (approved by NFPA May 20, 1970), 1972 (approved by NFPA May 16, 1972, and approved by ANSI on April 19, 1973), 1974 (approved by NFPA May 21, 1974, and approved by ANSI on February 5, 1975), and 1976 (adopted by NFPA November 17, 1976).

The 1977 edition of the standard was developed by the Sectional Committee on Recreational Vehicles, processed through the Correlating Committee on Mobile Homes and Recreational Vehicles, approved by 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 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 consists of a major editorial reorganization of the document in accordance with the NFPA *Manual of Style*, 2000 edition. Other changes occur in the language of caution and warning labels.

Accredited Standards Committee A119 on Recreational Vehicles and Recreational Vehicle Parks and Campgrounds

Thomas R. Arnold, *Chair*
T.R. Arnold & Associates, IN

Mark Luttich, *Vice Chair*
Nebraska Public Service Commission, Housing & Recreational Vehicle Department, NE

Bruce A. Hopkins, *Staff Liaison*
Recreation Vehicle Industry Assn., VA

Larry Anderson, Winnebago Industries, Inc., IA
Larry Budica, Fleetwood Enterprises, Inc., CA
Jeff Christner, Newmar Corporation, IN
Beverly Edwards, Good Sam Club, CO
William R. Garpow, Recreational Park Trailer Industry
Association (RPTIA), GA
John Harvey, State of Washington Dept. of Labor
& Industries, WA
Jerome Hoover, Monaco Coach Corp., IN

James Jaeger, P.E., Jaeger Engineering, WA
Mike Kobel, Int'l Assn. of Plumbing & Mechanical
Officials, CA
Blaine R. Lanning, CSA International, OH
John Pabian, Underwriters Laboratories, Inc., IL
Bruce J. Swiecicki, P.E., National Propane Gas Assn., IL
Monte Taylor, State of Oregon Building Codes Division,
OR

Alternates

Susan Bray, Good Sam Club, CA
Ted Huff, T. R. Arnold & Associates, IN
Suzanne Mark, ARVC, National Assn. of RV Parks &
Campgrounds, VA

Kent Perkins, Recreation Vehicle Industry Assn., VA
James Thiel, Underwriters Laboratories, Inc., IL

ANS Plumbing Task Force

Mark Luttich, *Chair*
Nebraska Public Service Commission, Housing & Recreational Vehicle Department, NE

Bruce A. Hopkins, *Staff Liaison*
Secretary Recreation Vehicle Industry Assn., VA

Jeff Christner, Newmar Corporation, IN
Ray Cole, BPC Manufacturing, IN
James W. Finch, Kampgrounds of America, Inc., MT
John Harvey, State of Washington Dept. of Labor
& Industries, WA
Ralph Herzler, Majara Corp., MI
Jerome Hoover, Monaco Coach Corp., IN

Mike Kobel, Int'l Assn. of Plumbing & Mechanical
Officials, CA
Patrick Lewis, State of Oregon DCBS, OR
Earl Sweet, Thetford Corp., MI
Gary Wight, ARVC, National Association of RV Parks
& Campgrounds, WA
Robert Wozniak, Fleetwood Enterprises, Inc., CA

Alternates

Homer Staves, Kampgrounds of America, Inc., MT

Marianne Wrobel State of Arizona, Office of
Manufactured Housing, AZ

Technical Committee on Recreational Vehicles

Mark Luttich, *Chair*

Nebraska Public Service Commission, NE [E]

Bruce A. Hopkins, *Secretary*

Recreation Vehicle Industry Association, VA [M]

Charles Ballard, Pacific West Associates Inc., WY [SE]

Donald D. Bartz, Winnebago Industries, Inc., IA [M]

James V. Bertoch, Testing Engineer International, Inc., UT [RT]

Joseph M. Bloom, Bloom Fire Investigation, OR [SE]

Jeffrey A. Christner, Newmar Corp., IN [M]

James W. Finch, Kampgrounds of America, Inc., MT [U]

David Gorin, National Association of RV Parks and Campgrounds, VA [U]

John P. Harvey, State of Washington, WA [E]

Ralph E. Herzler, Majara Corp., MI [SE]

Jerome Hoover, Monaco Coach Corp., IN [M]

Jon O. Jacobson, Jacobson Engineers, WA [SE]

Blaine R. Lanning, International Approval Services/CSA, OH [RT]

Samuel E. McTier, McTier Supply Co., IL [IM]

Arthur H. Mittelstaedt, Jr., Recreation Safety Institute Ltd, NY [SE]

Rep. American Alliance for Health, Physical Education, Recreation, and Dance

Robert Ohlund, Thor California, CA [M]

John Pabian, Underwriters Laboratories Inc., IL [RT]

Robert E. Wozniak, Fleetwood Enterprises, Inc., CA [M]

Patrick Yee, Canadian Standards Association, Canada [RT]

Alternates

Allen Aschim, Oregon Building Codes Division, OR [E]

(Vot. Alt. to Oregon Building Codes Division Rep.)

Christopher J. Bloom, CJB Fire Consultants, OR [SE]

(Alt. to J. M. Bloom)

Vincent Guy Fiorucci, Underwriters Laboratories Inc., IL [RT]

(Alt. to J. Pabian)

Suzanne Mark, National Association of RV Parks and Campgrounds, VA [U]

(Alt. to D. Gorin)

James D. Lake, NFPA Staff Liaison

Kent Perkins, Recreation Vehicle Industry Association, VA [M]

(Alt. to B. A. Hopkins)

Homer Staves, Kampgrounds of America, Inc., MT [U]

(Alt. to J. W. Finch)

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

This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

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.

Contents

<p>Chapter 1 General 1192– 6</p> <p>1.1 Scope 1192– 6</p> <p>1.2 Purpose 1192– 6</p> <p>1.3 Application 1192– 6</p> <p>1.4 Retroactivity 1192– 6</p> <p>1.5 Equivalency 1192– 6</p> <p>1.6 Use of International System of Units (SI) 1192– 6</p> <p>Chapter 2 Referenced Publications 1192– 6</p> <p>2.1 General 1192– 6</p> <p>2.2 NFPA Publications 1192– 6</p> <p>2.3 Other Publications 1192– 6</p> <p>Chapter 3 Definitions 1192– 7</p> <p>3.1 General 1192– 7</p> <p>3.2 NFPA Official Definitions 1192– 7</p> <p>3.3 General Definitions 1192– 7</p> <p>3.4 Definitions Applicable to Chapter 7 1192– 9</p> <p>Chapter 4 General Requirements 1192–10</p> <p>4.1 Differing Standards 1192–10</p> <p>4.2 U.S. Federal Regulations 1192–10</p> <p>4.3 Exterior Labels Required by This Standard 1192–10</p> <p>4.4 Electrical Requirements 1192–10</p> <p>Chapter 5 Fuel Systems and Equipment 1192–10</p> <p>5.1 Quality of Design and Installation 1192–10</p> <p>5.2 LP-Gas Systems 1192–10</p> <p>5.3 Fuel Oil Supply for Heat-Producing Appliances 1192–13</p> <p>5.4 Fuel Gas Piping Systems 1192–13</p> <p>5.5 Fuel Oil Piping System 1192–16</p>	<p>5.6 Fuel-Burning Appliances 1192–17</p> <p>5.7 Circulating Air Systems for Heating (Other than Automotive-Type) 1192–19</p> <p>5.8 Air-Conditioning (Other than Automotive-Type) 1192–21</p> <p>5.9 Consumer Information 1192–21</p> <p>5.10 Gasoline or Diesel Fuel Systems 1192–23</p> <p>5.11 LP-Gas Engine Fuel Installations 1192–25</p> <p>Chapter 6 Fire and Life Safety Provisions 1192–25</p> <p>6.1 Interior Finish and Textile or Film Materials 1192–25</p> <p>6.2 Recreational Vehicle Exit Facilities 1192–25</p> <p>6.3 Fire Detection Equipment 1192–26</p> <p>6.4 Other Considerations 1192–26</p> <p>Chapter 7 Plumbing Systems 1192–27</p> <p>7.1 Introduction to Chapter 1192–27</p> <p>7.2 Scope of Chapter 1192–28</p> <p>7.3 Plumbing System, General Requirements 1192–28</p> <p>7.4 Plumbing Fixtures 1192–28</p> <p>7.5 Water Distribution Systems 1192–29</p> <p>7.6 Drainage Systems 1192–31</p> <p>7.7 Vents and Venting 1192–33</p> <p>7.8 Plumbing System Tests 1192–34</p> <p>Annex A Explanatory Material 1192–35</p> <p>Annex B Gas Pipe Sizing 1192–36</p> <p>Annex C Informational References 1192–38</p> <p>Index 1192–39</p>
--	---

ANSI A119.2/NFPA 1192

Standard on Recreational Vehicles

2002 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, Annex C lists the complete title and edition of the source documents for both mandatory and nonmandatory extracts. 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 appropriate technical committee.

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

NOTICE: Requirements for plumbing are developed by the ANSI A119 Committee, of which the Recreation Vehicle Industry Association is Secretariat. The fire safety requirements are developed by NFPA and are also published and distributed separately as NFPA 1192.

Chapter 1 General

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 a reasonable level of 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 is applicable to new recreational vehicles manufactured on or after September 1, 2002; however, nothing shall prevent the use of the standard prior to September 1, 2002, if the purchaser and the manufacturer agree.

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

Chapter 2 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, P.O. Box 9101, Quincy, MA 02269-9101.

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

NFPA 58, *Liquefied Petroleum Gas Code*, 2001 edition.

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

NFPA 70, *National Electrical Code*®, 2002 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., 11 West 42nd Street, 13th floor, New York, NY 10036.

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

ANSI/ASTM A53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*, 2001.

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

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 Pressure Vessels, 1998.

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*, 1998.

ASTM A 539, *Standard Specifications for Electric-Resistance Welded Coiled Steel Tubing for Gas and Fuel Oil Lines*, 1996.

ASTM B 88, *Standard Specifications for Seamless Copper Water Tube*, 1996.

ASTM B 280, *Specifications for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service*, 1998.

ASTM E 162, *Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source*, 1998.

2.3.4 CGA Publication. Compressed Gas Association, 1725 Jefferson Davis Highway, Arlington, VA 22202-4100.

CGA V-1, *Compressed Gas Cylinder Valve Outlet and Inlet Connections*, 1994.

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, 1996.

SAE J1508, *Hose Clamp Specifications*, 1997.

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

UL 94, *Standard for Safety Test for Flammability of Plastic Materials for Parts in Devices and Appliances*, 1996.

UL 144, *Standard for LP-Gas Regulators*, 1997.

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

UL 217, *Standard for Single and Multiple Station Smoke Alarms*, 1997.

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

UL 484, *Standard for Room Air Conditioners*, 1993.

UL 569, *Standard for Pigtailed and Flexible Hose Connectors for LP-Gas*, 1995.

UL 842, *Standard for Valves for Flammable Liquids*, 1997.

UL 1484, *Standard for Residential Gas Detectors*, 1994.

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

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

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 included, common usage of the terms shall apply.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). The organization, office, or individual responsible 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.

3.3.2 Appliance.

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

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

3.3.3* 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.

3.3.4 Compartment. A space completely enclosed by walls and a ceiling. The compartment enclosure is permitted to have openings to an adjoining space if the openings have a minimum lintel depth of 8 in. (203 mm) from the ceiling. [13:1.4]

3.3.5 Container. A receptacle used for storing or transporting materials of any kind. Containers include, but are not limited to, the following: (a) bags (b) barrels (c) cans (d) cartons (e) cylinders (f) drums (g) tanks.

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

3.3.7 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.

3.3.8 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.

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

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

3.3.11 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.

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

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

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

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

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

3.3.17* Interior Finish. Exposed interior surfaces of buildings, excluding movable items that can be removed when occupants change. Interior finish includes interior wall and ceiling finish and interior floor finish. With respect to interior wall and ceiling finish, this means the exposed interior surfaces of buildings including, but not limited to, fixed or movable walls and partitions, columns, and ceilings. With respect to interior floor finish, this means the exposed floor surfaces of buildings including coverings that might be applied over a normal finished floor or stairs, including risers. Furnishings, which in some cases might be secured in place for functional reasons, should not be considered as interior finish. [555:1.7]

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

3.3.19 Motor Home. A vehicular unit designed to provide temporary living quarters for recreational, camping, or travel use, built on or permanently attached to a self-propelled motor vehicle chassis or on a chassis cab or van that is an integral part of the completed vehicle. (See 3.3.25.)

3.3.20 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.

3.3.21* Pipe. Rigid conduit of iron, steel, copper, brass, aluminum, or plastic. [54:1.7]

3.3.22* Piping. The tubing or conduit of the system. There are three general classes of piping, as follows.

3.3.22.1 Branch (Lateral) Lines. Those sections or portions of the piping system that serve a room or group of rooms on the same story of the facility. [99:3.3]

3.3.22.2 Main Lines. Those parts of the system that connect the source (pumps, receivers, etc.) to the risers or branches, or both.

3.3.22.3 Risers. The vertical pipes connecting the system main line(s) with the branch lines on the various levels of the facility.

3.3.23 Pressure Relief Valve. A type of pressure relief device designed to both open and close to maintain internal fluid pressure. Pressure relief valves are further characterized as follows.

3.3.23.1 External Pressure Relief Valve. A relief valve that is located entirely outside the container connection except the threaded portion, which is screwed into the container connection, and that has all of its parts exposed to the atmosphere.

3.3.23.2 Flush-Type Full Internal Pressure Relief Valve. A full internal relief valve in which the wrenching section is also within the container connection, except for pipe thread tolerances on makeup.

3.3.23.3 Full Internal Pressure Relief Valve. A relief valve in which all working parts are recessed within the container connections, and the spring and guiding mechanism are not exposed to the atmosphere.

3.3.23.4* Internal Spring-Type Pressure Relief Valve. A relief valve in which only the spring and stem are within the container connection, and the spring and stem are not exposed to the atmosphere.

3.3.23.5 Sump-Type Full Internal Pressure Relief Valve. A relief valve in which all working parts are recessed within the container connection, but the spring and guiding mechanism are exposed to the atmosphere. [58:1.6]

3.3.24 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. [1901:1.7]

3.3.25 Recreational Park Trailer. See ANSI 119.5, *Standard for Park Trailers*.

3.3.26* Recreational Vehicle (RV). A vehicular-type unit primarily designed as temporary living quarters for recreational, camping, travel, or seasonal use that either has its own motive power or is mounted on, or towed by, another vehicle.

3.3.27 Tank. A closed vessel having a liquid capacity in excess of 60 U.S. gal (227 L). [122:1.4]

3.3.28 Trailer.

3.3.28.1 Camping Trailer. A vehicular portable unit mounted on wheels and constructed with collapsible partial side walls that fold for towing by another vehicle and unfold at the campsite to provide temporary living quarters for recreational, camping, or travel use. (See 3.3.26.)

3.3.28.2 Fifth Wheel Trailer. A vehicular unit, mounted on wheels, designed to provide temporary living quarters for recreational, camping, or travel use, of such size or weight as not to require special highway movement permit(s), of gross trailer area not to exceed 400 ft² (37.2 m²) in the set-up mode, and designed to be towed by a motorized vehicle that contains a towing mechanism that is mounted above or forward of the tow vehicle's rear axle. (See 3.3.26.)

3.3.28.3 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 ft² (29.7 m²). (See 3.3.26.)

3.3.29 Truck Camper. A portable unit that is constructed to provide temporary living quarters for recreational, travel, or camping use, consists of a roof, floor, and sides, and is designed to be loaded onto and unloaded from the bed of a pickup truck. (See 3.3.26.)

3.3.30* Tubing. Semirigid conduit of copper, steel, aluminum, or plastic. [54:1.7]

3.4 Definitions Applicable to Chapter 7.

3.4.1 Accessible. As applied to a fixture, connection, appliance, or equipment. Having access thereto, but such access may require the removal of an access panel, door, or similar obstruction.

3.4.2 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.

3.4.3 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.

3.4.4 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.

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

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

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

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

3.4.8 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.

3.4.9 Connection.

3.4.9.1 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.

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

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

3.4.11 Diameter. The nominal inside diameter designated commercially.

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

3.4.12.1 Fixture Drain. The drain from a fixture's trap to the drain outlet or to the junction of that drain with any other drain pipe.

3.4.12.2 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).

3.4.12.3 Continuous Waste. A drain from a maximum of two fixtures connected to a single trap.

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

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

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

3.4.16 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.

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

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

3.4.19 Grade. See definition of Slope.

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

3.4.21 Pipe.

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

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

3.4.22 Pitch (or Grade). See definition of Slope.

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

3.4.24 System.

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

3.4.24.2 Flexible Drain System. A liquid waste drainage system (including the trap, strainer, hose, and connectors) with a minimum free waterway of $\frac{5}{8}$ in. (15.9 mm) inside diameter (or equivalent passage) used where authorized under 7.6.9.

3.4.24.3 Side-Vented Drainage System. A liquid waste drainage system 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 for use where authorized under 7.6.9.

3.4.24.5 Water Distribution System. The potable water piping within or permanently attached to the recreational vehicle.

3.4.25 Tank.

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

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

3.4.26 Toilet.

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

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

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

3.4.27 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.

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

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

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

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

3.4.31 Valve.

3.4.31.1 Check Valve. A mechanical valve that permits the flow of liquid in only one direction.

3.4.31.2 Fullway Termination Valve. A valve that when fully opened has a nonfouling passageway not less than the inside diameter of connected piping.

3.4.32 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.

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

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

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

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

3.4.32.5 Primary Vent. The main vent of the vent system which is open to the outside atmosphere.

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

3.4.32.7 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.

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

3.4.33 Waste.

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

3.4.33.2 Liquid Waste. The discharge from any fixture, appliance, area, or appurtenance that does not contain body 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 Required by This Standard.

4.3.1 Exterior labels required by Chapters 5 and 6 shall be made of etched, metal-stamped, or embossed brass, stainless steel, plastic laminates 0.005-in. (0.13-mm) minimum, or anodized or clad 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 adequate 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, *National Electrical Code*[®]. All low voltage electrical installations, systems, and equipment shall comply with ANSI/RVIA 12V, "Low Voltage Systems in Conversion and Recreational Vehicles."

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 LP-Gas Systems.

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

- (1) One but not more than three nonpermanently mounted cylinders having individual water capacities of 105 lb (47.6 kg) maximum [approximately 45 lb (20.4 kg) LP-Gas capacity]
- (2) One or more permanently mounted tanks having a maximum aggregate water capacity of 200 gal (757 L) [approximately 672 lb (323 kg) LP-Gas capacity]

5.2.2 Construction of LP-Gas Containers. Cylinders shall be constructed and marked in accordance with the specifications for LP-Gas cylinders of the U.S. Department of Transportation (DOT). Tanks utilizing vapor withdrawal shall be constructed and marked in accordance with the Rules for Construction of Pressure Vessels, Section VIII, Division I, *ASME Boiler and Pressure Vessel Code*, and shall have a design pressure of at least 312.5 psi (2155 kPa).

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

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

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

- (2) LP-Gas containers with their control valves shall be installed in compliance with one of the following:
- In a recess or compartment other than on the roof that is vaportight to the inside of the recreational vehicle.
 - 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.
 - Tanks mounted on the chassis or to the floor of a motor home or chassis-mount camper, provided neither the tank or its support is located in front of the front axle. Tanks mounted between the front and rear axles shall be installed with as much road clearance as practical but not lower than the front axle height. Tanks mounted behind the rear axle of a motor home or chassis-mount camper shall be installed in such a manner that the bottom of the tank and any connection thereto shall not be lower than either the rear axle height (excluding the differential) or any section of the frame immediately to the rear of the tank, whichever is higher. All clearances shall be determined from the bottom of the tank or from the lowest fitting, support, or attachment on the tank or tank housing, whichever is lower when all axles are loaded to their gross axle weight rating.
 - Tanks mounted to the chassis or to the floor of a travel trailer or fifth wheel trailer. 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. 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.

5.2.4 Securing of LP-Gas Containers. Containers shall be secured in place so they will not become dislodged when a load equal to eight times the container's filled weight is applied to the filled container's center of gravity in any direction. 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 LP-Gas Containers. LP-Gas 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 LP-Gas Container Enclosures.

5.2.6.1 Ventilation of Compartments Containing LP-Gas Containers. Compartments shall be ventilated at or near the top and at the extreme bottom to facilitate diffusion of vapors. The compartment shall be ventilated with at least two vents having an aggregate free area equal to at least 1 in.² for each 7 lb (1 cm² per 500 grams) of the total LP-Gas fuel capacity of the maximum number of largest cylinder(s) the compartment can hold. The vents shall be equally distributed between the floor and ceiling of the compartment. If the lower vent is located in the access door or wall, the bottom edge of the vent shall be flush

with the floor level of the compartment. The top vent shall be located in the access door or wall with the bottom of the vent within 12 in. (305 mm) of the ceiling of the compartment. Vents shall have an unrestricted discharge to the outside atmosphere. Doors or panels providing access to valves shall not be equipped with locks or require special tools to open.

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

5.2.6.3 Fastenings for LP-Gas 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.

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

5.2.7 LP-Gas Container Valves and Appurtenances.

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

5.2.7.2 Location of Tank Appurtenances. The manual control of the tank's shutoff valve, the LP-Gas fill connection, and the liquid level outage valve of permanently installed tanks shall be located not more than 18 in. (457 mm) from the vehicle's outside wall. The LP-Gas fill connection and its liquid level outage valve shall be located in accordance with like requirements for LP-Gas pressure relief valves (*see 5.2.8.3*).

*Exception: Vehicles shall be permitted to be equipped with a remotely controlled normally closed electronic shutoff valve installed within 9 in. (228 mm) of the outlet of the tank's shutoff valve using piping or tubing. A double backflow check valve shall be installed in the fill opening of the tank. The remote fill connection, liquid level outage valve, and electronic shutoff valve control shall be located within 18 in. (457 mm) of the vehicle outside wall and shall be located in accordance with like requirements for LP-Gas pressure relief valves (*see 5.2.8.3*).*

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

5.2.7.4 Overfilling Prevention Devices. Tanks shall be equipped with a listed overfilling prevention device. Cylinders with a 4-lb through 40-lb propane capacity shall be equipped with a listed overfilling prevention device and a CGA 791 (Type 1, 1⁵/₁₆ in. Acme) outlet as described in Compressed Gas Association (CGA) V-1, *Compressed Gas Cylinder Valve Outlet and Inlet Connections*.

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

5.2.7.6 LP-Gas Regulators. A listed two-stage regulator system or an integral two-stage regulator shall be required for vapor withdrawal systems. The regulator(s) shall have a capacity that is not less than the total input of all LP-Gas appliances installed in the recreational vehicle. The regulator(s) shall be installed with the pressure relief vent opening pointing downward within 45 degrees of vertical to vertical to allow for drainage of any moisture collected on the diaphragm of the regulator. Regulator(s) installed below floor level shall be installed in a compartment that provides protection against the weather and wheel spray. The compartment shall be of sufficient size to permit tool operation for connection to and replacement of the regulator(s), shall be vaportight to the interior of the vehicle, shall have a 1 in.² (6.5 cm²) minimum vent opening to the exterior located within 1 in. (25 mm) of the bottom of the compartment, and shall not contain flame- or spark-producing equipment. The regulator vent outlet shall be at least 2 in. (51 mm) above the compartment vent opening. Regulators installed elsewhere and not installed in compartments as specified above shall be equipped with a durable cover [that will not become brittle at temperatures as low as -40°F (-40°C)] designed to protect the regulator vent opening from sleet, snow, freezing rain, ice, mud, and wheel spray. If the regulator is not mounted by the recreational vehicle manufacturer, instructions for installation shall be supplied.

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

- (1) Permanently mounted tanks shall require a manual shutoff valve equipped with a listed internal excess flow valve that is designed to close automatically at the rated closing flow of vapor or liquid specified by the manufacturer. The internal excess flow valve shall be designed with a bypass not to exceed a number 60 drill size opening to allow equalization of pressure.
- (2) Cylinders shall require a manual shutoff valve for vapor service that will not allow gas to flow until a positive seal is achieved between that valve and its mating connection. The mating connection shall be installed in the regulator furnished with the vehicle as follows:
 - (a) The mating connection to the cylinder valve shall be furnished with a thermal element that will activate at a temperature range of 240°F to 300°F (116°C to 149°C) and will positively shut off the flow of gas from the cylinder valve.
 - (b) The mating connection to the cylinder valve shall also incorporate a listed excess flow valve that will close at a flow not greater than 200 ft³/hr at 100 psi (5.66 m³ at 69 kPa) and has a bypass area that will not allow a flow greater than 10 ft³/hr at 100 psi (28 m³ at 69 kPa).
 - (c) The mating connection to the cylinder valve shall be provided with a CGA 791 female connection that will not attach to a CGA 510 female POL connector.

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

5.2.8.1 LP-Gas Container Pressure Relief Valves. Cylinders shall be provided with pressure relief valves as required by the regulations of the U.S. Department of Transportation. Tanks for recreational vehicle use shall be provided with full internal or flush-type full internal pressure relief valves in accordance with 8.2.3 of NFPA 58, *Liquefied Petroleum Gas Code*. Containers

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

5.2.8.2 Regulator Pressure Relief Valves. 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 within the limits specified in UL 144, *Standard for LP-Gas Regulators*. This pressure relief valve shall limit the outlet pressure of the second stage of a two-stage regulator system to 2.0 psi (14 kPa) when the regulator seat disc is removed and the inlet pressure to the regulator is 10.0 psi (69 kPa) or less as specified in UL 144.
- (2) An integral overpressure shutoff device that shuts off the flow of LP-Gas vapor when the outlet pressure of the regulator reaches the overpressure limits specified in UL 144. Such a device shall not open to permit flow of gas until it has been manually reset.

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

- (1) LP-Gas containers shall be so located that the discharge from their pressure relief valves shall be not less than 3 ft (0.9 m) measured horizontally along the surface of the vehicle from any of the following located below the level of such discharge:
 - (a) Openings into the recreational vehicle
 - (b) Fuel-burning appliance intake and exhaust vents
 - (c) All internal combustion engine exhaust terminations

Exception: This section shall not apply to unventilated compartment doors containing either door or body side seals and entry doors not containing screens or openable windows below the level of the LP-Gas discharge outlet(s).
- (2) The LP-Gas tank pressure relief valve discharge system(s) shall be installed as follows:
 - (a) The pressure relief valve discharge shall be directed upward or downward within 45 degrees of vertical so that its discharge shall not directly impinge on the prime mover engine nor be directed into the interior of the vehicle.
 - (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 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 LP-Gas.
 - (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 LP-Gas containers installed on the outside of the vehicle, the breakaway adapter and any attached fittings, without the hose attached, shall deflect the pressure relief valve discharge upward or downward within 45 degrees of vertical and shall meet the other requirements of 5.2.8.3(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 5.2.8.3(2)(b).
 - (n) Where the pressure relief valve outlets on cylinders are located in a compartment vaportight to the vehicle interior, discharge from these valves shall be considered to be located at the compartment vents and shall meet the location requirements of 5.2.8.3(1).
- (3) Where the relief device outlets on cylinders are located in a compartment vaportight to the vehicle interior, discharge from these devices shall be considered to be located at the compartment vents and shall meet the location requirements of 5.2.8.3(1).

5.2.9 LP-Gas System Design and Service Line Pressures.

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

Exception: Liquid withdrawal systems shall be permitted to supply LP-Gas as engine fuel. (See Section 5.11 for engine fuel installations.)

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

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

- (1) *The appliance shall provide for a separate fuel supply system or provide a means to prevent high pressure from entering the recreational vehicle's low-pressure system.*
- (2) *The high-pressure fuel system shall be located entirely on the exterior of the vehicle or in a compartment that is vaportight to the vehicle's interior.*
- (3) *Exterior rated labels shall be permanently attached to the appliance or appliance compartment and at the fuel source in a visible location indicating the following:*
 - (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*

- (4) *The fuel system shall be tested at six times its working pressure prior to its installation and at its working pressure after installation.*
- (5) *A two-stage regulator system shall not be required for the high-pressure system.*
- (6) *The appliance shall be listed for RV use at the specified operating pressure.*

5.2.9.3 Mounting of LP-Gas Containers. Container openings for vapor withdrawal shall be located in the vapor space when the container is in service or shall be provided with a permanent internal withdrawal tube that communicates with the vapor space in or near the highest point in the container when it is mounted in service position with the vehicle on a level surface. Tanks shall have vapor withdrawal located midway between tank ends. Each cylinder shall be permanently and legibly stamped to show the correct mounting position. Stamping shall be ¼ in. (6 mm) minimum letter height. The method of mounting in place shall be such as to minimize the possibility of an incorrect positioning of the cylinder.

5.3 Fuel Oil Supply for Heat-Producing Appliances.

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

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

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

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

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

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

5.4 Fuel Gas Piping Systems.

5.4.1 General. The requirements of this section shall govern the installation of all fuel gas piping attached to any recreational vehicle intended for carrying gas in the vapor state. None of the requirements listed in this section shall apply to the piping supplied as a part of a listed appliance. Liquid withdrawal piping shall comply with the requirements of NFPA 58, *Liquefied Petroleum Gas Code*, Section 2.4 and 3.2.13.

5.4.2 Gas Piping System Materials. Materials used for the installation, extension, alteration, or repair of any gas piping system shall be new and free from defects or internal obstructions. Inferior or defective materials in gas piping or fittings shall be replaced and shall not be repaired. Inferior or defective materials shall be removed and replaced with acceptable material. The system shall be made of materials having a melting point of not less than 1450°F (788°C), except as provided in 5.4.5, 5.4.6, and 5.4.12, or of materials (used in piping or fittings) listed for the specific use intended. Gas piping system materials shall be permitted to consist of one or more of the following materials:

- (1) Gas pipe shall be steel or wrought-iron pipe complying with ASTM A 53, *Specifications for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless*. Threaded copper or brass pipe in iron pipe sizes shall be permitted to be used.
- (2) Fittings for gas piping shall be wrought iron, malleable iron, steel, or brass (containing not more than 75 percent copper). Brass flare nuts shall be stress relieved or of the forged type.
- (3) Copper tubing shall be annealed Type K or L, conforming to ASTM B 88, *Standard Specifications for Seamless Copper Water Tube*, or shall comply with ASTM B 280, *Specifications for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service*. Where used on systems designed for natural gas, copper tubing shall be internally tinned.
- (4) 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).
- (5) Steel tubing shall be constructed in accordance with ASTM A 539, *Standard Specifications for Electric-Resistance Welded Coiled Steel Tubing for Gas and Fuel Oil Lines*, and shall be externally corrosion-protected.

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

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

5.4.4 Gas Pipe Sizing. Gas piping systems shall be sized so that the pressure drop to any appliance inlet connection from the gas supply connection or connections, where all appliances are in operation at maximum capacity, is not more than 0.5 in. water column (0.125 kPa) where used with natural gas if the system is designed for both natural and LP-Gas, or where used with LP-Gas if the system is designed for LP-Gas only. Conformance shall be permitted to be determined on the basis of test, or the gas piping system shall be permitted to be sized in accordance with one of Table 5.4.4(a) through Table 5.4.4(d) or other approved method. 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 gas piping size.)

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

5.4.6 Gas Tubing Joints. Gas tubing joints shall be permitted to be made with a single or double flare of 45 degrees conforming to SAE J533, *Flares for Tubing*, as recommended by the tubing manufacturer, or by means of listed vibration-resistant fittings, or

Table 5.4.4(a) Sizing of Low-Pressure Gas Piping Systems Maximum Capacity of Iron Pipe Sizes in Thousands of Btu per Hour Combination of LP-Gas/Natural Gas System

Nominal Iron Pipe Size (I.D.)		Length of Piping													
		ft		m		ft		m		ft		m		ft	
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 5.4.4(b) Sizing of Low-Pressure Gas Piping Systems Maximum Capacity of Semi-Rigid Tubing in Thousands of Btu per Hour Combination of LP-Gas/Natural Gas System

Tubing Size				Length of Piping															
in.		mm		ft		m		ft		m		ft		m		ft		m	
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 5.4.4(c) Sizing of Low-Pressure Gas Piping Systems Maximum Capacity of Iron Pipe Sizes in Thousands of Btu per Hour LP-Gas System

Nominal Iron Pipe Size (I.D.)		Length of Piping													
		ft	m	ft	m	ft	m	ft	m	ft	m	ft	m		
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 5.4.4(d) Sizing of Low-Pressure Gas Piping Systems Maximum Capacity of Semi-Rigid Tubing in Thousands of Btu per Hour LP-Gas System

Tubing Size				Length of 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

the joints shall be brazed with a material having a melting point exceeding 1000°F (538°C). Brazing alloys shall not contain phosphorus. Sealants shall not be used on tubing joints. Ball sleeve or one-piece internal compression-type tubing fittings shall not be used. (See 5.5.5.)

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

5.4.8 Routing and Protection of Tubing. Tubing shall not be run inside walls, floors, partitions, or roof, except that ¼ in. (6 mm) O.D. tubing shall be permitted to be concealed provided it is enclosed with a metallic covering of thickness equivalent to the thickness of the tubing enclosed. Where tubing passes through walls, floors, partitions, roofs, or similar installations, such tubing shall be protected by the use of weather-resistant grommets that shall fit snugly both the tubing and the hole through which the tubing passes. Tubing shall be routed to be protected from physical damage, sharp edges, and moving parts.

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

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

5.4.11 Gas Supply Connections.

5.4.11.1 Natural Gas Supply Connectors. 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.

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

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

- (1) If the regulator is not directly connected to a permanently mounted container shutoff valve, it shall be connected to the container shutoff valve by a listed high-pressure flexible hose connector or by material conforming to 5.4.2.
- (2) 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.

- (3) The connection between the shutoff valve of a cylinder intended to be removed and mounted on the tongue (A-frame) and a regulator permanently mounted other than as described in 5.4.11.3(2) shall be made with a listed high-pressure flexible hose connector.
- (4) The connection between the shutoff valve of a cylinder intended to be removed and mounted within a compartment shall be made with a listed high-pressure flexible hose connector if the regulator is not directly attached to the shutoff valve.

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

- (1) The connection between a permanently mounted regulator or a regulator directly attached to a permanently mounted container and the gas supply system shall be made with a listed flexible hose connector or with material conforming to 5.4.2.
- (2) The connection between a regulator mounted on a cylinder support bracket or a regulator directly attached to the shutoff valve of a cylinder and the gas supply system shall be made with a listed flexible hose connector.

5.4.12 Flexible Nonmetallic Tubing and Hose Connections.

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

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

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

5.4.15 Gas Inlet Cap.

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

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

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

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

5.4.18 Testing for Gas Leakage.

5.4.18.1 Before Appliances Are Connected. Piping systems shall be proven by test to be leak-free by maintaining an air pressure of at least 6 in. mercury (20.7 kPa) or 3 psi (20.7 kPa) for a period of at least 10 minutes. Before the test is begun, the temperature of the air and of the piping shall be approximately the same, and a uniform temperature shall be maintained throughout the period. Leaks, if observed, shall be located and corrected. Defective material shall be replaced. Products that contain ammonia or chlorine shall not be used for testing. Tests shall be conducted by either of the following methods:

- (1) The source of the air pressure to the piping system shall be shut off. The pressure in the system shall be measured over a period of 10 minutes with a mercury manometer, slope gauge, or equivalent device, calibrated so as to be read in increments of not greater than $\frac{1}{10}$ psi (0.7 kPa). During the 10-minute period a drop in pressure shall not occur.
- (2) A bubble-type leak detector shall be installed between the source of air pressure and the piping system. The bubble detector shall not indicate any air flow for a period of 1 minute.

5.4.18.2 After Appliances Are Connected. When 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 8 in. water column (1.99 kPa) nor more than 14 in. water column (3.5 kPa). 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. Leaks if observed shall be located and corrected. Products containing ammonia or chlorine shall not be used for locating leaks. Defective material shall be replaced. Test shall be permitted to be conducted by any of the following methods:

- (1) 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. When the test gauge is installed downstream of an appliance regulator, before the test is begun, open one valve and lower the pressure to 8 in. \pm 0.5 in. water column (1.99 kPa \pm 0.5 kPa) so that the appliance regulator is in an open condition. The pressure in the system shall be measured over a period of 3 minutes with a manometer or with a pressure-sensing device designed and calibrated to read, record, or indicate a pressure loss due to leakage during the pressure test period. During the 3-minute period, a drop in pressure shall not occur.
- (2) A bubble-type leak detector shall be installed between the source of air pressure and the piping system. The bubble detector shall not indicate any air flow for a period of 1 minute.
- (3) As an alternate test, the appliance connections shall be tested for leakage with either soapy water or bubble solution.

5.5 Fuel Oil Piping System.

5.5.1 General. The requirements of this section shall govern the installation of all fuel oil piping attached to any recreational vehicle. The requirements listed in this section shall not apply to the piping in the appliance(s).

5.5.2 Oil Piping System Materials. All materials used for the installation, extension, alteration, or repair of any oil piping system shall be new and free from defects or internal obstructions. Oil piping system materials shall be made of materials having a melting point of not less than 1450°F (788°C), except as provided in 5.5.4. Oil piping system materials shall be permitted to consist of one or more of the following materials:

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

5.5.3 Oil Piping Sizing. The minimum size of all fuel oil tank piping connecting outside tanks to the appliance shall be not smaller than ¼ in. (6.4 mm) IPS copper tubing or ⅜ in. (9.5 mm) O.D. In those cases where No. 1 fuel is used with a listed automatic pump (fuel lifter), ¼ in. (6.4 mm) O.D. copper tubing shall be permitted to be used if specified by the pump manufacturer.

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

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

- (1) After cutting, tubing ends shall be internally reamed prior to flaring.
- (2) Flares shall be square with the axis of the tubing within one-half degree.
- (3) Flares shall be free from loose scale, burrs, and cracks. Seating surfaces shall be smooth and free from pit marks. (See also 5.5.6.)

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

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

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

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

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

5.6 Fuel-Burning Appliances.

5.6.1 General.

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

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

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

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

5.6.2 Installation of Fuel-Burning Appliances.

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

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

Exception No. 1: A fuel-burning refrigerator shall be permitted to be installed to meet the requirements of 5.6.2.2 using panels supplied by the recreational vehicle manufacturer provided that the refrigerator manufacturer furnishes the necessary vents and grills as specified by the listing requirements and, in addition, the refrigerator is equipped with the necessary means to ensure the integrity of the separation of the combustion system when the refrigerator is removed for field service and reinstalled.

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

- (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 will prevent burner operation under any operating conditions that would 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.

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

5.6.2.4 Auxiliary Heating Devices. Primary mover engine auxiliary devices for heating interior living or storage space or for heating potable water shall not be required to be listed. Heat exchangers used in the potable water system shall be identified by the device manufacturer as being of a double-wall construction. Exhaust termination of engine block heaters with a gasoline- or diesel-fired source other than the primary mover engine shall comply with 6.4.3.

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

5.6.3 Venting, Ventilation, and Combustion Air.

5.6.3.1 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.

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

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

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

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

Exception No. 2: Hooded gravity vents located directly above the appliance shall be permitted to exhaust through the sidewall. (See 5.6.8.3.)

Exception No. 3: Mechanical vents (exhaust fans) having a flow rating of 2 ft³/min (0.19 m³/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.

5.6.4 Marking Appliances (Installation and Operation Features).

5.6.4.1 Clearances, Input Ratings, Lighting, and Shutdown. Information on clearances, input ratings, lighting, and shutdown shall be attached to the appliance and located so that it is readable when the appliance is installed.

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

5.6.5 Accessibility for Service/Operation. Every appliance shall be accessible for inspection, service, repair, and replacement without removing permanent construction or other fuel-burning appliances. 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.

5.6.6 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.

5.6.7 Location of Privacy Curtains. When used, privacy curtains that can be placed or swung closer to a cooktop/range than the clearances specified on the labeled appliance shall be in accordance with the following:

- (1) Installed so that it can be secured outside the defined clearance area(s).
- (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 FIRE OR
SERIOUS INJURY.

5.6.8 Clearances of Heat-Producing Appliances.

5.6.8.1 Maintaining Listed Clearances. Clearances between heat-producing appliances and adjacent surfaces shall be not less than as specified in the terms of their listing. Clearance spaces shall be framed in or guarded to prevent creation of storage space within the clearance specified. The only exception to framing in or guarding such spaces shall be where such spaces will be necessary to allow access to shutoff valves or controls in order to comply with 5.4.9 and 5.6.2.1, in which case the unguarded area shall have a warning tag, posted in a readable location.

5.6.8.2 Warning Labels. 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.

5.6.8.3 Vertical Clearances of Ranges. Ranges shall have a vertical clearance between the cooking top and combustible material or metal cabinets in accordance with Table 5.6.8.3 or the terms of their listings.

Exception: Range covers.

5.6.9 Clothes Dryers.

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

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

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

- (1) A clothes dryer moisture-lint exhaust duct shall not be connected to any other duct, vent, or chimney.
- (2) The exhaust duct shall be of sufficient length so as not to terminate beneath the recreation 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.

5.6.9.3 Prevention of Negative Pressure in Recreation Vehicles. Fuel-burning clothes dryers shall receive their combustion air and drying air from outside the vehicle and shall exhaust the combustion products and drying air from inside the vehicle.

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

- (1) Its gas outlet shall be provided with a shutoff valve, the outlet of which is closed by threaded pipe plug or cap.
- (2) Its gas outlet shall be permanently labeled to identify it for use only as the supply connection for a gas clothes dryer.
- (3) The manufacturer shall provide written instructions to the owner on how to complete the exhaust duct installation in accordance with provisions of 5.6.9.2.

5.6.9.5 Provisions for Future Installation of an Electric Clothes Dryer. When wiring is installed to supply an electric clothes dryer for future installation by the owner, the manufacturer shall install a receptacle for future connection of the dryer and shall provide written instructions on how to complete the exhaust duct installation in accordance with the provisions of 5.6.9.2.

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

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

5.7.1 Supply System Ducts. Air supply ducts shall be made of galvanized steel, tin-plated steel, aluminum steel, or aluminum or made of Class 0 or Class 1 listed air ducts or air connectors as tested in accordance with UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors*. A duct system integral with the structure shall be of durable construction that can be demonstrated to be equally resistant to fire and deterioration. Air ducts and plenums constructed of sheet metal shall be in accordance with Table 5.7.1.

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

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. Provisions shall be made to permit the return of circulating air from all rooms and living spaces to the circulating air supply inlet of the furnace.

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

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. 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

Table 5.6.8.3 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	514
	Two rear burners — input not to exceed 9000 Btu/hr (2638 W) each — and two front burners — input not to exceed 12,000 Btu/hr (3517 W) each	22,000	6448	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

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. The cross-sectional area of the return air duct shall not be less than 2 in.² for each 1000 Btu/hr (44 cm²/1000 W) input rating of the appliance. A complete ducted heating system shall not be required to comply with this return air duct sizing requirement if the numerical total of the static pressure at the inlet and the outlet of the appliance is equal

to or less than that shown on the label of the appliance. For example: (supply duct static pressure) + (0.10 in. water column and return air duct static pressure) – (0.04 in. water column). Numerical total is 0.14 in. water column static pressure. Dampers shall not be placed in any return air duct, except that a diverting damper shall be permitted to be placed in a combination fresh air intake and return air duct so arranged that the required cross-sectional area will not be reduced at all possible positions of the damper.

Table 5.7.1 Minimum Metal Thickness for Ducts

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

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

5.7.7 Return Air Duct Permanent Unclosable Openings.

Living areas not served by return air ducts and closed off from the return opening of the furnace by doors, sliding partitions, or other means shall be provided with permanent unclosable openings in the doors or separating partitions to allow circulated air to return to the furnace. Such openings shall be permitted to be grilled or louvered. The net free area of each opening shall be equal to or greater than the area of the air supply to the closed-off area but not less than 1 in.² (6.5 cm²) for every 5 ft² (0.46 m²) of total living area closed off from the furnace by the door or partition serviced by that opening. Undercutting doors connecting the closed-off area shall be permitted to be used as a means of providing return air area. 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. Joints and seams of ducts shall be securely fastened and made substantially airtight. Slip joints shall have a lap of at least 1 in. (25 mm) and shall be individually fastened. Tape or caulking compound shall be permitted to be used for sealing mechanically secure joints. Where used, tape or caulking compound shall not be subject to deterioration under long exposures to temperatures up to 200°F (93.4°C) and to conditions of high humidity, excessive moisture, or mildew.

5.7.9 Air Duct Supports. Ducts shall be securely supported.

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

- (1) Registers or grills shall be made of a material classified 94 V-0 or 94 V-2 when tested as described in UL 94, *Standard for Safety Test for Flammability of Plastic Materials for Parts in Devices and Appliances*.
- (2) Floor registers or grills shall resist without structural failure a 200 lb (90.7 kg) concentrated load on a 2 in. (51 mm) diameter disc applied to the weakest area of the exposed face of the register or grill. For this test the register or grill is to be at a temperature of not less than 165°F (74°C) and is to be supported in accordance with the manufacturer’s instructions.

Exception: This 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, Standard for Safety Room Air Conditioners.

5.8 Air-Conditioning (Other than Automotive-Type).

5.8.1 General Requirement — Air Conditioning Appliances.

Every air-conditioning appliance or combination air-

conditioning and heating appliance used in a recreational vehicle shall be listed 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 Installation of Air Conditioning Appliances. The installation of each appliance shall conform to the terms of its listing and the manufacturer’s installation instructions. Appliances shall be secured in place to avoid displacement and movement from vibration and road shock.

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

5.8.2.3 Fuel-Burning Air Conditioners. Each fuel-burning air conditioner shall comply with Section 5.6.

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

5.9 Consumer Information.

5.9.1 Required Information.

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

5.9.1.2 Owner’s Manual. Each recreational vehicle shall be provided with an owner’s manual that shall contain as a minimum the information contained in 5.9.12(A) through (G).

(A) The following warning:



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

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



WARNING
IT IS NOT SAFE TO USE COOKING APPLIANCES FOR COMFORT HEATING.

- (1) Cooking appliances need fresh air for safe operation. Before operation:
 - (a) Open overhead vent or turn on exhaust fan.
 - (b) Open window.
- (2) Unlike homes, the amount of oxygen supply is limited due to the size of the recreational vehicle, and proper ventilation when using the cooking appliance(s) will avoid dangers of asphyxiation. It is especially important that cooking appliances not be used for comfort heating, as the danger of asphyxiation is greater when the appliance is used for long periods of time.

**FAILURE TO COMPLY COULD RESULT
IN DEATH OR SERIOUS INJURY.**

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

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

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

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

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

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

IF YOU SMELL GAS:

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

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

5.9.2 Required Markings.

5.9.2.1 Identification of Gas Supply Connections. Each recreational vehicle shall have permanently affixed, in a visible location at or near each gas supply connection, or at the end of the piping, an exterior label in accordance with Section 4.3 with 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:



**THIS GAS PIPING SYSTEM IS DESIGNED
FOR USE WITH LP-GAS ONLY.
DO NOT CONNECT NATURAL GAS TO
THIS SYSTEM.**

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.

or



**THIS GAS PIPING SYSTEM IS DESIGNED
FOR USE WITH EITHER LP-GAS OR
NATURAL GAS.
BEFORE TURNING ON GAS BE CERTAIN
APPLIANCES ARE DESIGNED AND
ARRANGED FOR THE GAS CONNECTED.
(SEE EACH APPLIANCE INSTRUCTION
PLATE.)**

Securely cap this inlet when not connected for use. After turning on gas, except after normal cylinder replacement, test gas piping and connections to appliance for leakage with soapy water or bubble solution.

Do not use products that contain ammonia or chlorine.

5.9.2.2 Warning Relative to Refueling. The following labels, where required near the LP-Gas containers, shall be permitted to be incorporated in the labels required by 5.9.2.1.

(A) Each vehicle shall have a permanent exterior warning label in accordance with Section 4.3 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 and shall be affixed in a visible location adjacent to the LP-Gas container that reads as follows:



**DO NOT FILL LP-GAS 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 with the word "DANGER" with minimum ¼ in. (6 mm) high

letters and body text with minimum 1/8 in. (3 mm) high letters on a contrasting background reading 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 LP-GAS CONTAINERS.
FAILURE TO COMPLY COULD RESULT IN
DEATH OR SERIOUS INJURY.

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

5.9.2.3 Warning if Gas Odor Is Detected. When fuel-burning equipment is installed by the recreational vehicle manufacturer, a permanent danger label with the word “DANGER” with minimum 1/4 in. (6 mm) high letters and body text with minimum 1/8 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 will be frequently used, shall read as follows:

 **DANGER**
IF YOU SMELL GAS

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

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

5.9.2.4 Warning Label for Cooking Appliances. A permanent warning label with the word “WARNING” with minimum 1/4 in. (6 mm) high letters and body text with minimum 1/8 in. (3 mm) high letters on a contrasting background shall be affixed in a visible location adjacent to fuel burning ranges and 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 vapor-tight 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 Generator Ready.

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

5.10.3 Fuel Tank Installation.

5.10.3.1 Location. The fuel tank shall be located under the floor, in a compartment, on a trailer A-frame, or forward of the front bulkhead below the overhang of a fifth wheel trailer. The fuel tank and any of its attachments and fittings shall be located above clearance lines as specified in 5.10.3.1(A) through 5.10.3.1(C). 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).

(A) Rear clearance line is defined as a 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 centerline of the rearmost wheel spindle to the lowest point on the intersection of the rear wall and floor lines. Where the fuel tank is located between the chassis main rails, the rear point may be taken at the bottom of the main rail. Skid bars shall not be used to lower this point.

(B) Front clearance line is defined as a 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 centerline of the forward most wheel spindle to the lowest point of the front chassis cross member. 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 1/2-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 vaportight to the vehicle interior and sealed so that vapors cannot travel into the interior of the recreational vehicle. Sealing com-

pounds used to seal the compartment shall be fuel resistant.

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

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

5.10.3.3 Fuel Tank Bonding. 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 5.6.3.3.

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. Equipment located above the clearance lines specified in 5.10.3.1(B) shall be considered protected.

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

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

5.10.5.4 Hose-to-tube joints shall remain leak free when subjected to a 20 lb (9.0 kg) axial pull test applied for 1 minute.

5.10.5.5 Hose-to-tube joints shall remain leak free when subjected to an internal pressure of 10 psig (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 will 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)(1) through (c)(5) and (d)(2), 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. Equipment located above the clearance lines specified in 5.10.3.1(B) shall be considered protected.

5.10.6.4 Fuel Dispensing Compartments.

5.10.6.4.1 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.

5.10.6.4.2 These compartments shall be ventilated with openings having a minimum area of 1.7 in.² (1100 mm²) at both the top and bottom.

5.10.6.4.3 Where compartment doors are equipped for ventilation, the openings shall be within 2 in. (50.8 mm) of the top and bottom of the door.

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

5.10.6.6 Nozzles shall be used for the dispensing of fuel and shall be listed to UL 842, *Standard for Valves for Dispensing Flammable Liquids*, designed for use with unleaded fuel, of a trigger and handle type, and made with a nonferrous body.

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

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

5.10.6.9 The fuel dispensing hose between the nozzle and its first connection on the vehicle shall be a hose assembly listed to UL 330, *Standard for Safety for Hose and Hose Assemblies for Dispensing Flammable Liquids*.

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

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

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

5.10.6.13 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, *National Electrical Code*, for Class 1, Group D, Division 2 locations.

5.10.6.14 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.

5.10.6.15 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.

5.10.6.16 Fuel dispensing systems shall be provided with an acceptable method of grounding during fuel dispensing to protect against any potential electrical static discharge.

5.10.6.17 All recreational vehicles equipped with fuel dispensing systems shall have a permanent label with the word "DANGER" in minimum $\frac{5}{8}$ in. (16 mm) high red block letters and body in minimum $\frac{3}{8}$ in. (9.5 mm) high red block letters on a contrasting background visible to the operator during dispensing of fuel from the recreational vehicle. The label shall be made of material that will not deteriorate when in contact with petroleum based products. The label shall read as follows:

 **DANGER**
NO SMOKING.

BEFORE DISPENSING FUEL, TURN OFF ALL
ENGINES, FUEL BURNING APPLIANCES, AND
THEIR IGNITORS. DO NOT DISPENSE FUEL
WITHIN 20 FEET OF AN IGNITION SOURCE.
FAILURE TO COMPLY COULD RESULT IN
FIRE, DEATH, OR SERIOUS INJURY.

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

5.10.6.19 In-line fuel filters shall be permitted. When installed, they shall be located in readily accessible locations for service and mounted in such a way that removal will not allow fuel to drip onto electrical or exhaust system components.

5.11 LP-Gas Engine Fuel Installations.

5.11.1 LP-Gas Vehicle Propulsion Engine Fuel Installations. LP-Gas systems supplying both vapor and liquid withdrawal shall comply with Section 8.2 of NFPA 58, *Liquefied Petroleum Gas Code*, except as provided for in 5.11.2.

5.11.2 Permanently mounted tanks shall be mounted in accordance with 5.2.3(2)(c) 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. Interior finish (as defined in 3.3.17) of walls, partitions, ceilings, exterior passage doors, cabinets, habitable areas, hallways, and bath or toilet rooms, including shower/tub walls, of recreational vehicles shall be of materials with a flame spread classification that does not exceed 200 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*. An alternate method of testing for cabinet door and drawer faces, exposed cabinet bottoms and end panels, and tub/shower walls shall be permitted to use ASTM E 162, *Standard Test Method for Surface Flammability of*

Materials Using a Radiant Heat Energy Source, to establish the flame spread rating not to exceed 200.

Exception: The flame spread limitations of 6.1.1 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, flexible plastic weather protection, and so forth, they shall conform to the requirements of 49 CFR 571.302, paragraphs S4.3 and S5 of Federal Motor Vehicle Safety Standard No. 302, "Flammability of Interior Materials."

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

6.2 Recreational Vehicle Exit Facilities.

6.2.1* Minimum Exit Facilities. Recreational vehicles shall have a minimum of two exits located remote from each other and so arranged as to provide a means of unobstructed travel to the outside of the vehicle. Each bedroom or area designed for sleeping shall have at least two unobstructed paths to exit. The path to exit 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. The alternate exits in motor homes and truck campers shall be located on a wall other than that wall where the main vehicle exit door is located or shall be located in the roof. Use of the driver's door as an alternate exit shall be permitted provided that the driver's seat locks only in the forward position and arm rests, if any, are retractable and nonlockable when in the arm rest position. The distance between the upright portion of the seat in its extreme forward position and the nearest point of the steering wheel shall be not less than 12 in. (305 mm).

6.2.3 Access to Alternate Exits. 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. The supporting surface shall be not more than 3 ft (0.9 m) below the bottom of the alternate exit and shall be capable of supporting a weight of 300 lb (136 kg). Recreational vehicles that contain a designated roof alternate exit shall be provided with a ladder or equivalent device for descending from the roof.

6.2.4 Operation of Exits. The latch mechanism of any required exit facility shall be operable by hand and shall not

require the use of a key or tool for operation from the inside. No more than 20 lb of force (89 N) shall be required to open a required exit.

6.2.5* Size of Alternate Exits. The alternate exit, if not an exterior passage door, shall provide an opening of sufficient size to permit unobstructed passage, keeping a major axis parallel to the plane of the opening and horizontal at all times, of an ellipsoid generated by rotating about its minor axis an ellipse having a major axis of 24 in. (610 mm) and a minor axis of 17 in. (432 mm). (See Figure A.6.2.5.) An exterior passage door if used for an alternate exit shall provide an unobstructed opening with a minimum horizontal dimension of 18 in. (457 mm) and a minimum vertical dimension of 48 in. (1.2 m).

6.2.6 Marking of Alternate Exits. Alternate exits other than exterior passage doors shall be identified by a waterproof label with the word "EXIT" in 1 in. (25.4 mm) minimum red letters on a contrasting background. The label shall be placed on the interior wall surface above or below the exit or on the interior ceiling surface, within 8 in. (203 mm) of the opening in an unobscured visible location or shall be installed on the interior of the exit frame or the movable portion of the exit approximately midway between the sides.

6.2.7 Identification of Alternate Exit Handles. Handles that must be operated to open alternate exits shall be colored red.

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

6.3 Fire Detection Equipment.

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

Exception: A fifth wheel or travel trailer that has only interior lighting capable of being powered only by a 120-V or 120-V/240-V external power supply shall be permitted to be equipped with a 120-V operated smoke 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, *Standard for Single and Multiple Station Smoke Alarms*.

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. The required smoke alarm shall be installed a minimum of 6 in. (152 mm) from all exterior walls measured edge to edge and away from the direct flow of air from heat and air-conditioning outlets.

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 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. Each motor home shall be equipped with a listed portable fire extinguisher with a minimum rating of 10-B:C. Each recreational vehicle equipped with fuel-burning equipment (other than the prime mover engine) or 120-/240-V electrical system shall be provided with a listed portable fire extinguisher with a minimum rating of 5-B:C as defined in NFPA 10, *Standard for Portable Fire Extinguishers*. The fire extinguisher shall be installed in accordance with its listing and Section 1.6 of NFPA 10 and shall be located within the recreational vehicle interior as near as practical to the primary means of exit.

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

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

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

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

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

6.4.5 Installation of Internal Combustion Engine Generators. Internal combustion engine-driven generator units (subject to the provisions of this standard) shall be listed and mounted in place in accordance with manufacturer's instructions and shall be installed in a compartment that is vaportight to the interior of the vehicle. Where generator compartments are used to isolate the generator from the vehicle's interior, generator compartments shall be lined with galvanized steel not less than 26 MSG thick. Seams and joints shall be lapped, mechanically secured, and made vaportight to the interior of the vehicle. Alternate materials and methods of construction shall be permitted to be used if they provide equivalent quality, strength, effectiveness, fire resistance, durability, and safety. Liquid fuel lines and exhaust sys-

tems shall not penetrate into the living area. Holes into the living area shall be sealed vaportight.

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

(A) A minimum of one opening or window on each side of the vehicle's longitudinal centerline having a minimum of 200 in.² (0.13 m²) of free area openable during transit shall be provided. This venting shall be permitted to be located on sidewalls, endwalls, or through the floor where permitted (*see 6.4.4*). The top of sidewall and endwall openings or windows shall not be more than 18 in. above the vehicle's interior floor level. As an alternate, a passive ram air ventilation system shall be permitted. This passive ram air ventilation system shall require a minimum of 10 in.² (65 cm²) of free openable area in the forward upper end of the transportation area pointing forward and a minimum of 10 in.² (65 cm²) of free openable area in the lower rear area pointing aft, out, or down.

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

(C) Electrical equipment and lighting installed in accordance with Sections 511.4(B) and 511.7(b) of NFPA 70, *National Electrical Code*.

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

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

(F) A danger label placed inside of the RV adjacent to each entry and visible to anyone entering the RV. This label(s) shall be printed with red letters on a white background with the word "DANGER" a minimum of 3/4 in. (19 mm) high text that shall be a minimum of 1/4 in. (6 mm) high, and shall read as follows:



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) Doors and windows in walls of separation (if installed) are to be closed while the vehicles are present.
- (3) Run fuel out of engine of stored vehicles after shutting off fuel at the tank.
- (4) Do not store or transport motor fuel inside this vehicle.
- (5) Ventilate the vehicle storage area.
- (6) Do not operate gas appliances, pilot lights, or electrical equipment when motorized vehicles or motorized equipment are inside vehicle.

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

(G) For vehicles that contain a special transportation area with a wall of separation and openings in the floor, a warning label with the word "WARNING" with minimum 5/8 in. (16 mm) high text and minimum 3/8 in. (9.5 mm) body text shall be visible to anyone entering the special transportation area reading as follows:



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

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

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

Exception No. 1: Recreational vehicles designed and promoted for the physically impaired are not required to comply with the requirements of 6.4.7.

Exception No. 2: Portions of recreational vehicles designed to transport livestock, having a permanent wall of separation (passage doors and windows permitted) from the living section, are not required to comply with 6.4.7.

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

Chapter 7 Plumbing Systems

7.1 Introduction to Chapter.

7.1.1 Need for Chapter. Those members of the engineering profession and others associated with the design, manufacturing, installation, and inspection of recreational vehicle plumbing systems have been aware of the need for uniform technical standards leading to the safe and sanitary use of this special

type of equipment. They have also recognized that because of conditions of transport and use, existing plumbing standards for permanent buildings are not completely applicable to recreational vehicles. It is with these factors in mind that this chapter has been developed.

7.1.2 Basis for Chapter. Much of the material in this chapter has been taken from, or is based on, nationally recognized standards for plumbing materials, fixtures, fittings, and equipment. (*Applicable standards are shown in Chapter 2.*)

7.2 Scope of Chapter.

7.2.1 Coverage of Chapter. This chapter covers the plumbing materials, fixtures, fittings, and equipment installed within or on recreational vehicles.

7.2.2 Limitations of Chapter. This chapter is not intended as a design specification or an instruction manual.

7.2.3 Alternate Materials, Equipment, and Procedures. The provisions of this standard are not intended to prevent the use of any material, method of construction, or installation procedures 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.

7.2.4 Differing Standards. Wherever nationally recognized standards for plumbing materials, fixtures, fittings, and equipment and this chapter differ, the requirements of this chapter shall apply.

7.3 Plumbing System, General Requirements.

7.3.1 Minimum Requirements. Any plumbing system installed in a recreational vehicle shall conform with the provisions of this standard. Requirements for any size, weight, or quality of material modified by the terms "minimum," "not less than," "at least," and similar expressions are "minimum standard."

7.3.1.1 Connections to Drainage System. 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.

7.3.1.2 Components. Plumbing materials, devices, fixtures, fittings, equipment, appliances, accessories, and appurtenances installed in or attached to a recreational vehicle shall conform to minimum standards and shall be listed or shall be specifically approved by the authority having jurisdiction when listing by an approved listing agency is not available. All listed components shall be installed in accordance with terms of their listing.

7.3.1.3 Component Installations. All design, construction, and workmanship shall be in conformance with accepted engineering practices.

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

7.3.1.5 Assembling of Pipe. All joints and connections shall be correctly assembled for tightness. Pipe threads shall be fully engaged with the threads of the fittings. Pipe threads and slip joints shall not be wrapped with string, paper, putty, or similar fillers. Plastic pipe and copper tubing shall be inserted to the full depth of the fitting sockets.

7.3.1.6 Solder Fittings/Joints. Solder joints for copper tubing shall be made with approved or listed sweat solder type fittings. Surfaces to be soldered shall be cleaned bright. 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. The use of self-cleaning fluxes shall not be permitted.

7.3.2 Prohibited Practices.

7.3.2.1 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.

7.3.2.2 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.

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

7.3.2.4 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.

7.3.2.5 Galvanized pipe shall not be bent or welded.

7.3.3 Protective Requirements.

7.3.3.1 Road Damage. Pipes, supports, drains, outlets, or drain hoses shall not extend or protrude in a manner by which they could be unduly subjected to road hazard. 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.

7.3.3.2 Rodent Proofing. Pipe and hoses shall be installed in a manner by which they cannot be unduly subject to dislocation, strain, or damage by extendable components (e.g., power cords).

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

7.3.4 Plumbing System Hangers and Supports.

7.3.4.1 Strains and Stresses. Piping in a plumbing system shall be installed without undue strains and stresses, and provision shall be made for expansion and contraction.

7.3.4.2 Hangers and Anchors. 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. Hangers and anchors shall be of sufficient strength to support their proportional share of the pipe and prevent rattling.

7.4 Plumbing Fixtures.

7.4.1 General Requirements.

7.4.1.1 Quality of Fixtures. 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.

7.4.1.2 Unobstructed Drain Fittings. The waste outlet of all plumbing fixtures, other than toilets, shall be equipped with a drain fitting that will provide an adequate unobstructed waterway.

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

7.4.1.4 Length of Tailpiece. The vertical distance from the fixture outlet to the trap shall not exceed 24 in. (609.6 mm). The horizontal distance from the fixture's outlet to the trap shall not exceed 30 in. (762 mm).

7.4.1.5 Concealed Connections. Concealed slip joint connections shall be provided with adequately sized unobstructed access panels and shall be accessible for inspection and repair.

7.4.1.6 Installation.

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

7.4.1.6.2 Alignment. Fixtures shall be set level.

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

7.4.2 Toilets.

7.4.2.1 Recirculating or Mechanical Seal Types. Recirculating or mechanical seal toilets may provide for storage of liquid waste and body waste as an integral part of the unit. 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.

7.4.2.2 Water Closets (Flush Toilets). Flush toilets shall not be installed in a system that incorporates a body waste holding tank.

7.4.2.3 Floor or Tank Connections. Toilets, when directly connected to a waste holding tank or drainage system, shall be securely bolted to either the tank or other approved fitting. 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. 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. A watertight seal shall be made between the toilet and flange or other approved fittings by the use of a gasket or sealing compound.

7.4.3 Shower Stalls.

7.4.3.1 Shower Stall Receptors. 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. 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. 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 form a watertight joint with each other, as well as with the receptor or shower floor.

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

7.4.3.2 Drain Connection. The joint around the drain connection and around the toilet outlet in combination compart-

ments shall be made watertight by a flange, clamping ring, or other approved or listed means.

7.4.3.3 Shower Doors and Tub and Shower Enclosures.

Shower doors and tub and shower enclosures shall be constructed so as to be waterproof and, if glazed, be glazed with safety glazing materials conforming to ANSI Z97.1, *Glazing Material Used in Buildings, Safety Performance Specifications and Methods of Test*. Hinged, swinging shower doors shall open outward.

7.5 Water Distribution Systems.

7.5.1 Materials.

7.5.1.1 Piping 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.

7.5.1.2 Fittings.

7.5.1.2.1 Appropriate fittings shall be used for all changes in size and where pipes are joined. The material and design of fittings shall conform to the type of piping used.

7.5.1.2.2 Fittings for screw piping shall be standard weight galvanized iron for galvanized iron and steel pipe, and brass for brass piping. They shall be installed where required for change in direction or reduction of size, or where pipes are joined together.

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

7.5.1.2.4 Faucet fittings shall be accessible for removal and repair.

7.5.1.3 Prohibited Practices.

7.5.1.3.1 Used piping materials shall not be permitted.

7.5.1.3.2 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.

Exception: An 18-in. (457.2-mm) length of listed cold water flexible tubing may be installed on the outlet side of a demand pressure pump. A minimum 24-in. (609.6-mm) length of separation shall be provided between the hot water heater and the flexible hose. 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 must be approved for the maximum test pressure specified in 7.8.1.1.

7.5.2 Installation of Piping.

7.5.2.1 Screw Pipe. Iron pipe-size brass or galvanized iron or steel pipe and fittings shall be joined with approved or listed standard pipe threads fully engaged in the fittings. Threads for screw pipe and fittings shall conform to the approved or applicable standard. Pipe ends shall be reamed out to size of bore, and all chips and cutting oil shall be removed. Pipe joint compound or thread lubricant shall be insoluble in water, shall be nontoxic, and shall be applied to male threads only.

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

7.5.3 Line Valves. 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.

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

7.5.5 Water Supply.

7.5.5.1 Sizing of Water Supply Piping.

7.5.5.1.1 Piping systems shall be sized to provide an adequate quantity of water to each plumbing fixture at a flow rate sufficient to keep the fixture in a clean and sanitary condition without any danger of backflow or siphonage. The size of water supply piping and branch lines shall not be less than shown in Table 7.5.5.1.1.

Table 7.5.5.1.1 Minimum Size Tubing and Pipe for Water Distribution Systems^a

Number of Fixtures	Tubing		Pipe
	I.D. (in.)	O.D. (in.)	Iron Pipe Size (in.)
1	1/4 ^b	3/8 ^b	3/8
2	1/4 ^c	3/8 ^c	3/8
3	3/8	1/2	1/2
4	3/8	1/2	1/2
5 or more	1/2	5/8	1/2

^aMinimum size for toilet water supply line shall not be less than the size recommended by the manufacturer.

^b12 ft (3.7 m) maximum length allowable only from water service connection to a single fixture.

^c6 ft (1.8 m) maximum length.

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

7.5.5.2 Potable Water Storage Tanks. If a tank is installed in such a manner that it is subject to road damage, it shall be protected. Each nonpressure or gravity tank shall be equipped with a vent at the top of the tank to assist in filling and drainage.

7.5.5.3 Labeling of Potable Water Tank Inlets.

7.5.5.3.1 Each inlet to a potable water tank shall have affixed a warning label 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.

7.5.5.3.2 Instructions for proper sanitizing of water distribution systems shall be consistent with those recognized by the U.S. Public Health Service and shall be furnished with each vehicle.

7.5.6 Water Service Connections, Outlets, and Backflow Prevention.

7.5.6.1 Water Service Connection. Each recreational vehicle with a water distribution system sized as required in Table 7.5.5.1.1, which may be connected to an outside source, shall be equipped with a 3/4-in. (19.0-mm) swivel female hose water service connection. A matching cap or plug shall be provided to close the water inlet when it is not in use and shall be attached in a secure manner. 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. of the outside wall.

Exception: A length of listed cold water flexible hose permanently connected to the water distribution system and equipped with a 3/4 in. swivel female hose water service connection with matching cap or plug that extends to the required location.

7.5.6.2 Prohibited Connections.

7.5.6.2.1 The installation of potable water supply piping or fixture or appliance connections shall be made in a manner to preclude the possibility of backflow (see 7.5.6.4).

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

7.5.6.3 Water Outlets.

7.5.6.3.1 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.

7.5.6.3.2 Valved hose outlets shall be installed to preclude a cross connection. It shall be permitted to use vacuum breakers, hose length, or a permanently secured retaining device. 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.

7.5.6.3.3 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.

7.5.6.4 Backflow Preventer. 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 check valve or other approved or listed type backflow prevention device installed in the water supply piping adjacent to the water service connection.

7.5.7 Safety Devices.

7.5.7.1 Temperature and Pressure Relief Valve. Every water heater shall be protected against over-temperature and over-pressure by an approved, listed, and adequately sized temperature and pressure relief valve. Such 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 7.5.1.

7.5.7.2 Relief Valve Drain. The 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 relief valve discharges into an area sealed off from the inside of the vehicle and drained and ventilated to the outside. The discharge end of the drain shall not be equipped with a thread or other means of capping or plugging. The threaded discharge of a relief valve not equipped with a drain shall be provided with a means to make capping or plugging difficult.

7.5.7.3 Air-Pressurized Water Storage Tanks. Water storage tanks, except water heaters, which may be pressurized by air, shall be equipped with a listed air pressure relief valve set to open at not more than 125 psig (862 kPa) or the tank manu-

facturer's recommended working pressure, whichever is lower. The air pressure relief valve shall be located above the maximum water level of the tank.

7.6 Drainage Systems.

7.6.1 Materials.

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

7.6.1.2 Fittings.

7.6.1.2.1 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. Drainage fittings shall be designed to provide for ¼ in. per ft (20.8 mm per meter) grade in horizontal piping.

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

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

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

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

7.6.2 Size of Drainage Piping.

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

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

7.6.2.3 Nominal 3-in. (76.2-mm) minimum diameter piping shall be required for toilets.

7.6.3 Slope of Horizontal Drainage Piping. Horizontal drainage piping, except fixture connections on the inlet side of the trap, shall have a uniform slope of not less than ⅛ in. per ft (10.4 mm per meter) toward the recreational vehicle main drain outlet.

7.6.4 Drain Piping Supports. 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.

7.6.5 Offsets and Branch Fittings.

7.6.5.1 Changes in Direction. Changes in direction of drainage piping shall be made by the appropriate use of approved or listed fittings and shall be of the following angles: 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.

7.6.5.2 Horizontal-to-Vertical Connections. 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. 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.

7.6.5.3 Horizontal-to-Horizontal Connections and Vertical-to-Horizontal Connections.

7.6.5.3.1 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.

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

7.6.6 Traps.

7.6.6.1 Traps Required. 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.

7.6.6.2 Traps for Dual Fixtures. 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, may be connected to one trap and may be considered as a single fixture for the purpose of drainage and vent requirements.

7.6.6.3 Installation of Traps. 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.

7.6.6.4 Prohibited Traps. Full "S" traps, bell traps, drum traps, and crown vented traps are prohibited. A trap that depends for its seal upon concealed interior partitions shall not be used except for listed flexible drain systems. Fixtures shall not be double trapped.

Exception: Listed flexible drain systems and listed systems utilizing a detachable waste holding tank with integral trap.

7.6.6.5 Trap Seals. 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.

7.6.6.6 Trap Size. Traps shall not be less than 1¼ in. (31.8 mm) in diameter. A trap shall not be larger than the waste pipe to which it is connected.

7.6.6.7 Accessibility of Traps. Traps shall be accessible for removal, repair, and inspection.

7.6.7 Trap Arms.

7.6.7.1 Grade of Trap Arm. The piping between a trap and the fixture tee or the vented waste line shall be graded ¼ in. per ft (20.8 mm per m) and in no event shall have a slope greater than its diameter. The vent opening at fixture tees shall not be below the weir of the trap outlet.

7.6.7.2 Trap Arm Offset. The piping between the trap and vent may change direction or be offset horizontally with the equivalent of no more than 180 degrees.

7.6.7.3 Length of Trap Arm. The distance between a trap and its vent or vented waste line shall be in accordance with Table 7.6.7.3. Not more than one trap shall connect to a trap arm.

Table 7.6.7.3 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

7.6.8 Wet-Vented Drainage System.

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

7.6.8.2 Size. Except as permitted in 7.7.3.4, a wet-vented drain pipe shall be at least one pipe size larger than the largest required trap. Not more than three fixtures shall be permitted to connect to a wet-vented drain system.

7.6.9 Side-Vented Drainage Systems and Flexible Drain Systems. A side-vented liquid waste drainage system or flexible drain system shall be permitted to be used under the following conditions:

- (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) A baffle or diverter tee shall be used to connect the trap arm to the highest fixture to the side-vented drain system.
 - (b) Traps 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 center of the horizontal vent offset 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. The vent termination through the outside wall shall be at least 3 ft away from appliance intake above the level of the vent.

Exception: The vent offset shall terminate through the sidewall horizontally without change in direction when the drain discharges into a liquid waste holding tank.

- (e) There shall be no connection between liquid and body waste drainage systems.

7.6.9.1 A flexible drain system shall be permitted to be used only on a single-compartment sink. Each flexible drain system shall be a listed system. A flexible drain system shall be permit-

ted 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 7.6.12.2.2. (See 7.6.12.2.2, *Exceptions No. 1 and 3, for related information on drain outlets.*)

7.6.10 Cleanouts.

7.6.10.1 Cleanout Fittings.

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

7.6.10.1.2 Design for Cleaning. 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.

7.6.10.2 Access to Cleanouts. Cleanouts shall be accessible through an unobstructed minimum clearance of 6 in. (152.4 mm) directly in front of the opening. Each cleanout fitting shall open in a direction opposite to the flow or at right angles to the pipe. 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.

7.6.10.3 Cleanout Plugs and Caps.

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

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

7.6.11 Waste Holding Tanks.

7.6.11.1 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 permanent structural members.

7.6.11.2 Liquid Waste Holding Tank.

7.6.11.2.1 Minimum size of inlet connections shall be determined by the total number of connected fixtures in accordance with 7.6.2. Neither the inlet nor vent fitting shall extend downward into the tank more than ½ in. (12.7 mm).

7.6.11.2.2 The drain opening shall be 1½-in. (38.1-mm) minimum pipe size located at the lowest point in the tank. A listed fullway termination valve shall be directly connected to the tank or installed in the drain pipe of the tank.

7.6.11.2.3 Except as otherwise permitted in 7.6.9, 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

7.6.11.3 Body Waste Holding Tank.

7.6.11.3.1 Toilet connections shall be 3-in. (76.2-mm) minimum pipe size and shall extend vertically. The inlet fitting shall not extend downward into the tank more than 1½ in. (38.1 mm). 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.

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

7.6.11.3.3 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

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

7.6.11.5 Operation and Location of Fullway Termination Valves. Fullway termination valves shall be designed for manual operation from outside the recreational vehicle and have no extension or activating device within the vehicle.

Exception: 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 valve control shall be installed outside the living volume of the vehicle with a security lockout.*

7.6.11.6 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.

7.6.12 Drain Outlets.

7.6.12.1 Size of Drain Outlets.

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

7.6.12.1.2 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.

7.6.12.2 Location of Main Drain Outlet(s).

7.6.12.2.1 Each recreational vehicle shall have a main drain outlet(s) that shall terminate at any point within 16 ft (4.9 m) of the rear, or within 12 in. (304.8 mm) forward of the wheel well, 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, and shall direct its discharge toward that side or toward the rear within an angle of 90 degrees formed between that side and the rear end of the vehicle or vertically downward.

7.6.12.2.2 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.

Exception No. 1: A recreational vehicle equipped with only a listed flexible drain system or a side-vent drain system 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 Exception No. 3.)

Exception No. 2: A recreational vehicle having a mechanical seal toilet with a waste holding tank or a recirculating chemical toilet may have a separate drain outlet installed in accordance with the location requirements specified in 7.6.12.2.

Exception No. 3: 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 Exception No. 1.)

Exception No. 4: Subject to the other requirements in 7.6.12.2, truck campers may have the main drain(s) located anywhere across the rear of the vehicle.

7.6.12.3 Drain Outlet Caps. Each drain outlet shall be equipped with a watertight cap that shall be attached to the vehicle or drain piping.

7.6.12.4 Clearance from Drain Outlets. 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.

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

7.7 Vents and Venting.

7.7.1 General. Each plumbing fixture trap shall be protected against siphonage and back pressure. Air circulation shall be ensured throughout all parts of the drainage system by means of vents installed in accordance with the requirements of this section or as otherwise required by this chapter. Except as specifically provided elsewhere in this chapter, vent pipes shall not be used as waste or drain pipes.

7.7.2 Materials.

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

7.7.2.2 Fittings. Appropriate fittings shall be used for all changes in direction, size, or shape, and where pipes are joined. The material and design of fittings shall conform to appropriate national standards. Listed rectangular tubing shall be permitted to be used for venting. Suitable listed transition fittings shall be used.

7.7.3 Size of Vent Piping.

7.7.3.1 Individual Vents.

7.7.3.1.1 Unless protected by an anti-siphon trap vent device (see 7.7.5), 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.

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

7.7.3.2 Common Vents. 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 may serve as a common vent without any increase in size.

7.7.3.3 Intersecting Vents. Where two or more vent pipes are joined together, no increase in size shall be required; however, the largest vent pipe shall extend full size through the roof.

7.7.3.4 Flush Toilet Venting. 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 7.6.7.3 for 3-in. (76-mm) trap arms. The connection 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

7.7.4 Vent Connections and Grades.

7.7.4.1 Horizontal Vents. 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 it is venting before offsetting horizontally or being connected with any other vent pipe. Vents for horizontal drains shall connect to the drain piping downstream of the trap. Vents other than wet-vented drains shall connect above the centerline of horizontal drain piping.

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

7.7.5 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.

7.7.6 Vent Terminations.

7.7.6.1 Roof Extension. 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. Vents terminating on curved roof recreation vehicles or recreation vehicles with elevating tops must pass through the roof or upper side of the recreation vehicle at a point as high as practicable and not less than 6 ft from the ground level.

7.7.6.2 Waste Holding Tank Vent Openings—Location. 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.

7.7.6.3 Flashing. The opening around each vent pipe shall be made watertight by an adequate flashing or flashing material.

7.7.6.4 Vent Caps. Vent caps, if provided, shall be of the removable type without removing the flashing from the roof.

7.8 Plumbing System Tests.

7.8.1 Water Piping System Tests. All pressure water piping in the water distribution system shall be subjected to a pressure test. An adequate and accurate pressure gauge or bubble-type leak detector shall be used on all tests. Tests shall be performed to one of the following methods, as appropriate. 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.

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

7.8.1.1 Pressurized System Test. 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 by the following:

- (1) Filling the entire piping system, including the hot water storage tank and the pressurized potable water storage tank, with water and pressure testing with air or water at 80 psi ± 5 psi (551 kPa ± 34 kPa)
- (2) Removing the water heater storage tank and the pressurized potable water storage from the piping system and pressure testing with air at 80 psi ± 5 psi (551 kPa ± 34 kPa)

Exception: PVC and CPVC systems shall be tested to parts (a) or the manufacturer’s recommended test procedure.

7.8.1.2 Demand System Test. 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 to the maximum discharge pressure of the pump for a period of 10 minutes without leakage or loss of pressure.

7.8.2 Tests for Drainage and Vent Systems. The waste and vent system shall be subjected to one of the three tests described in 7.8.2.1 through 7.8.2.3 without evidence of leaks.

7.8.2.1 Water Tests. 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.

7.8.2.2 Air Tests. 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.

7.8.2.3 Fixture Flood Level Tests. 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.) After all trapped air has been released, the test shall be sustained for not less than 15 minutes. 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.

7.8.3 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.