501

NFPA 501 Standard on Manufactured Housing 1997 Edition

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

NOTICE

All questions or other communications relating to this document should be sent only to NFPA headquarters, addressed to the attention of the Committee responsible for the document.

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Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

Statement on NFPA Procedures

This material has been developed under the published procedures of the National Fire Protection Association, which are designed to assure the appointment of technically competent Committees having balanced representation. While these procedures assure the highest degree of care, neither the National Fire Protection Association, its members, nor those participating in its activities accept any liability resulting from compliance or noncompliance with the provisions given herein, for any restrictions imposed on materials or processes, or for the completeness of the text.

NFPA has no power or authority to police or enforce compliance with the contents of this document, and any certification of products stating compliance with requirements of this document is made at the peril of the certifier.

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NFPA 501

Standard on

Manufactured Housing

1997 Edition

This edition of NFPA 501, *Standard on Manufactured Housing*, was prepared by the Technical Committee on Manufactured Homes and acted on by the National Fire Protection Association, Inc., at its Annual Meeting held May 19–22, 1997, in Los Angeles, CA. It was issued by the Standards Council on July 24, 1997, with an effective date of August 15, 1997, and supersedes all previous editions.

This edition of NFPA 501 was approved as an American National Standard on August 15, 1997.

Origin and Development of NFPA 501

The 1997 edition of NFPA 501, *Standard on Manufactured Housing*, is based on the 1977 edition of NFPA 501B, *Standard for Mobile Homes*. The 1977 criteria have been updated to include current technology and references and the format has been updated to conform with the NFPA *Manual of Style*.

This document is also based on the federal Manufactured Home Construction and Safety Standards which, when originally developed by HUD, were based on the 1977 edition of NFPA 501B. The scope of this document is to establish the minimum criteria for manufactured housing. This document is being further developed from the original NFPA 501B, *Standard for Mobile Homes* and the current HUD regulations to possibly address the international application for manufactured homes. The current HUD regulations only address those structures within the United States. It is also possible that HUD may consider the use of this document as part of their regulations governing manufactured homes.

Technical Committee on Manufactured Homes

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Committee Scope: This Committee shall have primary responsibility for documents on manufactured homes including the installation, sites and communities, and the maintenance of and improvements for existing manufactured homes.

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

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Standard on

Manufactured Housing

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

Information on referenced publications can be found in Chapter 11 and Appendix B.

Chapter 1 General

1-1 Scope. This standard shall cover all the equipment and installations used in the design, construction, transportation, fire safety, plumbing, heat-producing, and electrical systems of manufactured homes that are designed to be used as dwelling units. This standard shall, to the maximum extent possible, establish performance requirements. In certain instances, however, the use of specific requirements are necessary.

1-2 Definitions. The following definitions are common to all chapters of this standard and are in addition to the definitions provided in individual chapters.

Administrative Regulations. Regulations promulgated by the regulatory agency for administration and enforcement of the provisions of this standard.

Approved.* Acceptable to the authority having jurisdiction.

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

Bay Window. A window assembly whose maximum horizontal projection is no more than 2 ft (610 mm) from the plane of an exterior wall and is elevated above the floor level of the home.

Certification Label. The approved form of manufacturer certification that is permanently affixed to each transportable section of each manufactured home that is subject to this standard *(see Section 1-11).*

Dwelling Unit. One or more habitable rooms, designed to be occupied by one or more persons, with facilities for living, sleeping, cooking, and eating.

Equipment. Materials, appliances, devices, fixtures, fittings, or accessories used in the construction of manufactured homes and in the fire safety, plumbing, heat-producing, and electrical systems of manufactured homes.

Federal Manufactured Home Construction and Safety Standard. A standard either promulgated or adopted under authority of the National Manufactured Housing Construction and Safety Standards Act of 1974 (PL 93-383, as amended).

Installations. All arrangements and methods of construction, as well as fire safety, plumbing, heat-producing, and electrical systems used in manufactured homes.

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.

Length of a Manufactured Home. A manufactured home's largest overall length in the traveling mode, including cabinets and other projections which contain interior space. Length does not include bay windows, roof projections, overhangs, or eaves under which there is no interior space, nor does it include drawbars, couplings, or hitches.

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

Manufacturer. Any person engaged in manufacturing or assembling manufactured homes, including any person engaged in importing manufactured homes for resale.

Manufactured Home. A structure, transportable in one or more sections, that is 8 body-ft (24.4 cm) or more in width or 40 body-ft (1219 cm) or more in length in the traveling mode or, when erected on site, is 320 ft^2 (28 m^2) or more; which is, built on a chassis and designed to be used as a dwelling, with or without a permanent foundation, when connected to the required utilities, including the plumbing, heating, air conditioning, and electrical systems contained therein. Calculations used to determine the number of square feet in a structure will be based on the structure's exterior dimensions, measured at the largest horizontal projections when erected on site. These dimensions include all expandable rooms, cabinets, and other projections containing interior space, but do not include bay windows.

Manufactured Home Construction. All activities relating to the assembly and manufacture of a manufactured home including, but not limited to, those relating to durability, quality, and safety.

Manufactured Home Safety. The performance of a manufactured home in such a manner that the public is protected against any unreasonable risk of the occurrence of accidents or any unreasonable risk of death or injury to the user or to the public if such accidents do occur due to the design or construction of the manufactured home.

Modular Home. A home constructed, all or in part, in accordance with a standard adopted, administered, and enforced by the regulatory agency, or under reciprocal agreement with the regulatory agency, for conventional site-built dwellings.

Multi-Wide. A manufactured home that is made up of two or more transportable sections.

Registered Engineer or Architect. A person licensed to practice engineering or architecture in a state, subject to all laws and limitations imposed by the state's Board of Engineering and Architecture Examiners. A registered engineer or architect is engaged in the professional practice of rendering service or creative work that requires education, training, and experience in engineering sciences and special knowledge of mathematical, physical, and engineering sciences for

the purpose of securing compliance with specifications and design in such professional or creative work as consultation, investigation, evaluation, planning or design, and supervision of construction.

Regulatory Agency. The agency adopting, administering, and enforcing this standard.

Shall. Indicates a mandatory requirement.

Should. Indicates a recommendation or that which is advised but not required.

Single-Wide. A manufactured home that is made up of a single, transportable section.

State. Includes all 50 individual states that make up the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, the U.S. Virgin Islands, the Canal Zone, and American Samoa.

Width of a Manufactured Home. A manufactured home's largest overall width in the traveling mode, including cabinets and other projections that contain interior space. Width does not include bay windows, roof projections, overhangs, or eaves under which there is no interior space.

1-3 Consumer Manual Requirements. Consumer manuals shall be in accordance with Title 24, *Code of Federal Regulations*, Part 3283, *Manufactured Home Consumer Manual Requirements.*

1-4 Incorporation by Reference. The specifications, standards, and codes of the following organizations are incorporated by reference. Reference standards shall have the same force and effect as this standard.

Exception: When reference standards and this standard are inconsistent, the requirements of this standard shall prevail to the extent of the inconsistency.

AA — Aluminum Association, 900 19th Street N.W., Suite 300, Washington, DC 20006

AAMA — American Architectural Manufacturers Association, 1540 East Dundee Road, Palatine, IL 60067

AFPA — American Forest and Paper Association, 1250 Connecticut Avenue, N.W., Washington, DC 20036 [previously named (N)FPA-National Forest Products Association]

AGA — American Gas Association, 8501 East Pleasant Valley Road, Cleveland, OH 44131

AISC — American Institute of Steel Construction, One East Wacker Drive, Suite 3100, Chicago, IL 60601

AISI — American Iron and Steel Institute, 1101 17th Street, N.W., Washington, DC 20036

AITC — American Institute of Timber Construction, 11818 S.E. Mill Plain Blvd., Suite 415, Vancouver, WA 98684

ANSI — American National Standards Institute, 11 West 42nd Street, New York, NY 10036

APA — American Plywood Association, P.O. Box 11700, Tacoma, WA 98411

ARI — Air Conditioning and Refrigeration Institute, 1501 Wilson Blvd., 6th Floor, Arlington, VA 22209-2403

ASCE — American Society of Civil Engineers, 345 East 47th Street, New York, NY 10017-2398

ASHRAE — American Society of Heating, Refrigeration and Air Conditioning Engineers, 1791 Tullie Circle, N.E., Atlanta, GA 30329

ASME — American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017

ASSE — American Society of Sanitary Engineering, 28901 Clemens Road, Suite 100, Westlake, OH 44145

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

CISPI — Cast Iron Soil Pipe Institute, 5959 Shallowford Road, Suite 419, Chattanooga, TN 37421

DOC — U.S. Department of Commerce, National Institute of Standards and Technology, Office of Engineering Standards, Room A-166, Technical Building, Washington, DC 20234

FS — Federal Specifications, General Services Administration, Specifications Branch, Room 6039, GSA Building, 7th and D Streets, S.W., Washington, DC 20407

HPVA — Hardwood Plywood and Veneer Association, P.O. Box 2789, Reston, VA 22090 (previously named HPMA Hardwood Plywood Manufacturers Association)

HUD-FHA — Department of Housing and Urban Development, 451 Seventh Street, S.W., Washington, DC 20410

HUD — USER, Department of Housing and Urban Development, HUD User, P.O. Box 280, Germantown, MD 20874

IAPMO — International Association of Plumbing and Mechanical Officials, 20001 Walnut Drive South, Walnut, CA 91789-2825

IITRI — IIT Research Institute, 10 West 35th Street, Chicago, IL 60616

MIL — Military Specifications and Standards, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120

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

NPA — National Particleboard Association, 18928 Premiere Court, Gaithersburg, MD 20879

NSF — NSF International, P.O. Box 130140, Ann Arbor, MI 48113-0140

NWWDA — National Wood Window and Door Association, 1400 E. Toughy Avenue, Suite G-54, Des Plaines, IL 60018

SAE — Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096

SJI — Steel Joist Institute, 1205 48th Avenue North, Suite A, Myrtle Beach, SC 29577

TPI — Truss Plate Institute, 583 D'Onofrio Drive, Suite 200, Madison, WI 53719

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

1-5 Data Plate. Each manufactured home shall bear a data plate affixed in a permanent manner near the main electrical panel or in another readily accessible and visible location. Each data plate either shall be made of a material that will receive typed information, as well as preprinted information, that can be cleaned of ordinary smudges or household dirt without removing information contained on the data plate; or

shall be covered in a permanent manner with materials that will make it possible to clean the data plate of ordinary dirt and smudges without obscuring the information. Each data plate shall contain not less than the following information:

(a) Name and address of the manufacturing plant where the manufactured home was manufactured

(b) Serial number and model designation of the unit and the date the unit was manufactured

(c) The statement:

"This manufactured home is designed to comply with the National Fire Protection Standard 501 in effect at the time of manufacture."

(d) A list of the certification label(s) number(s) that is affixed to each transportable manufactured section in accordance with Section 1-11

(e) A list of major factory-installed equipment, including the manufacturer's name and the model designation of each appliance

(f) Reference to the roof load zone and wind load zone for which the home is designed and duplicates of the wind zone and roof load zone maps *(see Figures 4-5.3.2 and 4-5.3.3.1)*. This information shall be permitted to be combined with the heating/cooling certificate and insulation zone map required by Sections 6-10 and 6-11.

(g) On the wind zone map on the data plate shall read the following statement:

"This home has not been designed for the higher wind pressures and anchoring provisions required for ocean/coastal areas and should not be located within 1500 ft (457 m) of the coastline in Wind Zones II and III, unless the home and its anchoring and foundation system have been designed for the increased requirements specified for Exposure D in ANSI/ASCE 7-88."

(h) The statement:

"This home has _____ has not _____ (appropriate blank to be checked by manufacturer) been equipped with storm shutters or other protective coverings for windows and exterior door openings. For homes designed to be located in Wind Zones II and III, which have not been provided with shutters or equivalent covering devices, it is strongly recommended that the home be made ready to be equipped with these devices in accordance with the method recommended in the manufacturer's printed instructions."

(i) The statement:

"Design Approval by..." followed by the name of the agency that approved the design

1-6 Serial Number. A serial number that will identify the manufacturer and the state where the manufactured home is manufactured shall be stamped into the foremost cross member. Letters and numbers shall be ⅜-in. (9.5 mm) minimum in height. Numbers shall not be stamped into the hitch assembly or drawbar.

1-7 Excluded Structures. Certain structures shall be permitted to be exempted from this standard by the regulatory agency as modular homes under Title 24, *Code of Federal Regulations*, Part 3282.12.

1-8 Waivers.

1-8.1 Where any material piece of equipment or system does not meet precise requirements or specifications defined in this standard, the manufacturer shall be permitted to submit a written application to the regulatory agency for a waiver of the precise requirement or specification.

1-8.2 The written application for a waiver shall identify the specific provisions of this standard for which a waiver is requested, the specific alternative to the precise requirement or specification that is proposed by the manufacturer, and any supporting data.

1-8.3 The regulatory agency shall be permitted to require, at the manufacturer's expense, additional data, engineering calculations, and testing to demonstrate that the alternative proposed by the manufacturer will produce the equivalent safety and performance of the precise requirement or specification requested to be waived.

1-8.4 The regulatory agency shall issue written approval or disapproval of waiver applications within 30 calendar days from receipt of the application and any data, calculations, or test results requested under the authority of 1-8.3.

1-8.5 A copy of the written approval of a manufacturer's application for a waiver of precise requirements or specifications defined in this standard shall be included as an attachment to the consumer manual required by Section 1-3.

1-9 Interpretive Bulletins.

1-9.1 The regulatory agency shall be permitted to issue interpretive bulletins for the following purposes:

(a) To clarify the meaning of any administrative regulation adopted by the regulatory agency related to the administration and enforcement of this standard

(b) To clarify the meaning of any precise requirement or specification identified in this standard

1-9.2 Interpretive bulletins issued by the regulatory agency shall be uniquely identified by the year issued and the sequential number of the information bulletin issued within that year, beginning with the number 1.

1-9.3 Copies of interpretive bulletins issued by the regulatory agency shall be provided by first class mail to the addresses on record with the regulatory agency for each manufacturer and to each design approval agency, inspection agency, state agency, or other agency that is identified by administrative regulations.

1-9.4 Until modified or revoked by a subsequent interpretive bulletin, interpretive bulletins issued by the regulatory agency shall have the same weight and effect as the precise requirements and specifications of this standard or the administrative regulations.

1-10 Use of Alternative Construction. Applications for regulatory agency approval of alternative construction methods shall be made in accordance with Section 1-8.

1-11 Certification Label.

1-11.1 A permanent label shall be affixed to each transportable section of each manufactured home subject to this standard. This label shall be separate and distinct from the data plate required by Section 1-5.

1-11.2 The label shall be approximately 2 in. × 4 in. (50 mm × 100 mm) in size and shall be permanently attached to the manufactured home by means that render it difficult to remove without defacing it. The label shall be etched on a 0.32 in.-thick (8.2-mm) aluminum plate or other material identified by the administrative regulations. The label shall be etched or stamped with a sequence of letters identifying the production inspection agency followed by a series of sequential numbers in a manner identified in the administrative regulations.

1-11.3 The label shall read as follows:

"As evidenced by this label No. (e.g., ABC 000001), the manufacturer certifies to the best of the manufacturer's knowledge and belief that this manufactured home has been constructed and inspected in accordance with the requirements of the (regulatory agency name) and is in conformance with the National Fire Protection Association Standard 501 in effect on the date of manufacture. See data plate."

1-11.4* The label shall be located on the rear left road side of each transportable section of the manufactured home, approximately 1 ft (30 cm) up from the floor and 1 ft (30 cm) in from the road side, or as near that location on a permanent part of the exterior of the manufactured home unit as practicable.

Chapter 2 Planning Considerations

2-1 Scope. The purpose of this chapter shall be to state the planning requirements of manufactured homes to ensure the adequacy of architectural planning considerations that assist in determining a safe and healthful environment.

2-2 Definitions. The following additional definitions shall be applicable to this chapter.

Gross Floor Area. All wall to wall space including recessed entries not to exceed 5 ft^2 (0.46 m^2) and areas under built-in vanities and similar furniture. Where the ceiling height is less than that specified in Section 2-4, the floor area under such ceilings shall not be included. Floor area of closets shall not be included in the gross floor area.

Habitable Room. A room or enclosed floor space arranged for living, eating, food preparation, or sleeping purposes, not including bathrooms, foyers, hallways, and other accessory floor space.

Laundry Area. An area containing or designed to contain a laundry tray, clothes washer, and/or clothes dryer.

2-3 Light and Ventilation.

2-3.1 Lighting. Each habitable room shall be provided with exterior windows and/or doors having a total glazed area of not less than 8 percent of the gross floor area.

2-3.1.1 Kitchens, bathrooms, toilet compartments, laundry areas, and utility rooms shall be permitted to be provided with artificial light in lieu of windows.

2-3.1.2 Rooms and areas shall be permitted to be combined for the purpose of providing the required natural lighting, provided that at least one half of the common wall area is open and unobstructed and the open area is at least equal to 10 percent of the combined floor area or 25 ft^2 (2.3 m^2), whichever is greater.

2-3.2 Whole-House Ventilation. Each manufactured home shall be capable of continuously providing a minimum of 0.35 air changes per hour (ACH), or an equivalent hourly average rate. The requirements of 2-3.2.1 through 2-3.2.7 also shall apply.

2-3.2.1 Natural infiltration and exfiltration shall be considered as providing 0.25 ACH.

2-3.2.2 The remaining ventilation capacity of 0.10 ACH, or its hourly average equivalent, shall be calculated using 0.035 $ft^3/min/ft^2$ (.00018 $m^3/s/m^2$) of interior floor space. This ventilation capacity shall be in addition to any openable window area.

2-3.2.3 The remaining ventilation capacity shall be permitted to be provided by a mechanical system, a passive system, or a combination passive and mechanical system. The ventilation system or provisions for ventilation shall not create a positive pressure in U_0 value Zone 2 and Zone 3 or a negative pressure condition in U_0 value Zone 1. Mechanical systems shall be balanced. Combination passive and mechanical systems shall have adequately sized inlets or exhaust to release any unbalanced pressure. Passive systems shall have inlets and exhaust vents of sufficient size to alleviate unbalanced pressure conditions under normal conditions. Temporary imbalances due to gusting or high winds shall be permitted.

2-3.2.4 The ventilation system or provisions for ventilation shall exchange air directly with the exterior of the home, except it shall not draw or expel air with the space underneath the home. The ventilation system or provisions for ventilation shall not draw or expel air into the floor, wall, or ceiling/roof systems, even if those systems are vented.

2-3.2.5 The ventilation system or a portion thereof shall be permitted to be integral with the home's heating or cooling system. The system shall be capable of operating independently of the heating or cooling modes. A ventilation system that is integral with the heating or cooling system shall be listed as part of the heating and cooling system or listed as suitable for use therewith.

2-3.2.6 A mechanical ventilation system, or mechanical portion thereof, shall be provided with a manual control, and shall be permitted to be provided with automatic timers or humidistats.

2-3.2.7 Substantiation of the ventilation capacity to provide 0.10 ACH shall be provided for a mechanical system, a passive system, or a combination passive and mechanical system.

2-3.3 Additional Ventilation.

2-3.3.1 At least half of the minimum required glazed area in 2-3.1 shall be openable directly to the outside of the manufactured home for unobstructed ventilation. These same ventilation requirements shall apply to rooms combined in accordance with 2-3.1.2.

2-3.3.2 Kitchens shall be provided with a mechanical ventilation system that is capable of exhausting 100 cfm (0.047 m^3/s) to the outside of the home. The exhaust fan shall be located as close as possible to the range or cook top, but in no case shall it be farther than 10 ft (3.1 cm) horizontally from the range or cook top.

2-3.3.3 Each bathroom and separate toilet compartment shall be provided with a mechanical ventilation system capable

of exhausting 50 cfm (0.024 m^3/s) to the outside of the home. A separate toilet compartment shall be permitted to be provided with 1.5 ft^2 (13.4 m^2) of openable glazed area in place of mechanical ventilation.

Exception: Openable glazed area shall not be permitted to replace mechanical ventilation in U_0 value Zone 3.

2-4 Ceiling Heights.

2-4.1 Every habitable room and bathroom shall have a minimum ceiling height of not less than 7 ft (2.1 m) for a minimum of 50 percent of the room's floor area. The remaining area shall be permitted to have a ceiling with a minimum height of 5 ft (1.5 m). Minimum height under dropped ducts, beams, and other similar projections shall be 6 ft 4 in. (1.9 m).

2-4.2 Hallways and foyers shall have a minimum ceiling height of 6 ft 6 in. (2 m).

2-5 Exit Facilities — Exterior Doors.

2-5.1 Number and Location of Exterior Doors. Manufactured homes shall have a minimum of two exterior doors remotely located from each other.

2-5.1.1 Required egress doors shall not be located in rooms where a lockable interior door must be used in order to exit.

2-5.1.2 In order for exit doors to be considered remote from each other, they shall comply with 2-5.1.2.1 through 2-5.1.2.4.

2-5.1.2.1 The two required exit doors shall not be in the same room or in a group of rooms that are not defined by fixed walls.

2-5.1.2.2 Single-Wide Units. Doors shall not be less than 12 ft (3.7 m) c-c from each other, as measured in any straight line direction, regardless of the length of path of travel between doors.

2-5.1.2.3 Multi-Wide Units. Doors shall not be less than 20 ft (6.1 m) c-c from each other, as measured in any straight line direction, regardless of the length of path of travel between doors.

2-5.1.2.4 One of the required exit doors shall be accessible from the doorway of each bedroom without traveling more than 35 ft (10.7 m).

2-5.2 Door Design and Construction.

2-5.2.1 Exterior swinging doors shall be constructed in accordance with Section 5-5. Exterior sliding glass doors shall be constructed in accordance with Section 5-3.

2-5.2.2 All exterior swinging doors shall provide a minimum 28-in. wide × 74-in. high (71-cm × 188-cm) clear opening. All exterior sliding glass doors shall provide a minimum 28-in. wide × 72-in. (71-cm × 183-cm) high clear opening.

2-5.2.3 Each swinging exterior door, other than screen or storm doors, shall have a key-operated lock that has a deadlocking latch or a key-operated dead bolt with a passage latch. Locks shall not require the use of a key for operation from the inside.

2-5.2.4 All exterior doors, including storm and screen doors, that open outward shall be provided with a safety door check.

2-6 Exit Facilities — Egress Windows and Devices.

2-6.1 Every room designed expressly for sleeping purposes, unless it has an exit door *(see Section 2-5)*, shall have at least one outside window or approved exit device meeting the requirements of Section 5-4.

2-6.2 The bottom of the window opening shall not be more than 36 in. (91 cm) above the floor.

2-6.3 Locks, latches, operating handles, tabs, and any other window screen or storm window devices that need to be operated in order to permit exiting shall not be located in excess of 54 in. (137 cm) from the finished floor.

2-6.4 Integral rolled-in screens shall not be permitted in an egress window unless the window is of the hinged type.

2-7 Interior Privacy. Bathroom and toilet compartment doors shall be equipped with a privacy lock.

2-8 Interior Passage.

2-8.1 Interior doors having passage hardware without a privacy lock, or with a privacy lock not engaged, shall open from either side by a single movement in any direction of the hardware mechanism.

2-8.2 When provided, each privacy lock on interior doors shall have an emergency release on the outside to permit entry when the lock has been locked by a locking knob, lever, button, or other locking device from the inside.

2-9 Room Requirements.

2-9.1 Every manufactured home shall have at least one living area with not less than 150 ft^2 (13.9 m^2) of gross floor area.

2-9.2 Rooms designed for sleeping purposes shall have a minimum gross sq ft floor area, as follows:

(a) All bedrooms shall have at least 50 ft^2 (4.6 m^2) of floor area.

(b) Bedrooms designed for two or more people shall have 70 ft^2 (6.5 m^2) of floor area plus 50 ft^2 (4.6 m^2) for each person in excess of two.

(c) Every room designed for sleeping purposes shall have accessible clothes hanging space with a minimum inside depth of 22 in. (56 cm) and shall be equipped with a rod and shelf.

2-10 Minimum Room Dimensions. The gross floor area required by 2-9.1 and 2-9.2 shall have no clear horizontal dimension less than 5 ft (1.5 m). *(See Section 2-2 for a definition of gross floor area.)*

2-11 Toilet Compartments. Each toilet compartment shall be a minimum of 30 in. (76 cm) in width. At least 21 in. (53 cm) of clear space shall be provided in front of each toilet.

Exception: When the toilet is located adjacent to the short dimension of the tub, the distance from the tub to the center line of the toilet shall not be less than 12 in. (30 cm).

2-12 Hallways. Hallways shall have a minimum horizontal dimension of 28 in. (71 cm) measured from the interior finished surface of one wall to the interior finished surface of the opposite wall. Where appliances are installed in a laundry area, the measurement shall be taken from the front of the appliance to the opposite finished interior surface. Where appliances are not installed and a laundry area is provided, the area

shall have a minimum clear depth of 27 in. (69 cm) in addition to the 28 in. (71 cm) required for passage. In addition, a notice of the available clearance for washer/dryer units shall be posted in the laundry area. Minor protrusions into the minimum hallway width by doorknobs, trim, smoke detectors, or light fixtures shall be permitted.

2-13 Glass and Glazed Openings.

2-13.1 Windows and Sliding Glass Doors. All windows and sliding glass doors shall meet the requirements of Section 5-3.

2-13.2 Safety Glazing. Glazing in all entrance or exit doors; sliding glass doors; units (fixed or moving sections); unframed glass doors; unbacked mirrored wardrobe doors (i.e., mirrors not secured to a backing capable of being the door itself); shower and bathtub enclosures with surrounds to a height of 6 ft (1.8 m) above the bathroom floor level; storm doors or combination doors; and panels located within 12 in. (305 mm) on either side of exit or entrance doors, shall be of a safety glazing material. A safety glazing material shall be considered to be any glazing material capable of passing the requirements of ANSI Z97.1, *Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings.*

Chapter 3 Fire Safety

3-1 Scope. The purpose of this chapter shall be to set forth requirements that will ensure reasonable fire safety to the occupants by reducing fire hazards and providing methods for early detection.

3-2 Definitions. The following definitions shall be applicable to Chapters 3, 8, and 9.

Combustible Material. Any material not meeting the definition of limited-combustible or noncombustible material.

Flame Spread Index. The measurement of the propagation of flame on the surface of materials or their assemblies as determined by recognized standard tests conducted as required by this chapter.

Interior Finish. The surface material of walls, fixed or movable partitions, ceilings, columns, and other exposed interior surfaces affixed to the home's structure, including any materials such as paint or wallpaper and the substrate to which they are applied. Interior finish shall not include the following:

(a) Trim and sealant 2 in. (50 mm) or less in width adjacent to the cooking range and in furnace and water heater spaces, provided it is installed in accordance with the requirements of 3-3.2.3 or 3-3.2.4, and trim 6 in. (152 mm) or less in width in all other areas

(b) Windows and frames

(c) Single doors and frames and a series of doors and frames not exceeding 5 ft (1.5 m) in width;

(d) Skylights and frames

(e) Casings around doors, windows, and skylights not exceeding 4 in. (102 mm) in width

(f) Furnishings that are not permanently affixed to the home's structure

(g) Baseboards not exceeding 6 in. (152 mm) in height

(h) Light fixtures, cover plates of electrical receptacle outlets, switches, and other devices

(i) Decorative items attached to walls and partitions (e.g., pictures, decorative objects, etc.) constituting no more than 10 percent of the aggregate wall surface area in any room or space not more than 32 ft^2 (3.0 m^2) in surface area, whichever is less

(j) Plastic light diffusers, when suspended from a material that meets the interior finish provisions of 3-3.2

(k) Coverings and surfaces of exposed wood beams

(l) Decorative items that include the following:

1. Nonstructural beams not exceeding 6 in. (152 mm) in depth and 6 in. (152 mm) in width and spaced not closer than 4 ft (1.2 m) on center

2. Nonstructural lattice work

3. Mating and closure molding

4. Other items not affixed to the home's structure

Limited-Combustible. A material that meets the following criteria:

(a) The definition of Article 2-3 of NFPA 220, *Standard on Types of Building Construction,* which states:

> A building construction material not complying with the definition of noncombustible material that, in the form in which it is used, has a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg), where tested in accordance with NFPA 259, *Standard Test Method for Potential Heat of Building Materials,* and complies with 1. or 2. below. Materials subject to increase in combustibility or flame spread index beyond the limits herein established through the effects of age, moisture, or other atmospheric condition shall be considered combustible.
>
> 1. Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of 1/8 in. (3.2 mm) that has a flame spread index not greater than 50
>
> 2. Materials, in the form and thickness used, other than as described in 1., having neither a flame spread index greater than 25 nor evidence of continued progressive combustion and of such composition that surfaces that would be exposed by cutting through the material on any plane would have neither a flame spread index greater than 25 nor evidence of continued progressive combustion.

(b) 5/16-in. (8 mm) or thicker gypsum board

Noncombustible Material. A material that, in the form in which it is used and under the conditions anticipated, does not ignite, burn, support combustion, or release flammable vapors, when subjected to fire or heat. Materials that are reported as passing ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C,* shall be considered noncombustible materials.

Single-Station Alarm Device. An assembly incorporating the smoke detector sensor, the electrical control equipment, and the alarm-sounding device in one unit.

Smoke Alarm. A single or multiple station alarm responsive to smoke.

3-3 Flame Spread Limitations and Fire Protection Requirements.

3-3.1 Establishment of Flame Spread Index. The surface flame spread index of interior-finish material shall not exceed the values shown in 3-3.2 when tested in accordance with

NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials.* The surface flame spread rating of interior-finish materials required by 3-3.2.5 and 3-3.2.6 shall be permitted to be determined in accordance with ASTM E 162, *Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.*

The following materials shall not need to be tested to establish their flame spread index unless a lower rating is required.

(a) Flame Spread Index — 76 to 200:

1. 0.035-in. (0.9-mm) or thicker high-pressure laminated plastic panel countertop
2. ¼-in. (6-mm) or thicker unfinished plywood with phenolic or urea glue
3. Unfinished dimension lumber [1-in. (25-mm) or thicker nominal boards]
4. ⅜-in. (10-mm) or thicker unfinished particle board with phenolic or urea binder
5. The following materials either natural gum-varnished or latex- or alkyd-painted:
   a. ¼-in. (6-mm) or thicker plywood
   b. ⅜-in. (10-mm) or thicker particle board
   c. 1-in. (25-mm) or thicker nominal board
6. 5/16-in. (8-mm) gypsum board with decorative wallpaper
7. ¼-in. (6-mm) or thicker unfinished hardboard

(b) Flame Spread Index — 25 to 200:

1. Painted metal
2. Mineral-based acoustic tile
3. 5/16-in. (8-mm) or thicker unfinished gypsum wallboard (both latex- or alkyd-painted)
4. Ceramic tile

Use of these material applications shall not waive the requirements of 3-3.3 or Section 3-4.

3-3.2 Flame Spread Index Requirements.

3-3.2.1 The interior finish of walls, columns, and partitions shall not have a flame spread index exceeding 200, except as otherwise specified herein.

3-3.2.2 Ceiling interior finish shall not have a flame spread index exceeding 75.

3-3.2.3 Walls adjacent to or enclosing a furnace or water heater, and the ceilings above them, shall have an interior finish with a flame spread index not exceeding 25.

Exception: Sealants and other trim materials 2 in. (50 mm) or less in width that are used to finish adjacent surfaces within these spaces provided that all joints are completely supported by framing members or by materials having a flame spread index not exceeding 25.

3-3.2.4* Exposed interior finishes adjacent to the cooking range shall have a flame spread index not exceeding 50. *(See Section 3-4.)*

Exception: Backsplashes not exceeding 6 in. (152 mm) in height and sealants and other trim materials 2 in. (50 mm) or less in width that are used to finish adjacent surfaces provided that all joints are completely supported by a framing member.

3-3.2.5 Kitchen cabinet doors, countertops, backsplashes, exposed bottoms, and end panels shall have a flame spread index not exceeding 200.

Exception: Cabinet rails, stiles, mullions, and top strips.

3-3.2.6 Finished surfaces of plastic bathtubs, shower units, and tub or shower doors shall have a flame spread index not exceeding 200.

3-3.3 Fire-Protective Requirements.

3-3.3.1 Materials used to surface the following areas shall be limited-combustible materials [e.g., 5/16-in. (8-mm) gypsum board]:

(a) The exposed wall adjacent to the cooking range *(see 3-3.2.4)*

(b) Exposed bottoms and sides of kitchen cabinets, as required by Section 3-4

(c) Interior walls and ceilings enclosing furnace and/or water heater spaces

(d) Combustible doors that provide interior or exterior access to furnace and/or water heater spaces. The surface shall be permitted to be interrupted for louvers ventilating the enclosure. However, the louvers shall not be constructed of a material of greater combustibility than the door itself (e.g., plastic louvers on a wooden door)

3-3.3.2 No burner of a surface cooking unit shall be closer than 12 horizontal in. (305 mm) to a window or an exterior door with glazing.

3-4 Kitchen Cabinet Protection.

3-4.1 The bottom and sides of combustible kitchen cabinets located over cooking ranges to a horizontal distance of 6 in. (152 mm) from the outside edge of the cooking range shall be protected with at least 5/16-in. (8-mm) thick gypsum board or equivalent limited-combustible material.

Exception: 1-in. (25.4-mm) nominal framing members and trim shall be exempted from this requirement.

3-4.2 The cabinet area located over the cooking range or cooktops shall be protected by a metal hood (26-gauge sheet metal, 0.017 stainless steel, 0.024 aluminum, or 0.020 copper), with not less than a 3-in. (76-mm) eyebrow projecting horizontally from the front cabinet face. The 5/16-in. (8-mm) thick gypsum board or equivalent limited-combustible material that is above the top of the hood shall be permitted to be supported by the hood. A ⅜-in. (10-mm) enclosed air space shall be provided between the bottom surface of the cabinet and the gypsum board or equivalent material. The hood shall be at least as wide as the cooking range.

3-4.3 The 3-in. (76-mm) metal eyebrow required by 3-4.2 shall project from the front and rear cabinet faces when there is no adjacent surface behind the range, or 5/16-in. (8-mm) thick gypsum board or equivalent limited-combustible material shall be extended to cover all exposed rear surfaces of the cabinet.

3-4.4 The metal hood required by 3-4.1 and 3-4.2 shall not be required where an oven of equivalent metal protection is installed between the cabinet and the range and all exposed cabinet surfaces are protected as described in 3-4.1.

3-4.5 When a manufactured home is designed for the future installation of a cooking range, the metal hood and cabinet protection required by 3-4.1 and 3-4.2 and the wall-surfacing protection behind the range required by Section 3-3 shall be installed in the factory.

3-4.6 Vertical Clearance above Cooking Top. Ranges shall have a vertical clearance above the cooking top of not less than 24 in. (610 mm) to the bottom of combustible cabinets.

3-5 Carpeting. Carpeting shall not be used in a space or compartment designed to contain only a furnace and/or water heater. Carpeting shall be permitted to be used in other areas where a furnace or water heater is installed, provided that it is not located under the furnace or water heater.

3-6 Firestopping.

3-6.1* Firestopping of at least 1-in. (25.4-mm) nominal lumber, 5/16-in. (8-mm) thick gypsum board, or the equivalent, shall be provided to cut off concealed draft openings between walls and partitions, including furred spaces, and the roof or floors so as to retard vertical movement of fire. In particular, such concealed spaces shall be constructed so that floor-to-ceiling concealed spaces on one floor do not communicate with any concealed space on another floor level, any concealed spaces within the floor, or any concealed space in the roof cavity. A barrier shall be installed to prevent communication between adjacent concealed spaces.

3-6.1.1 Where the barrier is vertical, it shall be made of exterior or interior covering(s) equivalent to that used on the nearest exposed wall surface.

3-6.1.2 In all other cases, the barrier shall be made of 1-in. (25-mm) nominal lumber, 5/16-in. (8-mm) thick gypsum board, or the equivalent.

3-6.2 Openings for pipes and vents and other penetrations in walls, floors, and ceilings of furnace and water heater spaces shall be tight-fitted or firestopped. Pipes, vents, and other penetrations shall be considered to be tight-fitted when they cannot be moved freely in the opening.

3-7 Requirements for Foam Plastic Thermal Insulating Materials.

3-7.1 General. Foam plastic thermal insulating materials shall not be used within the cavity of walls (not including doors) or ceilings or be exposed to the interior of the home unless one of the following conditions exists:

(a) The foam plastic insulating material is protected by an interior finish of 5/16-in. (8-mm) thick gypsum board or equivalent limited-combustible material for all cavities where the material is to be installed.

(b) The foam plastic is used as a sheathing or siding backerboard, and it has the following characteristics:

1. Flame spread index of 75 or less and a smoke-developed index of 450 or less (not including outer covering or sheathing)

2. Does not exceed 3/8 in. (10 mm) in thickness

3. Is separated from the interior of the manufactured home by a minimum of 2 in. (50 mm) of mineral fiber insulation or an equivalent thermal barrier

(c) The foam plastic insulating material has been previously accepted by the regulatory agency for use in wall and/or ceiling cavities of manufactured homes, and the insulating material is installed in accordance with any restrictions imposed at the time of that acceptance.

(d) The foam plastic insulating material has been tested as required for its location in wall and/or ceiling cavities in accordance with testing procedures described in the Illinois Institute of Technology Research Institute (IITRI) Report, "Development of Mobile Home Fire Test Methods to Judge the Fire Safe Performance of Foam Plastic," J-6461, or other full-scale fire tests accepted by the regulatory agency, and it is installed in a manner consistent with the way the material was installed in the foam plastic test module. The materials shall be capable of meeting the following acceptance criteria required for their location.

3-7.1.1 Wall Assemblies. The foam plastic system shall demonstrate equivalent or superior performance to the control module as determined by the following:

(a) Time it takes to reach flashover [1112°F (600°C)] in the upper part of the room

(b) Time it takes to reach an oxygen (O_2) level of 14 percent (rate of O_2 depletion), a carbon monoxide (CO) level of 1 percent, a carbon dioxide (CO_2) level of 6 percent, and a smoke level of 0.26 optical density/meter measured at 5 ft (1.5 m) high in the doorway

(c) Rate of change concentration for O_2, CO, CO_2, and smoke measured 3 in. (76 mm) below the top of the doorway

3-7.1.2 Ceiling Assemblies. A minimum of three valid tests of the foam plastic system and one valid test of the control module shall be evaluated to determine if the foam plastic system demonstrates equivalent or superior performance to the control module. Individual factors to be evaluated include intensity of cavity fire (temperature-time) and post-test damage.

3-7.1.3 Post-Test Damage Assessment for Wall and Ceiling Assemblies. The overall performance of each total system also shall be evaluated in determining the acceptability of a particular foam plastic insulating material.

3-7.2 All foam plastic thermal insulating materials used in manufactured housing shall have a flame spread index of 75 or less (not including outer covering or sheathing) and a maximum smoke-developed index of 450.

3-8 Fire Detection Equipment.

3-8.1 General. At least one smoke alarm (a single-station alarm device is acceptable) shall be installed in the home in the location(s) specified in 3-8.2.

3-8.2 Smoke Alarm Locations.

3-8.2.1 A smoke alarm shall be installed on any wall in the hallway or space communicating with each bedroom area between the living area and the first bedroom door. If a door(s) separates the living area from that bedroom area, the smoke alarm(s) shall be installed on the living area side as close to the door(s) as practicable. Homes having bedroom areas separated by any one or combination of common-use areas, such as a kitchen, dining room, living room, or family room (but not a bathroom or utility room), shall have at least one smoke alarm protecting each bedroom area.

3-8.2.2 When located in hallways, the smoke alarm shall be placed between the return air intake and the living area.

3-8.2.3 When a home is equipped or designed for future installation of a roof-mounted evaporative cooler or other equipment discharging conditioned air through a ceiling grille into the living space environment, the smoke alarm closest to the air discharge shall be located no closer than 3 ft (914 mm) horizontal from any discharge grille.

3-8.2.4 A smoke alarm shall not be placed in a location that impairs its effectiveness.

3-8.3 Labeling. Smoke alarms shall be labeled as conforming with the requirements of UL 217, *Single and Multiple Station Smoke Detectors.*

3-8.4 Installation. Each smoke alarm shall be installed in accordance with its listing and manufacturer's instructions. The required smoke alarm(s) shall be attached to an electrical outlet box and the device connected by a permanent wiring method to an ac power source. AC power shall be supplied either from a dedicated branch circuit or the unswitched portion of a branch circuit also used for power and lighting. Operation of a switch (other than a circuit breaker) or a ground-fault circuit-interrupter shall not cause loss of ac power.

3-8.5 Interconnection of Smoke Alarms. Where more than one smoke alarm is required, the devices shall be arranged so that operation of any smoke alarm causes all smoke alarms within the home to sound.

3-8.6 Testing and Maintenance.

3-8.6.1 Following installation, smoke alarms shall be functionally tested in accordance with alarm manufacturer's instructions.

3-8.6.2 Home manufacturers shall provide specific instructions to set-up crews or other responsible parties for the inspection and testing of smoke alarms during manufactured home setup.

3-8.6.3 Home manufacturers shall provide the homeowner with the alarm manufacturer's information describing the operation, method, and frequency of testing, and proper smoke alarm maintenance.

3-9 Fire Testing. All fire testing conducted in accordance with this chapter shall be performed by nationally recognized testing laboratories with expertise in fire technology. In case of dispute, the regulatory agency shall determine if a particular agency is qualified to perform such fire tests.

Chapter 4 Body and Frame Construction Requirements

4-1 Scope. This chapter shall cover the minimum requirements for materials, products, equipment, and workmanship needed to ensure that the manufactured home will provide the following:

(a) Structural strength and rigidity

(b) Protection against corrosion, decay, insects, and other similar destructive forces

(c) Protection against hazards of windstorm

(d) Resistance to the elements

(e) Durability and economy of maintenance

4-2 Definitions. The following definitions shall be applicable to Chapter 4 only.

Anchoring Equipment. Straps, cables, turnbuckles, and chains, including tensioning devices, that are used with ties to secure a manufactured home to ground anchors.

Anchoring System. A combination of ties, anchoring equipment, and ground anchors that will, when properly designed and installed, resist overturning and lateral movement of the manufactured home from wind forces.

Diagonal Tie. A tie intended to primarily resist horizontal forces, but which also can be used to resist vertical forces.

Footing. That portion of the support system that transmits loads directly to the soil.

Ground Anchor. Any device at the manufactured home stand designed to transfer manufactured home anchoring loads to the ground.

Loads:

Dead Load. The weight of all permanent construction, including walls, floors, roof, partitions, and fixed service equipment.

Live Load. The weight superimposed by the use and occupancy of the manufactured home, including wind load and snow load, but not including dead load.

Wind Load. The lateral or vertical pressure or uplift on the manufactured home due to wind blowing in any direction.

Main Frame. The structural component on which the body of the manufactured home is mounted.

Pier. That portion of the support system between the footing and the manufactured home, exclusive of caps and shims.

Sheathing. Material that is applied on the exterior side of a building frame under the exterior weather-resistant covering.

Stabilizing Devices. All components of the anchoring and support systems, including piers, footings, ties, anchoring equipment, ground anchors, and any other equipment that supports the manufactured home and secures it to the ground.

Support System. A combination of footings, piers, caps, and shims that will, when properly installed, support the manufactured home.

Tie. Straps, cable, or securing devices used to connect the manufactured home to ground anchors.

Vertical Tie. A tie intended to resist uplifting or overturning forces.

4-3 General Requirements.

4-3.1 Minimum Requirements. The design and construction of a manufactured home shall conform with the provisions of this standard. Requirements for any size, weight, or quality of material modified by the terms "of minimum," "not less than," "at least," and similar expressions, are minimum standards. The manufacturer or installer shall be permitted to exceed these standards, provided such deviation does not result in any inferior installation or defeat the purpose and intent of this standard.

4-3.2 Construction. All construction methods shall be in conformance with accepted engineering practices to ensure durable, livable, and safe housing and shall demonstrate acceptable workmanship that reflects a journeyman quality of work.

4-3.3 Structural Analysis. The strength and rigidity of the component parts and/or the integrated structure shall be determined by engineering analysis or by suitable load tests to simulate the actual loads and conditions of application that can occur. *(See Chapters 5 and 10.)*

4-3.4 New Materials and Methods.

4-3.4.1 Any new material or method of construction not provided for in this standard and any material or method of ques-

tioned suitability proposed for use in the manufacture of the structure shall nevertheless conform in performance to the requirements of this standard.

4-3.4.2 Unless based on accepted engineering design for the use indicated, all new manufactured home materials, equipment, systems, or methods of construction not provided for in this standard shall be subjected to the tests specified in 4-3.6.

4-3.5 Allowable Design Stress. The design stresses of all materials shall conform to accepted engineering practices. The use of materials not certified with a strength or stress grade shall be limited to the minimum allowable stresses under accepted engineering practices.

4-3.6 Alternate Test Procedures. In the absence of recognized testing procedures either in these standards or the applicable provisions of those standards incorporated by reference, the manufacturer shall develop or cause to be developed testing procedures to demonstrate the structural properties and significant characteristics of the material, assembly, subassembly component, or member. Such testing procedures shall become part of the manufacturer's approved design.

4-3.6.1 Alternate testing procedures so developed shall be submitted to the regulatory agency for approval.

4-3.6.2 Upon notification of approval, the alternative test procedure shall be considered acceptable.

4-3.6.3 Such tests shall be witnessed by an independent licensed, professional engineer or architect, or by a recognized testing organization. Copies of the test results shall be kept on file by the manufactured home manufacturer.

4-4 Materials. See Table 4-4 for some generally used materials and standard methods of construction.

Table 4-4 Materials and Methods for Construction

Materials	Reference Standards
Steel	
Specification for Aluminum Structures Construction Manual Series — Section 1, Fifth Edition	AA-30 — 1986
Specification for Structural Steel Buildings — Allowable Stress Design and Plastic Design (The following parts of this reference standard shall not be applicable: 1.3.3, 1.3.4, 1.3.5, 1.3.6, 1.4.6, 1.5.1.5, 1.5.5, 1.6, 1.7, 1.8, 1.9, 1.10.4 through 1.10.7, 1.10.9, 1.11, 1.13, 1.14.5, 1.17.7 through 1.17.9, 1.19.1, 1.19.3, 1.20, 1.21, 1.23.7, 1.24, 1.25.1 through 1.25.5, 1.26.4, 2.3, 2.4, 2.8 through 2.10.)	AISC-S335 — June 1, 1989
Specification for the Design of Cold-Formed Steel Structural Members (The following parts of this reference standard shall not be applicable: 3.1.2, 4.2.1, 4.2.4.)	AISI-SG-673 — 1986 edition with 1989 addendum
Stainless Steel Cold-Formed Structural Design Manual (The following part of this reference standard shall not be applicable: 3.1.2.)	ASCE-8 — 1991
Standard Specifications for Load Tables and Weight Tables for Steel Joists and Joist Girders. (Only Sections 1-6 and the table for "H series only" shall be applicable.)	SJI — 40th ed.
Manual for Structural Applications of Steel Cables for Buildings	ASCE-19 — 1996
Standard Specification for Strapping, Flat Steel and Seals	ASTM D 3953-91
Wood and Wood Products	
Basic Hardboard	AHA A 135.4-1995
Prefinished Hardboard Paneling	AHA A 135.5-1995
Hardboard Siding	AHA A 135.6-1990
Hardwood and Decorative Plywood	HPVA HP-1-1994
Structural Design Guide for Hardwood Plywood Wall Panels	HP Design Guide HP-SG-96
For wood products — *Structural Glued Laminated Timber*	AITC A 190.1-1992
Voluntary Product Standard, Construction and Industrial Plywood	V99-95
APA Design/Construction Guide, Residential and Commercial Design and Fabrication of All-Plywood Beams, Supp. 5	APA-E 30P-1996
Design and Fabrication of All-Plywood Beams, Supp. 5	APA-H 815E-1995
Plywood Design Specification	APA-Y 510S-1997
Design and Fabrication of Glued Plywood-Lumber Beams, Supp. 2	APA-S 812Q-1996
Design and Fabrication of Plywood Curved Panels, Supp. 1	APA-S 811N-1995
Design and Fabrication of Plywood Sandwich Panels, Supp. 4.	APA-U 814H-1993

Table 4-4 *(Continued)*

Materials	Reference Standards
Wood and Wood Products *(continued)*	
Performance Standards and Policies for Structural Use Panels	APA-PRP-E-108Q-95
Design and Fabrication of Plywood Stressed-Skin Panels, Supp. 3	APA-U 813L-1996
National Design Specifications for Wood Construction 1991 edition, with supplement, *Design Values for Wood Construction*	AFPA T01-97
Wood Structural Design Data, 1986 edition with 1992 revisions	AFPA T05
Span Tables for Joists and Rafters	PS-20-70, 1993 AFPA
Design Values for Joists and Rafters, American Softwood Lumber Standard Sizes	AFPA T04-93
Material Design Standard for Metal Plate Connected Wood Trusses	TPI-95
Mat-Formed Wood Particleboard	ANSI A 208.1-1989
Architectural Wood Flush Doors	NWWDA I.S.1a-93
Wood Windows	NWWDA I.S.2-93
Wood Sliding Patio Doors	NWWDA I.S.3-95
Water Repellent Preservative Non-Pressure Treatment for Millwork	NWWDA I.S.4-94
Standard Test Methods for Puncture and Stiffness of Paperboard, and Corrugated and Solid Fiberboard	ASTM D 781-68(73)
Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials	ASTM D 4442-92
Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters	ASTM D 4444-92
Other	
Standard Specification for Gypsum Wallboard	ASTM C 36-B95
Fasteners	
Application and Fastening Schedule: Power-Driven, Mechanically Driven and Manually Driven Fasteners-HUD-FHA Use of Materials Bulletin	UM 25d-73
Unclassified	
Minimum Design Loads for Buildings and Other Structures	ASCE 7-95
Performance Standard for Wood-Based Structural Use Panels	APA PS-2-96
Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Building	ANSI Z 97.1-1984

4-4.1 Dimension and board lumber shall not exceed 19 percent moisture content at time of installation.

4-4.2 Materials and methods of construction utilized in the design and construction of manufactured homes that are covered by the standards in Table 4-4, or any applicable portion thereof, shall comply with the requirements of this standard.

4-4.3 Engineering analysis and testing methods contained in the references in Table 4-4 shall be utilized to judge conformance with accepted engineering practices required in 4-3.3.

4-4.4 Materials and methods of installation conforming to the standards in Table 4-4 shall be considered acceptable when installed in conformance with the requirements of Chapter 4.

4-4.5 Materials meeting the standards in Table 4-4 (or the applicable portion thereof) shall be considered acceptable unless otherwise specified herein or substantial doubt exists as to conformance.

4-4.6 Wood products shall be identified as complying with the appropriate standards in Table 4-4.

4-5 Structural Design Requirements.

4-5.1 General. Each manufactured home shall be designed and constructed as a completely integrated structure capable of sustaining the design load requirements of this standard and capable of transmitting these loads to stabilizing devices without exceeding the allowable stresses or deflections. Roof framing shall be securely fastened to wall framing, walls to floor structure, and floor structure to chassis to secure and maintain continuity between the floor and chassis, so as to resist wind overturning, uplift, and sliding, as imposed by design loads in this area. Uncompressed finished flooring greater

than ⅛ in. (3 mm) in thickness shall not extend beneath load-bearing walls that are fastened to the floor structure.

4-5.2 Design Loads.

4-5.2.1 Design Dead Loads. Design dead loads shall be the actual dead load supported by the structural assembly under consideration.

4-5.2.2 Design Live Loads. The design live loads and wind and snow loads shall be as specified in Section 4-5 and shall be considered to be uniformly distributed. The roof live load or snow load shall not be considered as acting simultaneously with the wind load, and the roof live or snow load and floor live loads shall not be considered as resisting the overturning moment due to wind.

4-5.2.3 When engineering calculations are performed, allowable unit stresses shall be permitted to be increased as provided in the documents referenced in Table 4-4, except as otherwise indicated in 4-4.2 and 4-6.1.

4-5.2.4 Whenever the roof slope does not exceed 20 degrees, the design horizontal wind loads required by 4-5.3.1 shall be permitted to be determined without including the vertical roof projection of the manufactured home. However, regardless of the roof slope of the manufactured home, the vertical roof projection shall be included when determining the wind loading for split level or clerestory-type roof systems.

4-5.3 Wind, Snow, and Roof Loads.

4-5.3.1 Wind Loads — Design Requirements.

4-5.3.1.1 Standard Wind Loads (Zone 1). When a manufactured home is not designated to resist the wind loads for high wind areas (Zone II or Zone III) specified in 4-5.3.1.2, the manufactured home and each of its wind-resisting parts and portions shall be designed for horizontal wind loads of not less than 15 psf (718 Pa) and net uplift loads of not less than 9 psf (431 Pa).

4-5.3.1.2 Wind Loads for High Wind Areas (Zone II and Zone III). When designed for high wind areas (Zone II and Zone III), the manufactured home, each of its wind-resisting parts (including, but not limited to, shear walls, diaphragms, ridge beams, and their fastening and anchoring systems), and its components and cladding materials (including, but not limited to, roof trusses, wall studs, exterior sheathing, roofing and siding materials, exterior glazing, and their connections and fasteners) shall be designed by a professional engineer or architect to resist the following:

(a) The design wind loads for Exposure C specified in ANSI/ASCE 7-88, *Minimum Design Loads for Buildings and Other Structures,* for a 50-year recurrence interval, a design wind speed of 100 mph (160 k/hr), as specified for Wind Zone II, or 110 mph (177 k/hr), as specified for Wind Zone III *(see Figure 4-5.3.2)*

(b) The wind pressures specified in Table 4-5.3.1.2(b)

4-5.3.2 Wind Loads — Zone Designations. The wind zone and specific wind design load requirements shall be determined by the fastest basic wind speed (mph) within each zone and the intended location, based on Figure 4-5.3.2.

4-5.3.2.1 Wind Zone I. Wind Zone I shall consist of those areas shown in Figure 4-5.3.2 that are not identified in 4-5.3.2.2 or 4-5.3.2.3 as being within Wind Zone II or Wind Zone III, respectively.

4-5.3.2.2 Wind Zone II — 100 mph (160 k/m). The following areas shall be deemed to be within Wind Zone II in accordance with Figure 4-5.3.2.

Local Governments: The following local governments are listed by state and counties, unless specified otherwise:

(a) Alabama — Baldwin and Mobile

(b) Florida — All counties except those identified in 4-5.3.2.3(b) as within Wind Zone III

(c) Georgia — Bryan, Camden, Chatham, Glynn, Liberty, McIntosh

(d) Louisiana — Parishes of Acadia, Allen, Ascension, Assumption, Calcasieu, Cameron, East Baton Rouge, East Feliciana, Evangeline, Iberia, Iberville, Jefferson Davis, LaFayette, Livingston, Pointe Coupee, St. Helena, St. James, St. John the Baptist, St. Landry, St. Martin, St. Tammany, Tangipahoa, Vermillion, Washington, West Baton Rouge, and West Feliciana

(e) Maine — Hancock and Washington

(f) Massachusetts — Barnstable, Bristol, Dukes, Nantucket, and Plymouth

(g) Mississippi — George, Hancock, Harrison, Jackson, Pearl River, and Stone

(h) North Carolina — Beaufort, Brunswick, Camden, Chowan, Columbus, Craven, Currituck, Jones, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell, and Washington

(i) South Carolina — Beaufort, Berkeley, Charleston, Colleton, Dorchester, Georgetown, Horry, Jasper, and Williamsburg

(j) Texas — Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Orange, Refugio, San Patricio, and Willacy

(k) Virginia — Cities of Chesapeake, Norfolk, Portsmouth, Princess Anne, and Virginia Beach

4-5.3.2.3 Wind Zone III — 110 mph (177 k/m). The following areas shall be considered to be within Wind Zone III in accordance with Figure 4-5.3.2.

States and Territories. The following states and territories:

(a) The entire State of Hawaii

(b) The coastal regions of Alaska (as determined by the 90-mph isotach on the ANSI/ASCE 7-88 map)

(c) All of the U.S. Territories of American Samoa, Guam, Northern Mariana Islands, Puerto Rico, Trust Territory of the Pacific Islands, and the United States Virgin Islands

Local Governments. The following local governments are listed by state and counties, unless specified otherwise:

(a) Florida — Broward, Charlotte, Collier, Dade, Franklin, Gulf, Hendry, Lee, Martin, Manatee, Monroe, Palm Beach, Pinellas, and Sarasota

(b) Louisiana — Parishes of Jefferson, La Fourche, Orleans, Plaquemines, St. Bernard, St. Charles, St. Mary, and Terrabonne

(c) North Carolina — Carteret, Dare, and Hyde

4-5.3.2.4 Consideration of Local Requirements. For areas where local building code requirements exceed the design wind speed requirements of this standard, the regulatory agency shall consider the adoption through rulemaking of the more stringent requirements of the state or local building authority.

Table 4-5.3.1.2(b) Design Wind Pressures

Element	Wind Zone II — Design Wind Speed 100 mph (160 k/hr)	Wind Zone III — Design Wind Speed 110 mph (177 k/hr)
Anchorage for lateral and vertical stability *(See 4-6.1)* —		
Net Horizontal Drag[1,2]	±39 psf (1.9 kPa)	±47 psf (2.3 kPa)[3]
Uplift[4]	–27 psf (1.3 kPa)[5]	–32 psf (1.5 kPa)
Main wind force resisting system —		
Shearwalls, diaphragms, and their fastening and anchorage systems[1,2]	±39 psf (1.9 kPa)	±47 psf (2.3 kPa)
Ridge beams and other main roof support beams (beams supporting expanding room sections, etc.)	–30 psf (1.4 kPa)	–36 psf (1.7 kPa)
Components and cladding —		
Roof trusses[4] in all areas; trusses shall be doubled within 3.0 ft (0.9 m) from each end of the roof	–39 psf (1.9 kPa)[5]	–47 psf (2.3 kPa)[5]
Exterior roof coverings, sheathing, and fastenings[1,6,7] in all areas except the following:	–39 psf (1.9 kPa)[5]	–47 psf (2.3 kPa)[5]
Within 3.0 ft (0.9 m) from each gable end (overhang at end wall) of the roof or endwall if no overhang is provided[1,6,7]	–73 psf (3.5 kPa)[5]	–89 psf (4.3 kPa)[5]
Within 3.0 ft (0.9 m) from the ridge and eave (overhang at sidewall) or sidewall if no eave is provided[4,6,7]	–51 psf (2.4 kPa)[5]	–62 psf (3.0 kPa)[5]
Eaves (overhangs at sidewalls)[1,6,7]	–51 psf (2.4 kPa)[5]	–62 psf (3.0 kPa)[5]
Gables (overhangs at endwalls)[4,6,7]	–73 psf (3.5 kPa)[5]	–89 psf (4.3 kPa)[5]
Wall studs in sidewalls and endwalls, exterior windows, and sliding glass doors (glazing and framing), exterior coverings, sheathing and fastenings[8]		
Within 3.0 ft (0.9 m) from each corner of the sidewall and endwall	±48 psf (2.3 kPa)	±58 psf (2.8 kPa)
All other areas	±38 psf (1.8 kPa)	±46 psf (2.2 kPa)

NOTES:

[1] The net horizontal drag of ±39 psf (1.9 kPa) to be used in calculating anchorage for lateral and vertical stability and for the design of main wind force resisting systems is based on a distribution of wind pressures of +0.8 or +24 psf (+38 kPa or +1150 kPa) to the windward wall and -0.5 or -15 psf (-24 kPa or -720 kPa) to the leeward wall.

[2] Horizontal drag pressures need not be applied to roof projections when the roof slope does not exceed 20 degrees.

[3] (+) sign would mean pressures are acting towards or on the structure; (-) sign means pressures are acting away from the structure; (±) sign means forces can act in either direction, toward or away from the structure.

[4] Design values in this table are only applicable to roof slopes between 10 degrees (nominal $^{2}/_{12}$ slope) and 30 degrees.

[5] The design uplift pressures are the same whether they are applied normal to the surface of the roof or to the horizontal projection of the roof.

[6] Shingle roof coverings that are secured with 6 fasteners per shingle through an underlayment that is cemented to a $^{7}/_{8}$ in. (10 mm) structural rated roof sheathing need not be evaluated for these design wind pressures.

[7] Structural rated roof sheathing that is at least $^{7}/_{8}$ in. (10 mm) in thickness, installed with the long dimension perpendicular to roof framing supports, and secured with fasteners at 4 in. (101.6 mm) on center within 3.0 ft (0.9 m) of each gable end or endwall if no overhanging is provided, and 6 in. (152 mm) on center in all other areas, need not be evaluated for these design wind pressures.

[8] Exterior coverings that are secured at 6 in. (152 mm) on center to a $^{7}/_{8}$ in. (10 mm) structural rated sheathing that is fastened to wall framing members at 6 in. (152 mm) on center need not be evaluated for these design wind pressures.

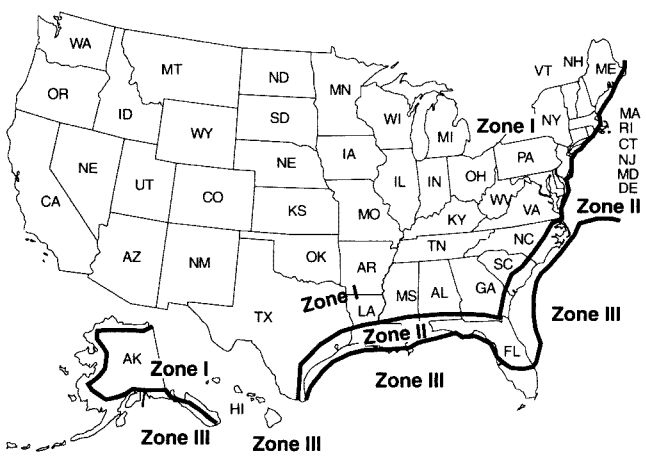


Figure 4-5.3.2 Basic wind zone map.

4-5.3.3 Snow and Roof Loads.

4-5.3.3.1 Flat, curved, and pitched roofs shall be designed to resist the live loads shown in Table 4-5.3.3.1 and Figure 4-5.3.3.1, applied downward on the horizontal projection as appropriate for the design zone marked on the manufactured home.

Table 4-5.3.3.1 Roof Load Zones

Zone	Psf (kPa)
North Zone	40 (1.9)
Middle Zone	30 (1.4)
South Zone	20 (1.0)

4-5.3.3.2 For exposures in areas (mountainous or other) where snow records, wind records, or experience indicate significant differences from the loads stated above, the regulatory

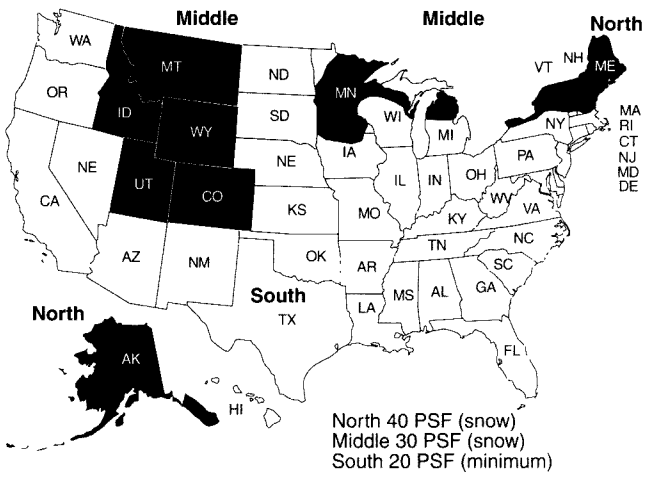


Figure 4-5.3.3.1 Roof load zone map.

agency shall be permitted to establish more stringent requirements for homes known to be destined for such areas. For snow loads, such requirements shall be based on a roof snow load of 0.6 of the ground snow load for areas exposed to wind and a roof snow load of 0.8 of the ground snow load for sheltered areas.

4-5.3.3.3 Eaves and cornices shall be designed for a net uplift pressure of 2.5 times the design uplift wind pressure cited in 4-5.3.1.1 for Wind Zone I and for the design pressures cited in 4-5.3.1.2 for Wind Zone II and Wind Zone III.

4-5.3.4 Data Plate Requirements. The data plate posted in the manufactured home *(see Section 1-5)* shall designate the wind and roof load zones or, if designed for higher loads, the actual design external snow and wind loads for which the home has been designed. The data plate shall include reproductions of Figures 4-5.3.2 and 4-5.3.3.1 with any related information. The load zone maps shall be not less than 3½ in. × 2¼ in. (89 mm × 57 mm).

4-5.4 Design Load Deflection.

4-5.4.1 When a structural assembly is subjected to total design live loads, the deflection for structural framing members shall not exceed the following (where L equals the clear span between supports, or two times the length of a cantilever):

(a) Floor — L/240

(b) Roof and ceiling — L/180

(c) Headers, beams, and girders (vertical load) — L/180

(d) Walls and partitions — L/180

4-5.4.2 The allowable eave or cornice deflection for uplift shall be measured at the design uplift load of 9 psf (430 Pa) for Wind Zone I and at the design uplift pressure cited in 4-5.3.1.2 for Wind Zone II and Wind Zone III. The allowable deflection shall be (2 × Lc)/180, where Lc is the measured horizontal eave projection from the wall.

4-5.5 Fastening of Structural Systems.

4-5.5.1 Roof framing shall be securely fastened to wall framing, walls to floor structure, and floor structure to chassis to secure and maintain continuity between the floor and chassis in order to resist wind overturning, uplift, and sliding.

4-5.5.2 For Wind Zone II and Wind Zone III, roof trusses shall be secured to exterior wall framing members (studs) and exterior wall framing members (studs) shall be secured to floor framing members with 26-gauge minimum steel strapping or brackets, or by a combination of 26-gauge minimum steel strapping or brackets and structural-rated wall sheathing that overlaps the roof and floor. Steel strapping or brackets shall be installed at a maximum spacing of 24 in. (610 mm) on center in Wind Zone II and at a maximum of 16 in. (406 mm) on center in Wind Zone III. The number and type of fasteners used to secure the steel straps, brackets, or structural sheathing shall be capable of transferring all uplift forces between elements being joined.

4-5.6 Walls. The walls shall be of sufficient strength to withstand the load requirements as defined in 4-5.3 for this part, without exceeding the deflections as specified in 4-5.4. The connections between the bearing walls, floor, and roof framework members shall be fabricated in such a manner as to provide support for the material used to enclose the manufactured home and to provide for transfer of all lateral and vertical loads to the floor and chassis.

4-5.6.1 Studs shall not be notched or drilled in the middle one-third of their length.

Exception: Where substantiated by engineering analysis or tests.

4-5.6.2 Interior walls and partitions shall be constructed with structural capacity adequate for the intended purpose and shall be capable of resisting a horizontal load of not less than 5 lb/ft^2 (24 k/m^2). An allowable stress increase of 1.33 times the permitted published design values shall be permitted to be used in the design of wood-framed interior partitions. Finish of walls and partitions shall be securely fastened to wall framing.

4-5.7 Floors.

4-5.7.1 Floor assemblies shall be designed in accordance with accepted engineering practice standards to support a minimum uniform live load of 40 lb/ft^2 (195 k/m^2) plus the dead load of the materials. In addition (but not simultaneously), floors shall be able to support a 200-lb (90.7-kg) concentrated load on a 1-in. (25-mm) diameter disc at the most critical location, with a maximum deflection not to exceed ⅛ in. (3 mm) relative to floor framing. Perimeter wood joists of more than 6 in. (152 mm) depth shall be stabilized against overturning from superimposed loads in accordance with the following:

(a) At ends, by solid blocking not less than 2 in. (51 mm) thickness by full depth of joist or by connecting to a continuous header not less than 2-in. (51-mm) thickness and not less than the depth of the joist with connecting devices

(b) At 8-ft (2.4-m) maximum intermediate spacing, by solid blocking or by wood cross-bridging of not less than 1 in. × 3 in. (25 mm × 76 mm), metal cross-bridging of equal strength, or by other approved methods

4-5.7.2 Wood, wood fiber, or plywood floors or subfloors in kitchens, bathrooms (including toilet compartments), laundry rooms, water heater compartments, and any other areas subject to excessive moisture shall be moisture resistant or shall be made moisture resistant by sealing or by an overlay of nonabsorbent material applied with water-resistant adhesive. Application of any of the following methods shall be considered to be in accordance with this requirement:

(a) Sealing the floor with a water-resistant sealer

(b) Installing an overlay of a nonabsorbent floor covering material applied with water-resistant adhesive

(c) Direct application of a water-resistant sealer to the exposed wood floor area when covered with a nonabsorbent overlay

(d) The use of a nonabsorbent floor covering, which shall be permitted to be installed without a continuous application of a water-resistant adhesive or sealant when the floor covering meets the following criteria:

1. The covering is a continuous membrane with any seams or patches seam-bonded or welded to preserve the continuity of the floor covering.

2. The floor is protected at all penetrations in these areas by sealing with a compatible water-resistant adhesive or sealant to prevent moisture from migrating under the nonabsorbent floor covering.

3. The covering is fastened around the perimeter of the subfloor in accordance with the floor covering manufacturer's instructions.

4. The covering is designed to be installed to prevent moisture penetration without the use of a water-resistant adhesive or sealer, except as required in 4-5.7.2. The vertical edges of penetrations for plumbing shall be covered with a moisture-resistant adhesive or sealant. The vertical penetrations located under the bottom plates of perimeter walls of rooms, areas, or compartments shall not be required to be sealed; this shall not include walls or partitions within the rooms or areas.

4-5.7.3 Carpet or carpet pads shall not be installed under concealed spaces subject to excessive moisture, such as plumbing fixture spaces or floor areas under installed laundry equipment. Carpet shall be permitted to be installed in laundry space provided the following:

(a) The appliances are not provided.

(b) The conditions of 4-5.7.2 are followed.

(c) Instructions are provided to remove carpet when appliances are installed.

4-5.7.4 Except where substantiated by engineering analysis or tests, the following requirements shall apply:

(a) Notches on the ends of joists shall not exceed one-fourth the joist depth.

(b) Holes bored in joists shall not be within 2 in. (51 mm) of the top or bottom of the joist, and the diameter of any such hole shall not exceed one-third the depth of the joist.

(c) Notches in the top or bottom of the joists shall not exceed one-sixth the depth and shall not be located in the middle third of the span.

4-5.7.5 Bottom board material (with or without patches) shall meet or exceed the level of 48 in./lb of puncture resistance as tested by the Beach Puncture Test in accordance with ASTM D 781, *Standard Test Methods for Puncture and Stiffness of Paperboard, and Corrugated and Solid Fiberboard.* The material shall be suitable for patches and the patch life shall be equivalent to the material life. Patch installation instructions shall be included in the manufactured home manufacturer's instructions.

4-5.8 Roofs.

4-5.8.1 Roofs shall be of sufficient strength to withstand the load requirements as defined in 4-5.2 and 4-5.3, without exceeding the deflections specified in 4-5.4. The connections between roof framework members and bearing walls shall be fabricated to provide for the transfer of design vertical and horizontal loads to the bearing walls and resistance to uplift forces.

4-5.8.2 Roofing membranes shall be of sufficient rigidity to prevent deflection that could lead to ponding of water or separation of seams due to wind, snow, ice, erection, or transportation forces.

4-5.8.3 Cutting of roof framework members for passage of electrical, plumbing, or mechanical systems shall not be permitted except where substantiated by engineering analysis.

4-5.8.4 All roof penetrations for electrical, plumbing, or mechanical systems shall be properly flashed and sealed. In addition, where a metal roof membrane is penetrated, a wood backer shall be installed. The backer plate shall be not less than $\frac{5}{16}$-in. (8-mm) plywood, with exterior glues, secured to the roof framing system beneath the metal roof, and shall be of a size to ensure that all screws securing the flashing are held by the backer plate.

4-5.9 Frame Construction. The frame shall be capable of transmitting all design loads to stabilizing devices without exceeding the allowable load and deflections of this section. The frame also shall be capable of withstanding the effects of transportation shock and vibration without degradation, as required by Chapter 10.

4-5.9.1 Welded Connections.

4-5.9.1.1 All welds shall be made in accordance with the applicable provisions of AISC, *Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design*, AISI, *The Specification for the Design of Cold-Formed Steel Structural Members*, and AISI, *Stainless Steel Cold-Formed Structural Design Manual.*

4-5.9.1.2 Regardless of the provisions of any reference standard contained in this chapter, deposits of weld slag or flux shall be required to be removed only from welded joints at the following locations:

(a) Drawbar and coupling mechanisms

(b) Main member splices

(c) Spring hanger to main member connections

4-5.9.2 Protection of Metal Frames against Corrosion. Metal frames shall be made corrosion resistant or be protected against corrosion. Metal frames shall be permitted to be protected against corrosion by painting.

4-6 Windstorm Protection.

4-6.1 Provisions for Support and Anchoring Systems. Each manufactured home shall have provisions for support and anchoring or foundation systems that, when properly designed and installed, will resist overturning and lateral movement (sliding) of the manufactured home, as imposed by the respective design loads. For Wind Zone I, the design wind loads to be used for calculating resistance to overturning and lateral movement shall be the simultaneous application of the wind loads indicated in 4-5.3.1.1, increased by a factor of 1.5. The 1.5 factor of safety for Wind Zone I shall also be applied simultaneously to both the vertical building projection, as horizontal wind load, and across the surface of the full roof structure, as uplift loading. For Wind Zone II and Wind Zone III, the resistance shall be determined by the simultaneous application of the horizontal drag and uplift wind loads, in accordance

with 4-5.3.1.1. The basic allowable stresses of materials required to resist overturning and lateral movement shall not be increased in the design and proportioning of these members. No additional shape or location factors shall need to be applied in the design of the tiedown system. The dead load of the structure shall be permitted to be used to resist these wind loading effects in all wind zones.

4-6.1.1 The provisions of Section 4-6 shall be followed, and the support and anchoring systems shall be designed by a registered professional engineer or architect.

4-6.1.2 The manufacturer of each manufactured home shall be required to make provisions for the support and anchoring systems, but shall not be required to provide the anchoring equipment or stabilizing devices. When the manufacturer's installation instructions provide for the main frame structure to be used as the points for connection of diagonal ties, no specific connecting devices shall need to be provided on the main frame structure.

4-6.2 Contents of Instructions.

4-6.2.1 The manufacturer shall provide printed instructions with each manufactured home that specify the location and required capacity of stabilizing devices on which the design is based. The manufacturer shall provide drawings and specifications, certified by a registered professional engineer or architect, that indicate at least one acceptable system of anchoring, including the details of required straps or cables, their end connections, and all other devices needed to transfer the wind loads from the manufactured home to an anchoring or foundation system.

4-6.2.2 For anchoring systems, the instructions shall indicate the following:

(a) Minimum anchor capacity shall be required.

(b) Anchors shall be certified by a professional engineer, architect, or a nationally recognized testing laboratory as to their resistance, based on the maximum angle of diagonal tie and/or vertical tie loading *(see 4-6.3.3)* and angle of anchor installation, and type of soil in which the anchor is to be installed.

(c) Ground anchors shall be embedded below the frost line and be at least 12 in. (305 mm) above the water table.

(d) Ground anchors shall be installed to their full depth, and stabilizer plates shall be installed to provide added resistance to overturning or sliding forces.

(e) Anchoring equipment shall be certified by a registered professional engineer or architect to resist these specified forces in accordance with testing procedures in ASTM D 3953, *Standard Specification for Strapping, Flat Steel, and Seals.*

4-6.3 Design Criteria. The provisions made for anchoring systems shall be based on the following design criteria for manufactured homes:

(a) The minimum number of ties provided per side of each home shall resist design wind loads required in 4-5.3.1.

(b) Ties shall be as evenly spaced as practicable along the length of the manufactured home, with not more than 2-ft (610-mm) open-end spacing on each end.

(c) Vertical ties or straps shall be positioned at studs. Where a vertical tie and a diagonal tie are located at the same place, both ties shall be permitted to be connected to a single anchor, provided that the anchor used is capable of carrying both loadings simultaneously.

(d) Add-on sections of expandable manufactured homes shall have provisions for vertical ties at the exposed ends.

4-6.4 Requirements for Ties. Manufactured homes in Wind Zone I shall require only diagonal ties. These ties shall be placed along the main frame and below the outer side walls. All manufactured homes designed to be located in Wind Zone II and Wind Zone III shall have a vertical tie installed at each diagonal tie location.

4-6.5 Protection Requirements. Protection shall be provided at sharp corners where the anchoring system requires the use of external straps or cables. Protection also shall be provided to minimize damage to siding by the cable or strap.

4-6.6 Anchoring Equipment — Load Resistance. Anchoring equipment shall be capable of resisting an allowable working load equal to or exceeding 3150 lb (1.43×10^3 kg) and withstanding a 50 percent overload (4725 lb total) (2.14×10^3 kg) without failure of either the anchoring equipment or the attachment point on the manufactured home.

4-6.7 Anchoring Equipment — Weatherization. Anchoring equipment exposed to weathering shall have a resistance to weather deterioration at least equivalent to that provided by a coating of zinc on steel of not less than 0.30 oz/ft^2 (9 g/m^2) of surface coated, and in accordance with the following:

(a) Slit or cut edges of zinc-coated steel strapping shall not need to be zinc-coated.

(b) Type 1, Finish B, Grade 1 steel strapping, 1¼ in. (32 mm) wide and 0.035 in. (1 mm) in thickness, certified by a registered professional engineer or architect as conforming with ASTM D 3953, *Standard Specification for Strapping, Flat Steel, and Seals.*

4-7 Resistance to Elements and Use.

4-7.1 Exterior coverings shall be of moisture- and weather-resistant materials attached with corrosion-resistant fasteners to resist wind, snow, and rain. Metal coverings and exposed metal structural members shall be of corrosion-resistant materials or shall be protected to resist corrosion. All joints between portions of the exterior covering shall be designed and assembled to protect against the infiltration of air and water, except for any designed ventilation of wall or roof cavity.

4-7.2 Joints between dissimilar materials and joints between exterior coverings and frames of openings shall be protected with a compatible sealant suitable to resist infiltration of air or water.

4-7.3 Where adjoining materials or assemblies of materials are of such nature that separation can occur due to expansion, contraction, wind loads, or other loads induced by erection or transportation, sealants shall be of a type that maintains protection against infiltration or penetration by air, moisture, or vermin.

4-7.4 Exterior surfaces shall be sealed to resist the entrance of rodents.

4-8 Formaldehyde Emission Controls for Certain Wood Products.

4-8.1 Formaldehyde Emission Levels. All plywood and particleboard materials bonded with a resin system or coated with a surface finish containing formaldehyde shall not exceed the following formaldehyde emission levels when installed in manufactured homes:

(a) Plywood materials shall not emit formaldehyde in excess of 0.2 parts per million (ppm), as measured by the air chamber test method specified in Section 5-6.

(b) Particleboard materials shall not emit formaldehyde in excess of 0.3 ppm, as measured by the air chamber test specified in Section 5-6.

4-8.2 Product Certification and Continuing Qualification. All plywood and particleboard materials bonded with a resin system or coated with a surface finish containing formaldehyde, other than an exclusively phenol-formaldehyde resin system or finish, that are installed in manufactured homes shall be certified by a nationally recognized testing laboratory as complying with 4-8.1.

4-8.2.1 Separate certification shall be done for each plant where the particleboard is produced or where the plywood or particleboard is surface-finished.

4-8.2.2 To certify plywood or particleboard, the testing laboratory shall witness or conduct the air chamber test specified in Section 5-6 on randomly selected panels initially, and at least quarterly thereafter.

4-8.2.3 The testing laboratory shall approve a written quality control plan for each plant where the particleboard is produced or finished or where the plywood is finished. The quality control plan shall be designed to ensure that all panels comply with 4-8.1. The plan shall establish ongoing procedures to identify increases in the formaldehyde emission characteristics of the finished product resulting from the following changes in production:

(a) In the case of plywood

1. The facility where the unfinished panels are produced is changed.

2. The thickness of the panels is changed so that the panels are thinner.

3. The grooving pattern on the panels is changed so that the grooves are deeper or closer together.

(b) In the case of particleboard

1. The resin formulation is changed so that the formaldehyde-to-urea ratio is increased.

2. The amount of formaldehyde resin used is increased.

3. The press time is decreased.

(c) In the case of plywood or particleboard

1. The finishing or top coat is changed and the new finishing or top coat has a greater formaldehyde content.

2. The amount of finishing or top coat used on the panels is increased, provided that such finishing or top coat contains formaldehyde.

4-8.2.4 The testing laboratory shall periodically visit the plant to monitor quality control procedures to ensure that all certified panels meet the standard.

4-8.2.5 To maintain its certification, plywood or particleboard shall be tested by the air chamber test specified in Section 5-6 whenever one of the following events occurs:

(a) In the case of particleboard, the resin formulation is changed so that the formaldehyde-to-urea ratio is increased.

(b) In the case of particleboard or plywood, the finishing or top coat is changed and the new finishing or top coat contains formaldehyde.

(c) In the case of particleboard or plywood, the testing laboratory determines that an air chamber test is necessary to ensure that panels comply with 4-8.1.

4-8.2.6 In the event that an air chamber test measures levels of formaldehyde from plywood or particleboard in excess of those permitted under 4-8.1, the tested product's certification shall immediately lapse as of the date of production of the tested panels. No panel produced on the same date as the tested panels, or on any day thereafter, shall be used or certified for use in manufactured homes unless in accordance with 4-8.2.6.1 and 4-8.2.6.2.

4-8.2.6.1 A new product certification shall be permitted to be obtained by testing randomly selected panels that were produced on any day following the date of production of the tested panels. If such panels pass the air chamber test specified in Section 5-6, the plywood or particleboard produced on that day and subsequent days shall be permitted to be used and certified for use in manufactured homes.

4-8.2.6.2 Plywood or particleboard produced on the same day as the tested panels, and panels produced on subsequent days, if not certified pursuant to 4-8.2, shall be permitted to be used in manufactured homes only under the following circumstances:

(a) Each panel is treated with a scavenger, sealant, or other means of reducing formaldehyde emissions that does not adversely affect the structural quality of the product.

(b) Panels randomly selected from the treated panels are tested by and pass the air chamber test specified in Section 5-6.

4-8.3 Panel Identification. Each plywood and particleboard panel bonded or coated with a resin system containing formaldehyde, other than an exclusively phenol-formaldehyde resin system, that is installed in manufactured homes shall be stamped or labeled so as to identify the product manufacturer, date of production and/or lot number, and the testing laboratory certifying compliance with this section.

4-8.4 Treatment after Certification. If certified plywood or particleboard subsequently is treated with paint, varnish, or any other substance containing formaldehyde, the certification shall no longer be valid. In such a case, each stamp or label placed on the panels pursuant to 4-8.3 shall be obliterated. The treated panels shall be permitted to be recertified and reidentified in accordance with 4-8.2 and 4-8.3.

4-9 Health Notice on Formaldehyde Emissions.

4-9.1 Each manufactured home shall have a health notice on formaldehyde emissions prominently displayed in a temporary manner in the kitchen (e.g., countertop or exposed cabinet face). The notice shall read as follows:

IMPORTANT HEALTH NOTICE

Some of the building materials used in this home emit formaldehyde. Eye, nose, and throat irritation, headache, nausea, and a variety of asthma-like symptoms, including shortness of breath, have been reported as a result of formaldehyde exposure. Elderly persons and young children, as well as anyone with a history of asthma, allergies, or lung problems, may be at greater risk. Research is continuing on the possible long-term effects of exposure to formaldehyde.

Reduced ventilation resulting from energy efficiency standards may allow formaldehyde and other contaminants to accumulate in the indoor air. Additional ventilation to dilute the indoor air may be obtained from a passive or mechanical ventilation system offered by the manufacturer. Consult your dealer for information about the ventilation options offered with this home.

High indoor temperatures and humidity raise formaldehyde levels. When a home is to be located in areas subject to extreme summer temperatures, an air-conditioning system can be used to control indoor temperature levels. Check the comfort cooling certificate to determine if this home has been equipped or designed for the installation of an air-conditioning system.

If you have any questions regarding the health effects of formaldehyde, consult your doctor or local health department.

4-9.2 The notice shall be legible and typed using letters at least ¼ in. (6 mm) in size. The title shall be typed using letters at least ¾ in. (19 mm) in size.

4-9.3 The notice shall not be removed by any party prior to delivery of the home to the first purchaser of the home for purposes other than resale.

4-9.4 A copy of the notice shall be included in the consumer manual required by Section 1-3.

Chapter 5 Testing

5-1 Structural Load Tests. Every structural assembly tested shall be capable of meeting the Proof Load Test or the Ultimate Load Test.

5-1.1 Proof Load Tests. Every structural assembly tested shall be capable of sustaining its dead load plus superimposed live loads equal to 1.75 times the required live loads for a period of 12 hours without failure. Tests shall be conducted with loads applied and deflections recorded in ¼ design live load increments at 10-minute intervals until 1.25 times design live load plus dead load has been reached. Additional load shall then be applied continuously until 1.75 times design live load plus dead load has been reached. Assembly failure shall be considered as design live load deflection (or residual deflection measured 12 hours after live load removal) that is greater than the limits set in 4-5.4, rupture, fracture, or excessive yielding. An assembly to be tested shall be of the minimum quality of materials and workmanship of the production. Each test assembly, component, or subassembly shall be identified as to type and quality or grade of material. All assemblies, components, or subassemblies qualifying under this test shall be subject to a continuing qualification testing program acceptable to the regulatory agency.

5-1.2 Ultimate Load Tests. Ultimate load tests shall be performed on a minimum of three assemblies or components to generally evaluate the structural design. Every structural assembly or component tested shall be capable of sustaining its total dead load plus the design live load increased by a factor of safety of at least 2.5. A factor of safety greater than 2.5 shall be used when required by an applicable reference standard in Section 4-4. Tests shall be conducted with loads applied and deflections recorded in ¼ design live load increments at 10-minute intervals until 1.25 times design live load plus dead load has been reached. Additional loading shall then be applied continuously until failure occurs, or the total of the factor of safety times the design live load plus the dead load is reached. Assembly failure shall be considered as design live load deflection greater than the limits set in 4-5.4, rupture, fracture, or excessive yielding. Assemblies to be tested shall be representative of average quality or materials and workmanship of the production. Each test assembly, component, or subassembly shall be identified as to type and quality or grade of material. All assemblies, components, or subassemblies qualifying under this test shall be subject to a periodic qualification testing program acceptable to the regulatory agency.

5-2 Test Procedure for Roof Trusses.

5-2.1 Roof Load Tests. The following shall be an acceptable test procedure, consistent with the provisions of Section 5-1, for roof trusses that are supported at the ends and that support design loads. Roof trusses that act as support for other members, act as cantilevers, or support concentrated loads shall be tested accordingly.

5-2.2 General. Trusses shall be permitted to be tested in pairs or singly in a suitable test facility. When tested singly, simulated lateral support of the test assembly shall be permitted to be provided, but in no case shall this lateral support exceed that which is specified for the completed manufactured home. When tested in pairs, the trusses shall be spaced at the design spacing, mounted on solid support, and accurately positioned to give the required clear span distance (L) as specified in the design. The top and bottom chords shall be braced and covered with the material and have connections or method of attachment, as specified by the completed manufactured home.

5-2.2.1 As an alternate test procedure, the top chord shall be permitted to be sheathed with ¼-in. × 12-in. (6-mm × 305-mm) plywood strips. The plywood strips shall be at least long enough to cover the top chords of the trusses at the designated design truss spacing. Adjacent plywood strips must be separated by at least ⅛ in. (3 mm). The plywood strip shall be nailed with 4d nails or equivalent staples no closer than 8 in. (203 mm) on center along the top chord. The bottom chords of the adjacent trusses shall be permitted to be either of the following:

(a) Unbraced

(b) Laterally braced together (not cross-braced) with 1-in. × 2-in. (25-mm × 51-mm) stripping no closer than 24 in. (610 mm) on center, nailed with only one 6d nail at each truss

(c) Covered with the material and having connections or methods of attachment, as specified for the completed manufactured home

5-2.2.2 Truss deflections shall be measured relative to a taut wire running over the support and weighted at the end to ensure constant tension or by other approved methods. Deflections shall be measured at the two quarter points and at midspan. Loading shall be applied to the top chord through a suitable hydraulic, pneumatic, or mechanical system with masonry units or weights to simulate design loads. Load units for uniformly distributed loads shall be separated so that arch action does not occur and spaced not more than 12 in. (305 mm) on center so as to simulate uniform loading.

5-2.3 Nondestructive Test Procedure. See Figure 5-2.3.

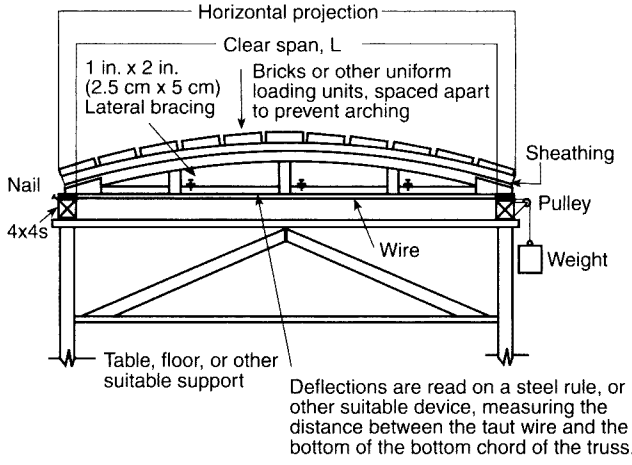


Figure 5-2.3 Nondestructive test procedure.

5-2.3.1 Dead Load Plus Live Load. The following method shall be permitted to be used to test roof trusses:

(a) Noting Figure 5-2.3, measure and record initial elevation of the truss in test position at no load.

(b) Apply load units to the top chord of the truss equal to the full dead load of roof and ceiling. Measure and record deflections.

(c) Maintaining the dead load, add live load in approximate ¼ design live load increments. Measure the deflections after each loading increment. Apply incremental loads at a uniform rate in such a manner that approximately 30 minutes are required to establish the total design load condition. Measure and record the deflections five minutes after loads have been applied. The maximum deflection due to design live load (deflection measured in item c minus item b) shall not exceed L/180, where L is a clear span measured in the same units.

(d) Continue to load truss to dead load plus 1.75 times the design live load. Maintain this loading for 12 hours and inspect the truss for failure.

(e) Remove the total superimposed live load. Trusses not recovering to at least the L/180 position within 12 hours shall be considered as failing.

5-2.3.2 Uplift Loads. The following test shall only be required for truss designs that are critical under uplift load conditions.

(a) Measure and record initial elevation of the truss in an inverted test position at no load. The bottom chord of the truss shall be mounted in the horizontal position.

(b) Apply the uplift load as stated in 4-5.3 to the bottom chord of the truss. Measure and record the deflections five minutes after the load has been applied.

(c) Continue to load the truss to 1.75 times the design uplift load. Maintain this load for three hours and inspect the truss for failure.

(d) Remove applied loads, and within three hours the truss must recover to at least L/180 position, where L is a clear span measured in the same units.

5-2.4 Destructive Test Procedure. Destructive tests shall be performed on three trusses to generally evaluate the truss design. The test procedure shall be as follows:

(a) Noting Figure 5-2.3, apply the load units to the top chord of the truss assembly equal to full dead load of roof and ceiling. Measure and record deflections. Then apply load and record deflections in ¼ design live load increments at 10-minute intervals until 1.25 times design live load plus dead load has been reached.

(b) Additional loading shall then be applied continuously until failure occurs or the factor of safety times the design live load plus the dead load is reached.

(c) Assembly failure shall be considered as design live load deflection greater than the limits set in 4-5.4, rupture, fracture, or excessive yielding.

(d) The assembly shall be capable of sustaining the dead load plus the applicable factor of safety times the design live load (the applicable factor of safety for wood trusses shall be taken as 2.50).

5-2.5 Trusses qualifying under the nondestructive test procedure by tests in 5-2.3.1 and 5-2.3.2 (when required) shall be subject to a continuing qualification testing program acceptable to the regulatory agency. Trusses qualifying under the destructive test procedures by tests in 5-2.3.2 (when required) and 5-2.4 shall be subject to periodic tests only.

5-3 Requirements for Windows and Sliding Glass Doors Used in Manufactured Homes.

5-3.1 Scope. Section 5-3 shall set the requirements for prime windows and sliding glass doors.

Exception: Windows used in entry doors are components of the door and thus are excluded from these requirements.

5-3.2* Performance. All primary windows and sliding glass doors shall comply with AAMA Standard 1701.2, *Primary Window and Sliding Glass Door Voluntary Standard for Utilization in Manufactured Housing.*

Exception: The exterior and interior pressure tests shall be conducted at the design wind loads required for components and cladding specified in 4-5.3.1.

5-3.3 Installation. All primary windows and sliding glass doors shall be installed in a manner that allows proper operation and provides protection against the elements. *(See Section 4-7.)*

5-3.4 Glass.

5-3.4.1 Safety glazing materials, where used, shall meet the requirements of ANSI Z97.1, *Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings.*

5-3.4.2 Sealed insulating glass, where used, shall meet all performance requirements for Class C in accordance with ASTM E 774, *Standard Specification for Sealed Insulating Glass Units.* The sealing system shall be qualified in accordance with ASTM E 773, *Standard Test Methods for Seal Durability of Sealed Insulating Glass Units.* Each glass unit shall be permanently identified with the name of the insulating glass manufacturer.

5-3.5 Certification. All primary windows and sliding glass doors to be installed in manufactured homes shall be certified as complying with AAMA Standard 1701.2, *Primary Window and Sliding Glass Door Voluntary Standard for Utilization in Manufactured Housing.* This certification shall be based on tests conducted at the design wind loads specified in 4-5.3.1.

5-3.5.1 All such windows and doors shall show evidence of certification by having a quality certification label affixed to the product in accordance with ANSI Z34.1, *For Certification — Third-Party Certification Program.*

5-3.5.2 In determining certifiability of the products, an independent quality assurance agency shall conduct preproduction specimen tests in accordance with AAMA 1701.2. Further, such agency shall inspect the product manufacturer's facility at least twice per year.

5-3.6* Protection of Primary Window and Sliding Glass Door Openings in High Wind Areas. For homes designed to be located in Wind Zone II and Wind Zone III, manufacturers shall design exterior walls surrounding the primary window and sliding glass door openings to allow for the installation of shutters or other protective covers, such as plywood, to cover these openings. The manufacturer shall provide to the homeowner instructions for at least one method of protecting primary window and sliding glass door openings if shutters or other protective covers are not provided. This method shall be capable of resisting the design wind pressures specified in Section 4-5 without taking the home out of conformance with the requirements in Section 5-3. These instructions shall be included in the printed instructions that accompany each manufactured home. The instructions also shall indicate whether receiving devices, sleeves, or anchors, for fasteners to be used to secure the shutters or protective covers to the exterior walls, have been installed or provided by the manufacturer.

5-4 Requirements for Egress Windows and Devices for Use in Manufactured Homes.

5-4.1 Scope and Purpose. The purpose of Section 5-4 shall be to establish the requirements for the design, construction, and installation of windows and approved devices intended to be used as emergency exits during conditions encountered in a fire or similar disaster.

5-4.2* Performance. Egress windows, including auxiliary frame and seals, if any, shall meet all requirements of AAMA Standard 1701.2, *Primary Window and Sliding Glass Door Voluntary Standard for Utilization in Manufactured Housing,* and AAMA 1704, *Voluntary Standard Egress Window Systems for Utilization in Manufactured Housing.*

Exception: The exterior and interior pressure tests for components and cladding shall be conducted at the design wind loads required by 4-5.3.1.

5-4.3 Installation.

5-4.3.1 Egress windows or devices shall be installed in a manner that allows for proper operation and provides protection against the elements. *(See Section 4-7.)*

5-4.3.2 An operational check of each installed egress window or device shall be made at the manufactured home factory. All egress windows and devices shall be capable of being opened to the minimum required dimension without binding or requiring the use of tools. Any window or device failing this check shall be repaired or replaced. A repaired window shall conform to its certification. Any repaired or replaced window or device shall pass the operational check.

5-4.4 Operating Instructions. Operating instructions shall be affixed to each egress window and device and shall carry the legend "Do Not Remove."

5-4.5 Certification of Egress Windows and Devices. Egress windows and devices shall be listed in accordance with the procedures and requirements of AAMA 1704, *Voluntary Standard Egress Window Systems for Utilization in Manufactured Housing.* This certification shall be based on tests conducted at the design wind loads specified in 4-5.3.1.

5-4.6* Protection of Egress Window Openings in High Wind Areas. For homes designed to be located in Wind Zone II and Wind Zone III, manufacturers shall design exterior walls surrounding the egress window openings to allow for the installation of shutters or other protective covers, such as plywood, to cover these openings. The manufacturer shall provide to the homeowner instructions for at least one method of protecting egress window openings if shutters or other protective covers are not provided. This method shall be capable of resisting the design wind pressures specified in Section 4-5 without taking the home out of conformance with the requirements in Section 5-4. These instructions shall be included in the printed instructions that accompany each manufactured home. The instructions also shall indicate whether receiving devices, sleeves, or anchors, for fasteners to be used to secure the shutters or protective covers to the exterior walls, have been installed or provided by the manufacturer.

5-5 Requirements for Swinging Exterior Passage Doors for Use in Manufactured Homes.

5-5.1 Scope. These requirements shall apply to all exterior passage door units. These requirements shall apply only to the door frame, consisting of jambs, head, and sill, and the attached door or doors.

Exception: Sliding doors and doors used for access to utilities and compartments shall be excluded from these requirements.

5-5.2 Performance Requirements. The design and construction of exterior door units shall meet all requirements of AAMA Standard 1702.2, *Swinging Exterior Passage Doors Voluntary Standard for Utilization in Manufactured Housing.*

5-5.3 Materials and Methods. Any material or method of construction shall conform to the performance requirements as outlined in 5-5.2. Wood materials or wood-based materials also shall conform to 5-5.3.1 and 5-5.3.2.

5-5.3.1 Wood. Doors shall conform to the Type 1 requirements of NWWDA I.S.1, *Wood Flush Doors.*

5-5.3.2 Plywood. Plywood shall be exterior type and preservative treated in accordance with NWWDA I.S.4, *Water Repellent Preservative Non-Pressure Treatment for Millwork.*

5-5.4 Exterior Doors. All swinging exterior doors shall be installed in a manner that allows proper operation and provides protection against the elements. *(See Section 4-7.)*

5-5.5 Certification. All swinging exterior doors to be installed in manufactured homes shall be certified as complying with AAMA Standard 1702.2, *Swinging Exterior Passage Doors Voluntary Standard for Utilization in Manufactured Housing*

5-5.5.1 All such doors shall show evidence of certification by having a quality certification label affixed to the product in accordance with ANSI Z34.1, *For Certification — Third-Party Certification Program.*

5-5.5.2 In determining certifiability of the products, an independent quality assurance agency shall conduct preproduction specimen tests in accordance with AAMA 1701.2. Further,

such agency shall inspect the product manufacturer's facility at least twice per year.

5-5.6* Protection of Exterior Doors in High Wind Areas. For homes designed to be located in Wind Zone II and Wind Zone III, manufacturers shall design exterior walls surrounding the exterior door openings to allow for the installation of shutters or other protective covers, such as plywood, to cover these openings. The manufacturer shall provide to the homeowner instructions for at least one method of protecting exterior door openings if shutters or other protective covers are not provided. This method shall be capable of resisting the design wind pressures specified in Section 4-5 without taking the home out of conformance with the requirements in Section 5-5. These instructions shall be included in the printed instructions that accompany each manufactured home. The instructions also shall indicate whether receiving devices, sleeves, or anchors, for fasteners to be used to secure the shutters or protective covers to the exterior walls, have been installed or provided by the manufacturer.

5-6 Air Chamber Test Method for Certification and Qualification of Formaldehyde Emission Levels.

5-6.1 Preconditioning. Preconditioning of plywood or particleboard panels for air chamber tests shall be initiated as soon as practicable but not in excess of 30 days after the plywood or particleboard is produced or surface-finished, whichever is later, using randomly selected panels.

5-6.1.1 If preconditioning is to be initiated more than two days after the plywood or particleboard is produced or surface-finished, whichever is later, the panels shall be dead-stacked or air-tight wrapped until preconditioning is initiated.

5-6.1.2 Panels selected for testing in the air chamber shall not be taken from the top or bottom of the stack.

5-6.2 Testing. Testing shall be conducted in accordance with ASTM E 1333, *Standard Test Method for Determining Formaldehyde Levels from Wood Products under Defined Test Conditions Using a Large Chamber*, with the following exceptions:

(a) The chamber shall be operated indoors.

(b) Plywood and particleboard panels shall be individually tested in accordance with the following loading ratios:

1. Plywood — 0.29 ft^2/ft^3
2. Particleboard — 0.13 ft^2/ft^3

(c) Temperature to be maintained inside the chamber shall be 77°F (25°C) plus or minus 2°F (1°C).

(d) The test concentration *(C)* shall be standardized to a level *(C_0)* at a temperature *(t_0)* of 77°F (25°C) and 50 percent relative humidity *(H_0)* by the following formula:

$$C = C_0[1 + A(H - H_0)]e^{R(1/t - 1/t_0)}$$

where:

C = test formaldehyde concentration
C_0 = standardized formaldehyde concentration
e = natural log base
R = coefficient of temperature (9799)
t = actual test condition temperature (°K)
t_0 = standardized temperature (°K)
A = coefficient of humidity (0.0175)
H = actual relative humidity (percent)
H_0 = standardized relative humidity (percent)

The standardized level (C_0) shall be the concentration used to determine compliance with 4-8.1.

(e) The air chamber shall be inspected and recalibrated at least annually to ensure its proper operation under test conditions.

Chapter 6 Thermal Protection

6-1 Scope. This chapter shall set forth the requirements for condensation control, air infiltration, thermal insulation, and certification for heating and comfort cooling.

6-2 Definitions.

6-2.1 The following definitions shall be applicable to Chapter 6 only.

Pressure Envelope. That primary air barrier surrounding the living space that serves to limit air leakage. In construction using ventilated cavities, the pressure envelope is the interior skin.

Thermal Envelope Area. The sum of the surface areas of outside walls, ceiling, and floor, including all openings. The wall area is measured by multiplying outside wall lengths by the inside wall height from floor to ceiling. The floor and ceiling areas are considered as horizontal surfaces, using exterior width and length.

6-3 Materials. Materials used for insulation shall be of proven effectiveness and adequate durability to ensure that required design conditions concerning thermal transmission are attained.

6-4 Condensation Control and Installation of Vapor Retarders.

6-4.1 Ceiling Vapor Retarders.

6-4.1.1 In U_0 value Zone 2 and value Zone 3, ceilings shall have a vapor retarder with a permanence of no greater than 1 perm (as measured by ASTM E 96, *Standard Test Methods for Water Vapor Transmission of Materials*) installed on the living space side of the roof cavity.

6-4.1.2 For manufactured homes designed for U_0 value Zone 1, the vapor retarder shall be permitted to be omitted.

6-4.2 Exterior Walls.

6-4.2.1 Exterior walls shall have a vapor barrier no greater than 1 perm (dry-cup method) installed on the living space side of the wall.

6-4.2.2 Unventilated wall cavities shall have an external covering and/or sheathing that forms the pressure envelope. The covering and/or sheathing shall have a combined permeance of not less than 5.0 perms. In the absence of test data, combined permeance shall be permitted to be computed using the formula:

$$P_{total} = \frac{1}{\left(\frac{1}{P_1}\right) + \left(\frac{1}{P_2}\right)}$$

where P_1 and P_2 are the permeance values of the exterior covering and sheathing in perms.

6-4.2.3 Formed exterior siding, applied in sections with joints not caulked or sealed, shall not be considered to restrict water vapor transmission.

6-4.2.4 Wall cavities shall be constructed so that ventilation is provided to dissipate any condensation occurring in these cavities.

6-4.3 Attic or Roof Ventilation.

6-4.3.1 Attic and roof cavities shall be vented in accordance with one of the following:

(a) A minimum free-ventilation area of not less than 1/300 of the attic or roof cavity floor area. At least 50 percent of the required free-ventilation area shall be provided by ventilators located in the upper portion of the space to be ventilated. At least 40 percent shall be provided by eave, soffit, or low gable vents. The location and spacing of the vent openings and ventilators shall provide cross ventilation to the entire attic or roof cavity space. A clear air passage space having a minimum height of 1 in. (25 mm) shall be provided between the top of the insulation and the roof sheathing or roof covering. Baffles or other means shall be provided where needed to ensure the 1 in. (25 mm) height of the clear air passage space is maintained.

(b) A mechanical attic or roof ventilation system shall be permitted to be installed instead of providing the free-ventilation area when the mechanical system provides a minimum air change rate of 0.02 cfm (.009 L/sec) per sq ft of attic floor area. Intake and exhaust vents shall be located so as to provide air movement throughout the space.

6-4.3.2 Single-section manufactured homes constructed with metal roofs and having no sheathing or underlayment installed shall not be required to be provided with attic or roof cavity ventilation, provided that the air leakage paths from the living space to the roof cavity created by electrical outlets, electrical junctions, electrical cable penetrations, plumbing penetrations, flue pipe penetrations, and exhaust vent penetrations are sealed.

6-4.3.3 Parallel membrane roof sections of a closed-cell-type construction shall not be required to be ventilated.

6-4.3.4 The vents provided for ventilating attics and roof cavities shall be designed to resist entry of rain and insects.

6-5 Air Infiltration.

6-5.1 Envelope Air Infiltration. The opaque envelope shall be designed and constructed to limit air infiltration to the living area of the home. Any design, material, method, or combination thereof that accomplishes this goal shall be permitted to be used. The goal of the infiltration control criteria is to reduce heat loss/heat gain due to infiltration as much as possible without impinging on health and comfort within the limits of reasonable economics.

6-5.1.1 Envelope Penetrations. Plumbing, mechanical, and electrical penetrations of the pressure envelope not exempted by this requirement, and installations of window and door frames, shall be constructed or treated to limit air infiltration. Penetrations of the pressure envelope made by electrical equipment, other than distribution panel boards and cable and conduit penetrations, shall be exempt from this requirement. Cable penetrations through outlet boxes shall be considered exempt.

6-5.1.2 Joints between Major Envelope Elements. Joints not designed to limit air infiltration between wall-to-wall, wall-to-ceiling, and wall-to-floor connections shall be caulked or otherwise sealed. When walls are constructed to form a pressure envelope on the outside of the wall cavity, they shall be deemed to meet this requirement.

6-6 Heat Loss/Heat Gain. The manufactured home heat loss/heat gain shall be determined by methods outlined in Sections 6-8 and 6-9. The U_0 (coefficient of heat transmission) value zone for which the manufactured home is acceptable and the lowest outdoor temperature to which the installed heating equipment will maintain a temperature of 70°F (21°C) shall be certified as specified in Section 6-10. The U_0 value zone shall be determined in accordance with Figure 6-6.

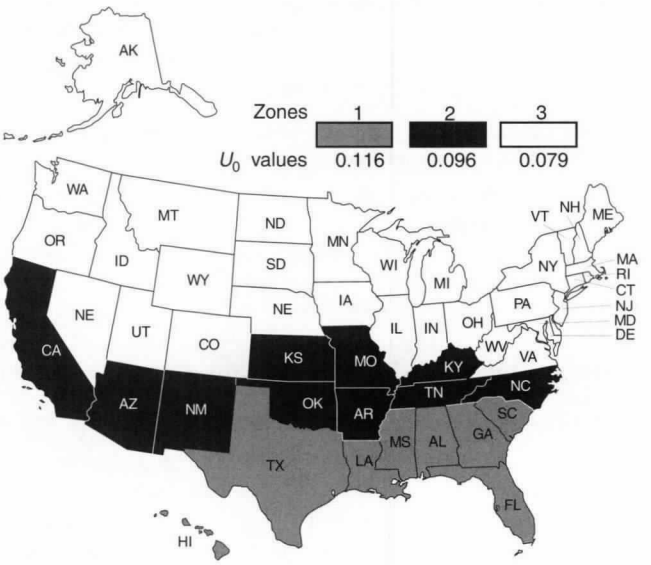


Figure 6-6 U_0 value Zone map.

6-6.1 Coefficient of Heat Transmission.

6-6.1.1 The overall coefficient of heat transmission *(U_0)* of the manufactured home for the respective zones and an indoor design temperature of 70°F (21°C), including internal and external ducts, and excluding infiltration, ventilation, and condensation control, shall not exceed the Btu/(hr) (sq ft) (°F) of the manufactured home envelope area as tabulated in Table 6-6.1.

Table 6-6.1 Coefficient of Heat Transmission (U_0)

U_0 Value Zone	Maximum Coefficient of Heat Transmission
1	0.116 Btu/hr • ft^2 • °F / 0.659 w/(m^2 • K)
2	0.096 Btu/hr • ft^2 • °F / 0.545 w/(m^2 • K)
3	0.079 Btu/hr • ft^2 • °F / 0.449 w/(m^2 • K)

6-6.1.2 To ensure uniform heat transmission in manufactured homes, cavities in exterior walls, floors, and ceilings shall be provided with thermal insulation.

6-6.1.3 Manufactured homes designed for U_0 value Zone 3 shall be factory-equipped with storm windows or insulating glass.

6-7 Comfort Heat Gain. Information necessary to calculate the home cooling load shall be provided as specified in this chapter.

6-7.1 Transmission Heat Gains. Homes complying with Section 6-7 shall meet the minimum heat loss transmission coefficients specified in 6-6.1.

6-8 Heat Loss, Heat Gain, and Cooling Load Calculations.

6-8.1 Information, values, and data necessary for heat loss and heat gain determinations shall be taken from the 1989 ASHRAE *Handbook of Fundamentals,* Chapters 20 through 27. The following portions of those chapters shall not be applicable:

21.1 Steel Frame Construction
21.2 Masonry Construction
21.3 Floor Systems
21.14 Pipes
21.16 Tanks, Vessels, and Equipment
21.17 Refrigerated Rooms and Buildings
22.15 Mechanical and Industrial Systems
23.13 Commercial Building Envelope Leakage
25.4 Calculation of Heat Loss from Crawl Spaces

6-8.2 The calculation of the manufactured home's transmission heat loss coefficient (U_0) shall be in accordance with the fundamental principals of the 1989 ASHRAE *Handbook of Fundamentals* and, at a minimum, shall address all the heat loss or heat gain considerations in a manner consistent with the calculation procedures provided in the document "Overall *U*-values and Heating/Cooling Loads — Manufactured Homes" — February 1992, PNL 8006, HUD User No. 0005945.

6-8.3 Areas where the insulation does not fully cover a surface or is compressed shall be accounted for in the *U* calculation *(see Section 6-6).* The effect of framing on the *U* value shall be included in the U_0 calculation. Other low-*R*-value heat-flow paths ("thermal shorts") shall be explicitly accounted for in the calculation of the transmission heat loss coefficient if, in the aggregate, all types of low-*R*-value paths amount to more than 1 percent of the total exterior surface area. Areas shall be considered low-*R*-value heat-flow paths if the following apply:

(a) They separate conditioned and unconditioned space.

(b) They are not insulated to a level that is at least one-half the nominal insulation level of the surrounding building component.

6-8.4 High-Efficiency Heating and Cooling Equipment Credit. The calculated transmission heat loss coefficient (U_0) used for meeting the requirement in 6-6.1 shall be permitted to be adjusted for heating and cooling equipment above that required by the National Appliance Energy Conservation Act of 1987 (NAECA) by applying the following formula:

U_0 adjusted = U_0 standard × [1 + (0.60) (heating efficiency increase factor) + (cooling multiplier) (cooling efficiency increase factor)]

where:

U_0 standard = maximum U_0 for U_0 Zone required by 6-6.1

U_0 adjusted = maximum U_0 standard adjusted for high-efficiency HVAC equipment

Heating efficiency increase factor = increase factor in heating equipment efficiency measured by the Annual Fuel Utilization Efficiency (AFUE) or by the Heating Seasonal Performance Factor (HSPF) for heat pumps, above that required by NAECA (indicated as "NAECA" in formula). The formula is heating efficiency increase factor = AFUE (HSPF) home – AFUE (or HSPF) NAECA ÷ AFUE (HSPF) NAECA.

Cooling efficiency increase factor = increase factor in the cooling equipment efficiency measured by the Seasonal Energy Efficiency Ratio (SEER) above that required by NAECA.

The formula is: cooling equipment = SEER home – SEER NAECA ÷ SEER NAECA.

The cooling multiplier for the U_0 Zone is taken from Table 6-8.4.

Table 6-8.4 Cooling Multiplier

U_0 Zone	Cooling Multiplier (Cm)
1	0.60 (Florida only)
1	0.20 (All other locations)
2	0.07
3	0.03

6-8.5 *U* values for any glazing (e.g., windows, skylights, and the glazed portions of any door) shall be based on tests using AAMA 1503.1, *Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections.* In the absence of tests, manufacturers shall use the residential window *U* values contained in Table 13 in Chapter 27 of the 1989 ASHRAE *Handbook of Fundamentals.* In the event that the classification of the window type is indeterminate, the manufacturer shall use the classification that gives the higher *U* value. For the purpose of calculating U_0 values, storm windows shall be treated as an additional pane.

6-8.6 Annual Energy Use-Based Compliance. As an alternative, homes shall be permitted to demonstrate compliance with the annual energy used implicit in the coefficient of heat transmission (U_0) requirement. The annual energy use determination must be based on generally accepted engineering practices. The home seeking compliance approval shall demonstrate a projected annual energy use, including both heating and cooling, less than or equal to a similar "base case" home that meets the standard. The calculations of the energy use for both homes must be based on the same assumptions, including assuming the same dimensions for all boundaries between conditioned and unconditioned spaces, site characteristics, usage patterns, and climate.

6-9 Criteria in Absence of Specific Data. In the absence of specific data for heat loss/heat gain calculations, the criteria in 6-9.1 through 6-9.3 shall be used.

6-9.1 Infiltration Heat Loss. In the absence of measured infiltration heat loss data, the following formula shall be used to calculate heat loss due to infiltration and intermittently operated fans exhausting to the outdoors. The perimeter calculation shall be based on the dimensions of the pressure envelope.

Infiltration Heat Loss = 0.7 (T) (ft of perimeter), BTU/hr

where T = 70 minus the heating system capacity certification temperature stipulated in the Heating Certificate, in °F.

6-9.2 Framing Areas. For walls, calculations shall be based on 15 percent of wall area less windows and doors. For floors and ceilings, calculations shall be based on 10 percent of the area.

6-9.3 Insulation Compression. Insulation compressed to less than nominal thickness shall have its nominal R-values reduced for that area which is compressed in accordance with Figure 6-9.3.

When insulation is installed over the framing members, the thermal performance of the insulation shall be reduced due to compression at the framing members. The resistance value of the insulation between the framing members shall be reduced by 12.5 percent for framing members 16 in. (406 mm) on center, 8.5 percent for framing members 24 in. (610 mm) on center, and 4 percent for framing members 48 in. (1220 mm) on center.

Reduction of insulation *R*-values when insulation is compressed

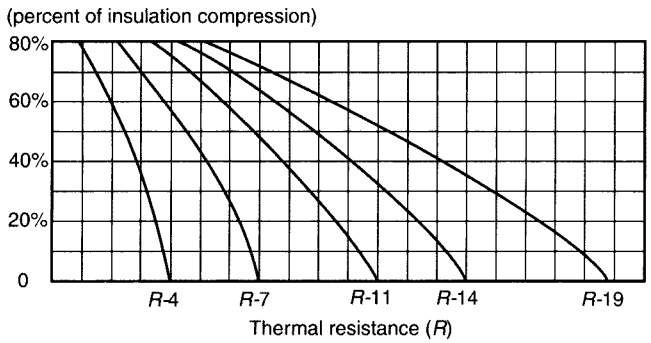


Figure 6-9.3 Thermal resistance graph.

6-9.4 Air Supply Ducts within Floor Cavity. Air supply ducts located within a floor cavity shall be assumed to be heating or cooling the floor cavity to living space temperatures unless the duct is structurally isolated by the framing system or thermally insulated from the rest of the floor cavity with a thermal insulation at least equal to R-4.

6-9.5 Air Supply Ducts within Ceiling Cavity. Where supply ducts are located in ceiling cavities, the influence of the duct on cavity temperatures shall be considered in calculating envelope heat loss or heat gain.

6-9.6 The supply duct heat loss, and/or heat gain where applicable *(see Section 6-11)*, shall be calculated using the actual duct surface area and the actual thickness of insulation between the duct and outside of the manufactured home. If there is an air space of at least ½ in. (13 mm) between the duct and the insulation, heat loss/heat gain need not be calculated if the cavity where the duct is located is assumed to be at living space temperature. The average temperature inside the supply duct, including ducts installed outside the manufactured home, shall be assumed to be 130°F (54°C) for purposes of calculation of heat loss and 60°F (16°C) for calculation of heat gain.

6-9.7 Return Air Cavities. Cavities used as return air plenums shall be considered to be at living space temperature.

6-10 Heat Loss Certificate.

6-10.1 Heating Certificate. The manufactured home manufacturer shall permanently affix the certificate shown in Figure 6-10.1 to an interior surface of the home that is readily visible to the homeowner.

Heating Certificate

Home Manufacturer _____
Plant Location _____
Model Home _____
(Include U_0 Value Zone Map)

This manufactured home has been thermally insulated to conform with the requirements of NFPA 501, 1997, for all locations within U_0 Value Zone _____.

Heating Equipment Manufacturer _____
Heating Equipment Model _____

The above heating equipment has the capacity to maintain an average 70°F temperature in this home at outdoor temperatures of _____ °F/°C (see 6-10.3). To maximize furnace operating economy and to conserve energy, it is recommended that this home be installed where the outdoor winter design temperature (97½ percent) is not higher than _____ °F/°C (see 6-10.4).

Figure 6-10.1 Heating certificate.

6-10.2 Heating Zone Certification. The heating certificate shall indicate the design zone at which the manufactured home heat loss complies with 6-6.1.1.

6-10.3 Outdoor Certification Temperature. The heating certificate shall indicate the lowest outdoor temperature at which the installed heating equipment will maintain a 70°F (21°C) temperature inside the home without storm sash or insulating glass for Zone 1 and Zone 2, with storm sash or insulating glass for Zone 3, and complying with Sections 6-8 and 6-9.

6-10.4 Operating Economy Certification Temperature. The temperature to be specified on the heating certificate for operating economy and energy conservation shall be 20°F (–7°C) or 30 percent of the design temperature difference, whichever is greater, added to the temperature specified as the heating system capacity certification temperature without storm windows or insulating glass in Zone 1 and Zone 2 and with storm windows or insulating glass in Zone 3. Design temperature difference is 70°F (21°C) minus the heating system capacity certification temperature.

6-11 Comfort Cooling Certificate and Information.

6-11.1 The manufactured home manufacturer shall permanently affix the comfort cooling certificate shown in Figure 6-11.1 to an interior surface of the home that is readily visible to the home owner. This certificate shall be permitted to be combined with the heating certificate required in Section 6-10.

The manufacturer shall be permitted to comply with this requirement using one of the following three alternatives.

6-11.1.1 Alternative 1. If a central air conditioning system is provided by the home manufacturer, the heat gain calculation necessary to properly size the air conditioning equipment shall be in accordance with procedures outlined in Chapter 22 of the 1989 ASHRAE *Handbook of Fundamentals,* with an assumed location and orientation. *(See Figure 6-11.1.1.)*

Comfort Cooling Certificate

Air Conditioner Manufacturer _____
Air Conditioner Model _____

Certified capacity _____ BTU/hr in accordance with the appropriate Air Conditioning and Refrigeration Institute Standards.

The central air conditioning system provided with this home has been sized assuming an orientation of the front (hitch) end of the home facing _____, and is designed on the basis of a 75°F (24°C) indoor temperature and an outdoor temperature of _____ °F/°C dry bulb and _____ °F/°C wet bulb.

Figure 6-11.1 Comfort cooling certificate.

Comfort Cooling Certificate

Manufactured Home Manufacturer _____
Plant Location _____
Manufactured Home Model _____
Air Conditioner Manufacturer _____

Certified capacity _____ BTU/hr in accordance with the appropriate Air Conditioning and Refrigeration Institute Standards.

The central air conditioning system provided with this home has been sized assuming an orientation of the front (hitch end) of the home facing _____. On this basis, the system is designed to maintain an indoor temperature of 75°F (24°C) when outdoor temperatures are _____ °F/ °C dry bulb and _____ °F/ °C wet bulb.

The temperature to which this home can be cooled will change depending upon the amount of exposure of the windows of this home to the sun's radiant heat. Therefore, the home's heat gains will vary dependent upon its orientation to the sun and any permanent shading provided. Information concerning the calculation of cooling loads at various locations, window exposures, and shadings are provided in Chapter 22 of the 1989 ASHRAE *Handbook of Fundamentals.*

Figure 6-11.1.1 Example comfort cooling certificate for Alternative 1.

6-11.1.2 Alternative 2. For each home suitable for a central air cooling system, the manufacturer shall provide the following statement: "The air distribution system of this home is suitable for the installation of a central air conditioning system." *(See Figure 6-11.1.2.)*

6-11.1.3 Alternative 3. If the manufactured home is not equipped with an air supply duct system, or if the manufacturer elects not to designate the home as being suitable for the installation of a central air conditioning system, the manufacturer shall provide the following statement: "The air distribution system of this home has not been designed in anticipation of its use with a central air conditioning system." *(See Figure 6-11.1.3.)*

6-11.2 Maximum Central Manufactured Home Air Conditioning Capacity. For each home designated as suitable for central air conditioning, the manufacturer shall provide the maximum central manufactured home air conditioning capacity certified in accordance with ARI 210/240, *Unitary Air-Conditioning and Air-Source Heat Pump Equipment,* and in accordance with 8-15.1.3 of this standard. If the capacity information provided is based on entrances to the air supply duct at other than the furnace plenum, the manufacturer shall indicate the correct supply air entrance and return air exit locations.

Comfort Cooling Certificate

Manufactured Home Manufacturer _____
Plant Location _____
Manufactured Home Model _____

The air distribution system of this home is suitable for the installation of a central air conditioning system.

The supply air distribution system installed in this home is sized for a manufactured home central air conditioning system of up to _____ Btu/hr rated capacity, which are certified in accordance with the appropriate Air Conditioning and Refrigeration Institute Standards. When the air circulators of such air conditioners are rated at 3.0 in. water column static pressure (75 Pa) or greater for the cooling air delivered to the manufactured home supply air duct system.

Information necessary to calculate cooling loads at various locations and orientations is included in the special comfort cooling information provided with this manufactured home.

Figure 6-11.1.2 Example comfort cooling certificate for Alternative 2.

Comfort Cooling Certificate

Manufactured Home Manufacturer _____
_____
Plant Location _____
Manufactured Home Model _____

The air distribution system of this home has not been designed in anticipation of its use with a central air conditioning system.

Figure 6-11.1.3 Example comfort cooling certificate for Alternative 3.

6-11.3* Comfort Cooling Information. For each manufactured home designated either "suitable for" or "provided with" a central air conditioning system, the manufacturer shall provide comfort cooling information specific to the manufactured home necessary to complete the cooling load calculations. The comfort cooling information shall include a statement to read as follows:

Information Provided By The Manufacture Necessary to Calculate Sensible Heat Gain

Walls (without windows and doors)	_____U
Ceilings and roofs of light color	_____U
Ceilings and roofs of dark color	_____U
Floors	_____U
Air ducts in floor	_____U
Air ducts in ceiling	_____U
Air ducts installed outside the home	_____U

Chapter 7 Plumbing Systems

7-1 Scope. This chapter shall cover the plumbing materials, fixtures, and equipment installed within or on manufactured homes. It is the intent of this chapter to ensure the use of water supply, drain, waste, and vent systems that permit satisfactory functioning and provide for health and safety under all conditions of normal use.

7-2 Definitions. The following definitions shall apply to Chapter 7 only.

Accessible. Able to approach, access a fixture, connection, appliance, or equipment. Access shall be permitted to require removal of an access panel or the opening of a door.

Air Gap (Water Distribution System). The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture, water-supplied appliance, or other device, and the flood level rim of the receptor.

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 manufactured home.

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

Backflow Connection. Any arrangement whereby backflow can occur.

Backflow Preventer. A device or means to prevent backflow.

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

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

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

Continuous Waste. A drain from two or more fixtures connected to a single trap.

Critical Level. A point established by the testing laboratory (usually stamped on the device by the manufacturer) that determines the minimum elevation above the flood level rim of the fixture or receptor served where the device can be installed. When a backflow prevention device does not bear a critical level marking, the bottom of the vacuum breaker, combination valve, or any such approved or listed device shall constitute the critical level.

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 can be a flow from one system or source to the other, the direction of flow depending on the pressure differential between the two systems.

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

Diameter. Unless otherwise specifically stated, the nominal (inside) diameter designated commercially.

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

Drain Connector. The removable extension, consisting of all pipes, fittings, and appurtenances, from the drain outlet to the drain inlet serving the manufactured home.

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

Drainage System. All piping, within or attached to the structure, that conveys sewage or other liquid waste to the drain outlet, not including the drain connector.

Fixture Drain. The drain from the trap of a fixture to the junction of that drain with any other drain pipe.

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

Flood Level. The edge of the receptor or fixture over which water overflows.

Flooded. The condition that results when the liquid in a fixture, container, or receptor rises to the flood level.

Flush Tank. That portion of a water closet that is designed to contain sufficient water to adequately flush the fixture.

Flush Valve. A device located at the bottom of a flush tank for flushing a water closet.

Flushometer Tank. A device integrated within an air accumulator vessel that is designed to discharge a predetermined quantity of water to fixtures for flushing purposes.

Flushometer Valve. A device that discharges a predetermined quantity of water to a fixture for flushing purposes and is closed by direct water pressure.

Grade. The fall (slope) of a pipe in reference to a horizontal plane, expressed in inches per foot length (mm per meters).

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

Horizontal Pipe. Any pipe or fitting that makes an angle of not more than 45 degrees with the horizontal.

Individual Vent. A pipe installed to vent a fixture drain.

Inlet Coupling. The terminal end of the water system to which the water service connection is attached. It can be a swivel fitting or threaded pipe end.

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

Main Drain. The lowest pipe of a drainage system that receives sewage from all the fixtures within a manufactured home and conducts these wastes to the drain outlet.

Main Vent. The principal artery of the venting system to which vent branches can be connected.

Offset. A combination of pipe and/or fittings that brings one section of the pipe out of line but into a line parallel with the other section.

Pitch. See definition of "Grade."

Plumbing Appliance. Any one of a special class of plumbing fixtures that is intended to perform a special plumbing function. Its operation and/or control can be dependent upon one or more energized components, such as motors, control, heating elements, or pressure- or temperature-sensing elements. Such fixture can operate automatically through one or more of the following actions: a time cycle, a temperature range, a pressure range, a measured volume, or weight. Alternatively, the fixture can be manually adjusted or controlled by the user or operator.

Plumbing Appurtenance. A manufactured device, a prefabricated assembly, or an on-the-job assembly of component parts that is an adjunct to the basic piping system, plumbing

system, and plumbing fixtures. An appurtenance demands no additional water supply, nor does it add any discharge load to a fixture or to the drainage system.

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

Plumbing System. The water supply and distribution pipes; plumbing fixtures, faucets, and traps; soil, waste, and vent pipes; and water-treating or water-using equipment.

Primary Vent. See definition of "Main Vent."

Relief Vent. An auxiliary vent that permits additional circulation of air in or between drainage and vent systems.

Secondary Vent. Any vent other than the main vent or those vents serving each water closet.

Sewage. Any liquid waste containing animal or vegetable matter in suspension or a solution permitted to include liquids containing chemicals in solution.

Siphonage. The loss of water seal from fixture traps resulting from partial vacuum in the drainage system can be either of the following two types, or a combination of the two:

(a) Self-siphonage resulting from vacuum in a fixture drain generated solely by the discharge of the fixture served by that drain

(b) Induced siphonage resulting from vacuum in the drainage system generated by the discharge of one or more fixtures other than the one under observation

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.

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

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

Vacuum Breaker. See definition of "Backflow Preventer."

Vent Cap. The device or fitting that protects the vent pipe from foreign substances with an opening to the atmosphere equal to the area of the vent it serves.

Vent System. That part of a piping installation that provides circulation of air within a drainage system.

Vertical Pipe. Any pipe or fitting that makes an angle of not more than 45 degrees with the vertical.

Water Closet Drain. That part of the drainage piping that receives the discharge from each individual water closet.

Water Connection. The fitting or point of connection for the manufactured home water distribution system designed for connection to a water supply.

Water Connector. The removable extension connecting the manufactured home water distribution system to the water supply.

Water Distribution System. Potable water piping within, or permanently attached to, the manufactured home.

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

Wet-Vented Drainage System. The specially designed system of drain piping that also vents one or more plumbing fixtures by means of a common waste and vent pipe.

Whirlpool Bathtub. A plumbing appliance consisting of a bathtub fixture that is equipped and fitted with a circulation piping system, pump, and other appurtenances and is so designed to accept, circulate, and discharge bathtub water upon each use.

7-3 General Requirements.

7-3.1 Minimum Requirements. Any plumbing system installed in a manufactured home shall conform with the minimum provisions of this chapter.

7-3.1.1 General. The plumbing system shall be of durable material, free from defective workmanship, and so designed and constructed as to give satisfactory service for a reasonable life expectancy.

7-3.1.2 Conservation. Water closets shall not use more than 1.6 gal (6 L) of water.

7-3.1.3 Connection to Drainage System. All plumbing, fixtures, drains, appurtenances, and appliances designed or used to receive or discharge liquid waste or sewage shall be connected to the manufactured home drainage system in a manner provided by this standard.

7-3.1.4 Workmanship. All design, construction, and workmanship shall be in conformance with accepted engineering practices and shall be of such character as to secure the results sought to be obtained by this standard.

7-3.1.5 Components. Plumbing materials, devices, fixtures, fittings, equipment, appliances, appurtenances, and accessories intended for use in, or for being attached to, a manufactured home shall conform to one of the applicable standards referenced in Table 7-4.1. Where an applicable standard is not referenced, or an alternative recognized standard is utilized, the plumbing component shall be listed by a nationally recognized testing laboratory, inspection agency, or other qualified organization as suitable for the intended use.

7-3.1.6 Prohibited Fittings and Practices.

7-3.1.6.1 Drainage or vent piping shall not be drilled and tapped for the purpose of making connections.

7-3.1.6.2 Vent pipes shall not be used as waste or drain pipes.

Exception: As specifically provided elsewhere in this standard.

7-3.1.6.3 Fittings, connections, devices, or methods of installation that obstruct or retard the flow of sewage or the flow of 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 acceptable in this standard, or their use is accepted as having a desirable and acceptable function of ultimate benefit to the proper and continued functioning of the plumbing system.

7-3.1.6.4 Cracks, holes, or other imperfections in materials shall not be concealed by welding, brazing, or soldering, or by paint, wax, tar, or other leak-sealing or repairing agents.

7-3.1.6.5 Piping, fixtures, or equipment shall be located so as not to interfere with the normal use or with the normal operation and use of windows, doors, or other required facilities.

7-3.1.6.6 Galvanized pipe shall not be bent or welded.

7-3.1.7 Alignment of Fittings. All valves, pipes, and fittings shall be installed in correct relationship to the direction of flow.

7-3.2 Protective Requirements.

7-3.2.1 Cutting Structural Members. Structural members shall not be unnecessarily or carelessly weakened by cutting or notching.

7-3.2.2 Exposed Piping. All piping, pipe threads, hangers, and supports exposed to the weather, water, mud, and road hazard, and subject to damage therefrom, shall be painted, coated, wrapped, or otherwise protected from deterioration.

7-3.2.3 Road Damage. Pipes, supports, drains, outlets, or drain hoses shall not extend or protrude in a manner where they could be unduly subjected to damage during transit.

7-3.2.4 Freezing. All piping and fixtures subject to freezing temperatures shall be insulated or protected to prevent freezing under normal occupancy. The manufacturer shall provide the following:

(a) Written installation instructions for the method(s) required for compliance to this section

(b) A statement in the installation instructions stating that if heat tape is used, it shall be listed for use with manufactured homes

(c) A receptacle outlet for the use of a heat tape located on the underside of the manufactured home, within 2 ft (610 mm) of the water supply inlet. The receptacle outlet provided shall not be placed on a branch circuit that is protected by a ground-fault circuit-interrupter

7-3.2.5 Drainage. All piping shall be designed to allow drainage.

Exception: Fixture trap.

7-3.2.6 Rodent Resistance. All exterior openings around piping and equipment shall be sealed to resist the entrance of rodents.

7-3.2.7 Heat Exposure. Piping and electrical wiring shall not pass through the same holes in walls, floors, or roofs. Plastic piping shall not be exposed to heat in excess of manufacturer's recommendation, or to radiation from heat-producing appliances.

7-4 Materials.

7-4.1 Minimum Standards. Materials, devices, fixtures, fittings, equipment, appliances, appurtenances, and accessories shall conform to one of the standards in Table 7-4.1 and shall be free from defects. Where an appropriate standard is not indicated in Table 7-4.1 or a standard not indicated in the table is preferred, the item shall be permitted to be used if it is listed. A listing also shall be required when so specified in other sections of this chapter.

7-4.2 Where more than one standard is referenced for a particular material or component, compliance with only one of those standards shall be required.

Exception No. 1: When one of the reference standards requires evaluation of chemical, toxicity, or odor properties that are not included in the other standard, then conformance to the applicable requirements of each standard shall be required.

Exception No. 2: When a plastic material or component is not covered by the standards in Table 7-4.1, it shall be certified as nontoxic in accordance with NSF 14, Plastic Piping Components and Related Materials.

7-5 Joints and Connections.

7-5.1 Tightness. Joints and connections in the plumbing system shall be gastight and watertight for the pressures required under testing procedures.

7-5.2 Assembling of Pipe. All joints and connections shall be correctly assembled for tightness. Pipe threads shall be fully engaged with the threads of the fitting. Plastic pipe and copper tubing shall be inserted to the full depth of the solder cup or welding sockets of each fitting. Pipe threads and slip joints shall not be wrapped with string, paper, putty, or similar fillers.

7-5.3 Threaded Joints. Threads for screw pipe and fittings shall conform to the approved or listed standard. Pipe ends shall be reamed out to size of bore. All burrs, chips, cutting oil, and foreign matter shall be removed. Pipe joint cement or thread lubricant shall be of approved type and applied to male threads only.

7-5.4 Solder Joints. Solder joints for tubing shall be made with approved or listed solder-type fittings. Surfaces to be soldered shall be cleaned bright. The joints shall be properly fluxed with noncorrosive paste-type flux and, for manufactured homes that are to be connected to a public water system, made with solder having not more than 0.2 percent lead.

7-5.5 Plastic Pipe, Fittings, and Joints. Plastic pipe and fittings shall be joined by installation methods recommended by the manufacturer or in accordance with the provisions of a recognized, approved, or listed standard.

7-5.6 Union Joints. Metal unions in water piping shall have metal-to-metal ground seats.

7-5.7 Flared Joints. Flared joints for soft-copper water tubing shall be made with approved or listed fittings. The tubing shall be expanded with a proper flaring tool.

7-5.8 Cast Iron Soil Pipe Joints. Approved or listed cast iron pipe shall be permitted to be joined as follows:

(a) Approved or listed hubless pipe and fittings shall be permitted to be joined with listed couplings or adapters, per the manufacturer's recommendations.

(b) Hub and plain-end soil pipe shall be permitted to be joined by compression fittings, per the manufacturer's recommendation.

7-6 Traps and Cleanouts.

7-6.1 Traps.

7-6.1.1 Traps Required. Each plumbing fixture shall be separately trapped by approved water seal "P" traps. All traps shall be effectively vented.

Exception: Listed toilets.

7-6.1.2 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. (760 mm) apart, in the same room, and flood level rims at the same level, shall be permitted to be connected to one "P" trap and considered as a single fixture for the purpose of drainage and vent requirements.

7-6.1.3 Prohibited Traps. A trap that depends for its seal on concealed interior partitions shall not be used. Full "S" traps, bell traps, drum traps, crown-vented traps, and running traps shall not be permitted. Fixtures shall not be double-trapped.

Table 7-4.1 Minimum Standards

Materials	Reference Standards
Ferrous Pipe and Fittings	
Gray Iron Threaded Fittings	ASME B 16.4-1992
Malleable Iron Threaded Fittings	ASME B 16.3-1992
Material and Property Standard for Special Cast Iron Fittings	IAPMO PS 5-1984
Welding and Seamless Wrought Steel Pipe	ASME B 36.10M-1995
Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless	ASTM A 53-1996
Pipe Threads, General Purpose (Inch)	ASME B 1.20.1-1983
Standard Specification for Cast Iron Soil Pipe and Fittings	ASTM A 74-1994
Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications	CISPI-301-1995
Nonferrous Pipe and Fittings	
Standard Specification for Seamless Copper Pipe, Standard Sizes	ASTM B 42-1993
Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube	ASTM B 251-1993
Standard Specification for Seamless Copper Water Tube	ASTM B 88-1995
Standard Specification for Copper Drainage Tube (DWV)	ASTM B 306-1995
Wrought Copper and Copper Alloy Solder-Joint Pressure Fitting	ASME B 16.22-1995
Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings-DWV	ASME B 16.29-1994
Cast Copper Alloy Solder-Joint Pressure Fittings	ASME B 16.18-1984
Cast Copper Alloy Solder-Joint Drainage Fittings-DWV	ASME B 16.23-1992
Cast Copper Alloy Fittings for Flared Copper Tubes	ASME B 16.26-1988
Standard Specification for Seamless Red Brass Pipe, Standard Sizes	ASTM B 43-1994
Cast Bronze Threaded Fittings, Classes 125 and 250	ASME B 16.15-1988
Plastic Pipe and Fittings	
Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings	ASTM D 2661-1995
Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings	ASTM D 2665-1995
Standard Specification for Drain, Waste and Vent (DWV) Plastic Fittings Patterns	ASTM D 3311-1994
Standard Specification for Acrylonitrile Butadiene-Styrene (ABS) Schedule 40, Plastic Drain, Waste, and Vent Pipe with a Cellular Core	ASTM F 628-1995
Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems	ASTM D 2846M-1995
Standard Specification for Polybutylene (PB) Plastic Hot- and Cold-Water Distribution Systems	ASTM D 3309-1995
Standard Specification for Crosslinked Polyethylene (PEX) Tubing	ASTM F876-1993
Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems	ASTM F877-1995
Plastic Piping Components and Related Materials	ANSI/NSF 14-1996
Miscellaneous	
Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings	ASTM C 564-1995
Backwater Valves	ASME A112.14.1-1975 (R1990)
Plumbing Fixture Setting Compound	TTP 1536A-1975
Material and Property Standard for Cast Brass and Tubing P-Traps	IAPMO PS 2-1989
Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems	ANSI Z 21.22-1986, with addendum Z 21.22a-1990
Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings	ASTM D 2235-1995
Standard Specification for Solvent Cement for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Systems	ASTM D 2564-1995

(continued)

Table 7-4.1 *(Continued)*

Materials	Reference Standards
Miscellaneous *(Continued)*	
Specification for Neoprene Rubber Gaskets for HUB and Spigot Cast Iron Soil Pipe and Fittings	CISPI-HSN-1985
Plumbing System Components for Manufactured Homes and Recreational Vehicles	NSF 24-1996
Material and Property Standard for Diversion Tees and Twin Waste Elbow	IAPMO PS 9-1984
Material and Property Standard for Flexible Metallic Water Connectors	IAPMO PS 14-1989
Material and Property Standard for Dishwasher Drain Airgaps	IAPMO PS 23-1989
Material and Property Standards for Backflow Prevention Assemblies	IAPMO PS 31-1995
Plumbing Fixtures	
Plumbing Fixtures (General Specifications)	FS WW P- 541E/GEN-1980
Vitreous China Plumbing Fixtures	ASME A112.19.2-1995
Enameled Cast Iron Plumbing Fixtures	ASME A112.19.1M-1987
Porcelain Enameled Formed Steel Plumbing Fixtures	ASME A112.19.4M-1994
Plastic Bathtub Units	ANSI Z 124.1-1995, with Addenda Z124.1a-1990 and Z124.16-1991
Standard for Porcelain Enameled Formed Steel Plumbing Fixtures	IAPMO TSC 22-1985
Plastic Shower Receptors and Shower Stalls	ANSI Z 124.2-1995, with Addendum Z124.2a-1990
Stainless Steel Plumbing Fixtures (Designed for Residential Use)	ASME A 112.19.3M-1987
Material and Property Standard for Drains for Prefabricated and Precast Showers	IAPMO PS 4-1995
Plastic Lavatories	ANSI Z 124.3-1995, with Addendum Z124.3a-1990
Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings	ANSI Z 97.1-1984 (R1994)
Plumbing Fixture Fittings	A 112.18.1M-1996
Trim for Water Closet Bowls, Tanks, and Urinals	ASME A112.19.5-1979 (R1990)
Plastic Water Closets, Bowls and Tanks	ANSI Z 124.4-1996, with Addendum Z124.4a-1990
Whirlpool Bathtub Appliances	ASME A112.19.7M-1995
Performance Requirements for Individual Thermostatic Pressure Balancing and Combination Control for Bathing Facilities	ASSE 1016-1990
Performance Requirements for Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures	ASSE 1037-1990
Performance Requirements for Water Closet Flush Tank Fill Valves (Ballcocks)	ASSE 1002 revision 5-1986 (ANSI/ASSE-1979)
Performance Requirements for Handheld Showers	ASSE 1014-1990
Hydrants for Utility and Maintenance Use	ASME A 112.21.3M-1985
Performance Requirements for Home Laundry Equipment	ASSE 1007-1986
Performance Requirements for Hot Water Dispensers, Household Storage Type Electrical	ASSE 1023-1979
Plumbing Requirements for Residential Use (Household) Dishwashers	ASSE 1006-1992
Performance Requirements for Household Food Waste Disposer Units	ASSE 1008-1986
Performance Requirements for Temperature-Activated Mixing Valves for Primary Domestic Use	ASSE 1017-1986
Water Hammer Arresters	ASSE 1010-1996
Suction Fittings for Use in Swimming Pools, Wading Pools, Spas, Hot Tubs, and Whirlpool Bathtub Appliances	ASME A 112.19.8M-1987
Air Gaps in Plumbing Systems	ASME A 112.1.2-1991
Performance Requirements for Diverters for Plumbing Faucets with Hose Spray, Anti-Siphon Type, Residential Applications	ASSE 1025-1978
Performance Requirements for Pipe Applied Atmospheric Type Vacuum Breakers	ASSE 1001-1990
Performance Requirements for Hose Connection Vacuum Breakers	ASSE 1011-1995
Performance Requirements for Wall Hydrants, Frost Proof Automatic Draining, Anti-Backflow Types	ASSE 1019-1995

7-6.1.4 Material and Design. Each trap shall be self-cleaning, with a smooth and uniform interior waterway. Traps shall be manufactured of cast iron, cast brass, or drawn brass tubing of not less than No. 20 Brown and Sharpe gauge, or of approved or listed plastic, or other approved or listed material. Union joints for a trap shall be beaded to provide a shoulder for the union nut. Each trap shall have the manufacturer's name stamped or cast in the body of the trap, and each tubing trap shall show the gauge of the tubing.

7-6.1.5 Trap Seal. Each "P" trap shall have a water seal of not less than 2 in. (50 mm) and not more than 4 in. (100 mm) and shall be set true to its seal.

7-6.1.6 Size. Traps shall be not less than 1¼ in. (32 mm) in diameter. A trap shall not be larger than the waste pipe to which it is connected.

7-6.1.7 Location. Each trap shall be located as close to its vent and fixture outlet as structural conditions will allow.

7-6.1.8 Length of Tailpiece. The vertical distance from a trap to the fixture outlet shall not exceed 24 in. (760 mm).

7-6.1.9 Installation.

7-6.1.9.1 Grade of Trap Arm. The piping between a "P" trap and the fixture tee or the vented waste line shall be graded ¼ in./ft (20 mm/m) towards the vent and in no case shall have a slope greater than its diameter. The vent opening at fixture tees shall not be below the weir of the "P" trap outlet.

7-6.1.9.2 Trap Arm Offset. The piping between the "P" trap and vent shall be permitted to change direction or be offset horizontally with the equivalent of no more than 180 degrees total change in direction, with a maximum of 90 degrees by any one fitting.

7-6.1.9.3 Concealed Traps. Traps with mechanical joints shall be accessible for repair and inspection.

7-6.1.9.4 Removability of Traps. Traps shall be designed and installed so the "U" bend is removable without removing the strainers from the fixture. Continuous waste and tail pieces that are permanently attached to the "U" bend also shall be removable without removing the strainer from the fixture.

7-6.2 Cleanout Openings.

7-6.2.1 Location of Cleanout Fittings.

7-6.2.1.1 Cleanouts shall be installed if the drainage system cannot be cleaned through fixtures, drains, or vents. Cleanouts also shall be provided when fittings of more than 45 degrees are used to affect an offset.

Exception: Where long turn ells provide sufficient "sweep" for cleaning.

7-6.2.1.2 A full-size cleanout shall be installed at the upper end of any section of drain piping that does not have the required minimum slope of ¼ in./ft (20 mm/m) grade.

7-6.2.1.3 A cleaning tool shall not be required to pass through more than 360 degrees of fittings, excluding removable "P" traps, to reach any part of the drainage system. Water closets shall be permitted to be removed for drainage system access.

7-6.2.2 Access to Cleanouts. Cleanouts shall be accessible through an unobstructed minimum clearance of 12 in. (305 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. Concealed cleanouts that are not provided with access covers shall be extended to a point above the floor or outside of the manufactured home with pipe and fittings installed, as required, for drainage piping without sags and pockets.

7-6.2.3 Material. Plugs and caps shall be brass, or approved or listed plastic, with screw pipe threads.

7-6.2.4 Design. Cleanout plugs shall have raised heads. Plugs at floor level shall have countersunk slots.

7-7 Plumbing Fixtures.

7-7.1 General Requirements.

7-7.1.1 Quality of Fixtures. Plumbing fixtures shall have smooth, impervious surfaces, be free from defects and concealed fouling surfaces, be capable of resisting road shock and vibration, and conform in quality and design to listed standards. Fixtures shall be permanently marked with the manufacturer's name or trademark.

7-7.1.2 Strainers. The waste outlet of all plumbing fixtures shall be equipped with a drain fitting that will provide an adequate unobstructed waterway.

Exception: Toilets.

7-7.1.3 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 materials. Inaccessible 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 1½ in. (40 mm) for sinks of two or more compartments, dishwashers, clothes washing machines, laundry tubs, and bath tubs; and not less than 1¼ in. (32 mm) for lavatories and single-compartment sinks having a 2-in. (50-mm) maximum drain opening.

7-7.1.4 Concealed Connections. Concealed slip joint connections shall be provided with adequately sized, unobstructed access panels and shall be accessible for inspection and repair.

7-7.1.5 Directional Fitting. An approved or listed "Y" or other directional-type branch fitting shall be installed in every tailpiece or continuous waste that receives the discharge from food waste disposal units, dishwashing, or other forced-discharge fixture or appliance. *(See also 7-7.2.4.2.)*

7-7.2 Fixtures.

7-7.2.1 Spacing. All plumbing fixtures shall be located and installed so as to be reasonably accessible for their intended use.

7-7.2.2 Water Closets.

7-7.2.2.1 Water closets shall be designed and manufactured according to approved or listed standards and shall be equipped with a water-flushing device capable of adequately flushing and cleaning the bowl at each operation of the flushing mechanism.

7-7.2.2.2 Water closet flushing devices shall be designed to replace the water seal in the bowl after each operation. Flush valves, flushometer valves, flushometer tanks, and ball cocks

shall automatically shut off at the end of each flush or when the tank is filled to operating capacity.

7-7.2.2.3 Flush tanks shall be fitted with an overflow pipe large enough to prevent flooding at the maximum flow rate of the ball cock. Overflow pipes shall discharge into the toilet through the tank.

7-7.2.2.4 Water closets that have fouling surfaces that are not thoroughly washed at each discharge shall not be permitted. Any water closet that allows the contents of the bowl to be siphoned back into the water system shall not be permitted.

7-7.2.2.5 Floor Connection. Water closets shall be securely bolted to an approved flange or other approved fitting that is secured to the floor by means of corrosion-resistant screws. The bolts shall be of solid brass or other corrosion-resistant material and shall be not less than ¼ in. (6 mm) in diameter. A watertight seal shall be made between the water closet and flange or other approved fitting by use of a gasket, sealing compound, or listed connector device.

7-7.2.3 Shower Compartment.

7-7.2.3.1 Each shower compartment shall be provided with an approved water-tight receptor with sides and back extending at least 1 in. (25 mm) above the finished dam or threshold. In no case shall the depth of a shower receptor be less than 2 in. (50 mm) or more than 9 in. (230 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 6 ft (2 m) above the bathroom floor level. Such walls shall form a water-tight joint with each other and with the bathtub, receptor, or shower floor. The floor of the compartment shall slope uniformly to the drain at not less than ¼ in./ft (20 mm/m) or more than ½ in./ft (43 mm/m).

7-7.2.3.2 The joint around the drain connection shall be made watertight by a flange, clamping ring, or other approved, listed means.

7-7.2.3.3 Shower doors and tub and shower enclosures shall be constructed so as to be waterproof and, if glazed, glazing shall comply with ANSI Z97.1, *Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings.*

7-7.2.3.4 Prefabricated plumbing fixtures shall be approved or listed.

7-7.2.3.5 Showers, bathtub, and bath-shower combinations shall be protected with individual control valves of the pressure-balancing, thermostatic, or combination pressure-balancing mixing valve type. The handle position or limit stops on such valves shall be set to deliver a maximum hot water setting of 120°F (49°C). The water heater thermostat shall not be considered a suitable control for adjusting the maximum hot water setting.

7-7.2.4 Dishwashing Machines.

7-7.2.4.1 A dishwashing machine shall discharge its waste through a fixed air gap installed above the machine; through a high loop as specified by the dishwashing machine manufacturer; or into an open standpipe-receptor with a height greater than the washing compartment of the machine. When a standpipe is used, it shall be at least 18 in. (457 mm), but not more than 30 in. (762 mm), above the trap weir. The drain connections from the air gap or high loop shall be permitted to connect to an individual trap; to a directional fitting installed in the sink tailpiece; or to an opening provided on the inlet side of a food waste disposal unit.

7-7.2.4.2 The drain from a dishwashing machine shall not be connected to a sink tailpiece, continuous waste line, or trap on the discharge side of a food waste disposal unit.

7-7.2.5 Clothes Washing Machines.

7-7.2.5.1 Clothes washing machines shall drain either into a properly vented trap; into a laundry tub tailpiece with watertight connections; into an open standpipe receptor; or over the rim of a laundry tub.

7-7.2.5.2 Standpipes shall be either 1½ in. (40 mm) minimum nominal iron pipe size, 1½ in. (40 mm) diameter nominal brass tubing not less than No. 20 Brown and Sharpe gauge, or 1½ in. (40 mm) approved plastic materials. Receptors shall discharge into a vented trap or shall be connected to a laundry tub tailpiece by means of an approved or listed directional fitting. Each standpipe shall extend not less than 18 in. (457 mm) or more than 30 in. (762 mm) above its trap and shall terminate in an accessible location no lower than the top of the clothes washing machine. A removable, tight-fitting cap or plug shall be installed on the standpipe when a clothes washing machine is not provided.

7-7.2.5.3 The clothes washing machine drain shall not be connected to the tailpiece, continuous waste, or trap of any sink or dishwashing machine.

7-7.2.6 Shower Valves. Shower and tub-shower combination valves shall be balanced pressure, thermostatic, or combination mixing valves that conform to the requirements of ASSE 1016, *Performance Requirements for Individual Thermostatic Pressure Balancing and Combination Control for Bathing Facilities.* Such valves shall be equipped with handle position stops that are adjustable in accordance with the valve manufacturer's instructions to a maximum hot water setting of 120°F (49°C).

7-7.3 Installation.

7-7.3.1 Access. Each plumbing fixture and standpipe receptor shall be located and installed so as to be accessible for usage, cleaning, repair, and replacement. Access to diverter valves and other connections from the fixture hardware shall not be required.

7-7.3.2 Alignment. Fixtures shall be set level and in true alignment with adjacent walls. Where practical, piping from fixtures shall extend to the nearest wall.

7-7.3.3 Brackets. Wall-hung fixtures shall be rigidly attached to walls by metal brackets or supports without any strain being transmitted to the piping connections. Flush tanks shall be securely fastened to water closets or to the wall with corrosive-resistant materials.

7-7.3.4 Tub Supports. Bathtub rims at the wall shall be supported on metal hangers or on end-grain wood blocking attached to the wall unless otherwise recommended by the manufacturer of the tub.

7-7.3.5 Fixture Fittings. Faucets and diverters shall be installed so that the flow of hot water from the fittings corresponds to the left-hand side of the fitting.

7-7.3.6 Whirlpool Bathtub Appliances.

7-7.3.6.1 Access Panel. A door or panel of sufficient size shall be installed to provide access to the pump for repair and/or replacement.

7-7.3.6.2 Piping Drainage. The circulation pump shall be accessibly located above the crown weir of the trap. The pump drain line shall be properly sloped to drain the volute after fixture use.

7-7.3.6.3 Piping. Whirlpool bathtub circulation piping shall be installed so as to be self-draining.

7-7.3.6.4 Electrical. Electrical installations shall be in accordance with Article 680, Part G, of NFPA 70, *National Electrical Code®*.

7-8 Hangers and Supports.

7-8.1 Strains and Stresses. Piping in a plumbing system shall be installed without undue strains and stresses, and provisions shall be made for expansion, contraction, and structural settlement.

7-8.2 Piping Supports. Piping shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents. Unless otherwise stated in the referenced standards in Table 7-4.1, or unless specified by the pipe manufacturer, plastic drainage piping shall be supported at intervals not to exceed 4 ft (1220 mm) and plastic water piping shall be supported at intervals not to exceed 3 ft (915 mm).

7-8.3 Hangers and Anchors.

7-8.3.1 Hangers and anchors shall be of sufficient strength to support their proportional share of the pipe alignments and prevent rattling.

7-8.3.2 Piping shall be securely attached to the structure by hangers, clamps, or brackets that provide protection against motion, vibration, road shock, or torque in the chassis.

7-8.3.3 Hangers and straps supporting plastic pipe shall not compress, distort, cut, or abrade the piping and shall allow free movement of the pipe.

7-9 Water Distribution Systems.

7-9.1 Water Supply.

7-9.1.1 Supply Piping. 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. *(See Table 7-9.6.1.)* The manufacturer shall include in the written installation instructions that the manufactured home has been designed for an inlet water pressure of 80 psi (552 kPa), and a statement that when the manufactured home is to be installed in areas where the water pressure exceeds 80 psi (552 kPa), a pressure-reducing valve shall be installed.

7-9.1.2 Hot Water Supply. Each manufactured home equipped with a kitchen sink, bathtub, and/or shower shall be provided with a hot water supply system, including a listed water heater.

7-9.2 Water Outlets and Supply Connections.

7-9.2.1 Water Connection. Each manufactured home with a water distribution system shall be equipped with a $^{3}/_{4}$-in. (20-mm) threaded inlet connection. This connection shall be tagged or marked "Fresh Water Connection" (or "Fresh Water Fill"). A matching cap or plug shall be provided to seal the water inlet when it is not in use and shall be permanently attached to the manufactured home or water supply piping. When a master cold water shutoff full-flow valve is not installed on the main feeder line in an accessible location, the manufacturer's installation instructions shall indicate that such a valve is to be installed in the water supply line adjacent to the home. When a manufactured home includes expandable rooms or is composed of two or more units, fittings or connectors designed for such purpose shall be provided to connect any water piping. When not connected, the water piping shall be protected by means of matching threaded caps or plugs.

7-9.2.2 Prohibited Connections.

7-9.2.2.1 The installation of potable water supply piping, or fixture or appliance connections, shall be made in a manner that prevents the possibility of backflow.

7-9.2.2.2 No part of the water system shall be connected to any drainage or vent piping.

7-9.2.3 Rim Outlets. The outlets of faucets, spouts, and similar devices shall be spaced at least 1 in. (25 mm) above the flood level of the fixture.

7-9.2.4 Appliance Connections. Water supplies connected to clothes washing or dishwashing machines shall be protected by an approved or listed fixed air gap provided within the appliance by the manufacturer.

7-9.2.5 Flushometer Valves or Manually Operated Flush Valves. An approved or listed vacuum breaker shall be installed and maintained in the water supply line on the discharge side of a water closet flushometer valve or manually operated flush valve. Vacuum breakers shall have a minimum clearance of 6 in. (152 mm) above the flood level of the fixture to the critical level mark unless otherwise permitted in their approval.

7-9.2.6 Flush Tanks. Water closet flush tanks shall be equipped with an approved or listed anti-siphon ball cock that shall be installed and maintained with its outlet or critical level mark not less than 1 in. (25 mm) above the full opening of the overflow pipe.

7-9.2.7 Hose Bibbs. When provided, all exterior hose bibbs and laundry sink hose connections shall be protected by a listed nonremovable backflow prevention device. This provision shall not be applicable to hose connections provided for automatic washing machines with built-in backflow prevention or water heater drain valves.

7-9.2.8 Flushometer Tanks. Flushometer tanks shall be equipped with an approved air gap or vacuum breaker assembly that is located above the flood level rim above the fixture.

7-9.3 Water Heater Safety Devices.

7-9.3.1 Relief Valves. All water heaters shall be installed with approved and listed fully automatic valve(s) designed to provide temperature and pressure relief.

7-9.3.1.1 Any temperature relief valve or combined pressure and temperature relief valve installed for this purpose shall have the temperature-sensing element immersed in the hottest water within the upper 6 in. (152 mm) of the tank. It shall be set to start relieving at a pressure of 150 psi (1034 kPa) or the rated working pressure of the tank, whichever is lower, and at or below a water temperature of 210°F (99°C).

7-9.3.1.2 Relief valves shall be provided with full-sized drains, with cross-sectional areas equivalent to that of the relief valve outlet, that shall be directed downward and discharge beneath the manufactured home. Drain lines shall be of a material listed for relief valve discharge tubing use or hot water distribution and shall drain fully by gravity. Drain lines shall not be trapped or have their outlets threaded. The end of the drain shall be visible for inspection.

7-9.4 Materials.

7-9.4.1 Piping Material. Water pipe shall be of standard weight brass, galvanized steel, Type K, Type L, or Type M copper tubing, approved or listed plastic, or other approved or listed material.

7-9.4.1.1 Plastic Piping. All plastic water piping and fittings in manufactured homes shall be listed for use with hot water.

7-9.4.2 Fittings. Appropriate fittings shall be used for all changes in pipe size and at the location where pipes are joined. The material and design of the fittings shall conform to the type of piping used. Special consideration shall be given to prevent corrosion where dissimilar metals are joined.

7-9.4.2.1 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, reduction of size, or where pipes are joined together.

7-9.4.2.2 Fittings for copper tubing shall be of cast brass or drawn copper (sweat-soldered) or shall be approved or listed fittings for the intended purpose.

7-9.4.3 Prohibited Material. Used piping materials shall not be permitted. Those pipe dopes, solders, fluxes, oils, solvents, chemicals, or other substances that are toxic, corrosive, or otherwise detrimental to the water system shall not be used. In addition, for those manufactured homes that are to be connected to a public water system, all water piping shall be lead-free [as defined in Section 109(c)(2) of the Safe Drinking Water Act Amendments of 1986], with solders and flux containing no more than 0.2 percent lead, and pipes and pipe fittings containing no more than 8 percent lead.

7-9.5 Installation of Piping.

7-9.5.1 Minimum Requirement. All piping equipment, appurtenances, and devices shall be installed in a workmanlike manner and shall conform with the provisions and intent of this standard.

7-9.5.2 Screw Pipe. Iron pipe-size brass or galvanized iron or steel pipe fittings shall be joined with approved or listed standard pipe threads fully engaged in the fittings. Pipe ends shall be reamed to the full bore of the pipe. Pipe-joint compound shall be insoluble in water, nontoxic, and applied to male threads only.

7-9.5.3 Solder Fittings. Joints in copper water tubes shall be made by the appropriate use of approved cast brass or wrought copper fittings and shall be properly soldered together. The surface to be soldered shall be thoroughly cleaned bright by mechanical means. The joints shall be properly fluxed and made with a solder that contains no more than 0.2 percent lead.

7-9.5.4 Flared Fittings. A flaring tool shall be used to shape the ends of flared tubing to match the flare of fittings.

7-9.5.5 Plastic Pipe and Fittings. Plastic pipe and fittings shall be joined by installation methods recommended by the manufacturer or in accordance with provisions of a listed standard.

7-9.6 Size of Water Supply Piping.

7-9.6.1 Minimum Size. The size of water supply piping and branch lines shall not be less than the sizes shown in Table 7-9.6.1.

7-9.6.2 Sizing Procedure. Both hot and cold water piping systems shall be computed by the following method:

(a) *Size of Branch.* Start at the most remote outlet on any branch of the hot or cold water piping and progressively count towards the water service connection, computing the total number of fixtures supplied along each section of piping. Where branches are joined together, the number of fixtures on each branch shall be totaled so that no fixture is counted twice. Following down the left-hand column of the

Table 7-9.6.1 Minimum Size Tubing and Pipe For Water Distribution Systems

Number of Fixtures	Tubing (nominal) Diameter (in.)	Tubing (nominal) Diameter (mm)	Tubing (nominal) Outer Diameter (in.)	Tubing (nominal) Outer Diameter (mm)	Pipe Iron Pipe Size (in.)	Pipe Iron Pipe Size (mm)
1	¼*	8	⅜	10	½	15
2	⅜	10	½	15	½	15
3	½	15	⅝	18	½	15
4	½	15	⅝	18	½	15
5 or more	¾	20	⅞	22	¾	20

*6-ft (1830-mm) maximum length

Exceptions to Table 7-9.6.1: ¾-in. (10-mm) nominal diameter or ½-in. (15-mm) OD minimum size for clothes washing or dishwashing machines, unless larger size is recommended by the fixture manufacturer. ½-in. (15-mm) nominal diameter or ⅝-in. (16-mm) OD minimum size for flushometer or metering type valves unless otherwise specified in their listing. No galvanized screw piping shall be less than ½-in. (15-mm) iron pipe size.

preceding table, a corresponding number of fixtures will be found. The required pipe or tubing size is indicated in the other columns on the same line.

(b) A water heater, food waste disposal unit, evaporative cooler, or ice maker shall not be counted as a water-using fixture when computing pipe sizes.

7-9.7 Line Valves. Valves, when installed in the water supply distribution system and fully opened, shall have a cross-sectional area of the smallest orifice or opening through which the water flows at least equal to the cross-sectional area of the nominal size of the pipe in which the valve is installed.

Exception: Those valves immediately controlling a one-fixture supply.

7-10 Drainage Systems.

7-10.1 General.

7-10.1.1 Each fixture directly connected to the drainage system shall be installed with a water seal trap *(see 7-6.1).*

7-10.1.2 The drainage system shall be designed to provide an adequate circulation of air in all piping, with no danger of siphonage, aspiration, or forcing of trap seals under conditions of ordinary use.

7-10.2 Materials.

7-10.2.1 Pipe. Drainage piping shall be standard weight galvanized steel; brass; copper; tube DWV; listed Scheduled 40 ABS plastic; listed Scheduled 40 PVC plastic; cast iron; or other listed or approved materials.

7-10.2.2 Fittings. Drainage fittings shall be of a recessed drainage pattern with smooth interior waterways of the same diameter as the piping and of a material conforming to the type of piping used. Drainage fittings shall be designed to provide for a ¼-in./ft (20-mm/m) grade in horizontal piping.

7-10.2.2.1 Fittings for screw pipe shall be cast iron, malleable iron, brass, or listed plastic and shall have standard pipe threads.

7-10.2.2.2 Fittings for copper tubing shall be cast brass or wrought copper.

7-10.2.2.3 Socket-type fittings for plastic piping shall comply with those standards listed in Table 7-4.1.

7-10.2.2.4 Brass or bronze adapter or wrought copper fittings shall be used to join copper tubing to threaded pipe.

7-10.3 Drain Outlets.

7-10.3.1 General. Each manufactured home shall have only one drain outlet.

7-10.3.2 Clearance from Drain Outlet. The drain outlet shall be provided with a minimum clearance of 3 in. (76 mm) in any direction from all parts of the structure or appurtenances, and with not less than 18 in. (457 mm) unrestricted clearance directly in front of the drain outlet.

7-10.3.3 Drain Connector. The drain connector shall not be smaller than the piping to which it is connected and shall be equipped with a watertight cap or plug matching the drain outlet. The cap or plug shall be permanently attached to the manufactured home or drain outlet.

7-10.3.4 Pipe Size. The drain outlet and drain connector shall not be less than 3 in. (75 mm) inside diameter.

7-10.3.5 Preassembly of Drain Lines. Section(s) of the drain system that are designed to be located underneath the home shall not be required to be factory-installed when the manufacturer designs the system for site assembly and provides all materials and components, including piping, fittings, cement, supports, and instructions necessary for proper site installation.

7-10.4 Fixture Connections. Drainage piping shall be provided with approved or listed inlet fittings for fixture connections that are correctly located according to the size and type of fixture to be connected.

7-10.4.1 Water Closet Connection. The drain connection for each water closet shall be 3 in. (76 mm) minimum inside diameter and shall be fitted with an iron, brass, or listed plastic floor flange adapter ring securely screwed, soldered, or otherwise permanently attached to the drain piping in an approved manner and shall be securely fastened to the floor.

7-10.5 Size of Drainage Piping.

7.10.5.1 Fixture Load. Drain pipe sizes shall be determined by the type of fixture and the total number of fixtures connected to each drain.

Exception: As provided by 7-11.4.

7-10.5.1.1 Piping of 1½-in. (40-mm) minimum diameter shall be required for one, and not more than three, individually vented fixture(s).

7-10.5.1.2 Piping of 2-in. (50 mm) minimum diameter shall be required for four or more individually vented fixtures.

7-10.5.1.3 Piping of 3-in. (75-mm) minimum diameter shall be required for water closets.

7-10.6 Wet-Vented Drainage System. Plumbing fixture traps shall be permitted to connect into a wet-vented drainage system designed and installed to accommodate the passage of air and waste in the same pipe.

7-10.6.1 Horizontal Piping. All parts of a wet-vented drainage system, including the connected fixture drains, shall be horizontal. Where required by structural design, wet-vented drain piping shall be permitted to be offset vertically when other vented fixture drains or relief vents are connected to the drain piping at or below the vertical offsets.

Exception: Wet-vented vertical risers shall terminate with a 1½-in. (40-mm) minimum diameter continuous vent.

7-10.6.2 Size. A wet-vented drain pipe shall be 2-in. (50-mm) minimum diameter and at least one pipe size larger than the largest connected trap or fixture drain. No more than three fixtures shall be permitted to connect to a 2-in. (50-mm) diameter wet-vented drain system.

7-10.6.3 Length of Trap Arm. Fixture traps shall be located within the distance given in 7-11.3.5. No more than one trap shall connect to a trap arm.

7-10.7 Offsets and Branch Fittings.

7-10.7.1 Changes in Direction. Changes in the 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 combinations of fittings with equivalent radius or sweep.

7-10.7.2 Horizontal to Vertical. Horizontal drainage lines connecting with a vertical pipe shall enter through 45-degree "Y" branches, 60-degree "Y" branches, long-turn "TY" branches, sanitary "T" branches, or other approved or listed fittings or combination of fittings having equivalent sweep. Fittings having more than one branch at the same level shall not be used unless the fitting is constructed so that the discharge from any one branch cannot readily enter any other branch. However, a double sanitary "T" shall be permitted to be used when the drain line is increased not less than two pipe sizes.

7-10.7.3 Horizontal-to-Horizontal and Vertical-to-Horizontal. Horizontal drainage lines connecting with other horizontal drainage lines, or vertical drainage lines connecting 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 equivalent sweep.

7-10.8 Grade of Horizontal Drainage Piping. Horizontal drainage piping shall be run in practical alignment and shall have a uniform grade of not less than ¼ in./ft (20 mm/m) toward the manufactured home drain outlet. Where it is impractical, due to the structural features or arrangement of any manufactured home, to obtain a grade of ¼ in./ft (20 mm/m), the pipe or piping shall be permitted to have a grade of not less than ⅛ in./ft (10 mm/m) when a full-size cleanout is installed at the upper end.

Exception: Fixture connections on the inlet side of the trap.

7-11 Vents and Venting.

7-11.1 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 Section 7-11 and as otherwise required by this standard.

7-11.2 Materials.

7-11.2.1 Pipe. Vent piping shall be of standard weight steel, wrought iron, brass, copper tube DWV, listed plastic, cast iron, or other approved or listed materials.

7-11.2.2 Fittings. Appropriate fittings shall be used for all changes in direction or size and at the location where pipes are joined. The material and design of vent fittings shall conform to the type of piping used.

7-11.2.2.1 Fittings for screw pipe shall be cast iron, malleable iron, plastic, or brass and shall have standard pipe threads.

7-11.2.2.2 Fittings for copper tubing shall be cast brass or wrought copper.

7-11.2.2.3 Fittings for plastic piping shall be made in accordance with approved applicable standards.

7-11.2.2.4 Brass adapter fittings or wrought copper shall be used to join copper tubing to threaded pipe.

7-11.2.2.5 Listed rectangular tubing shall be permitted to be used for vent piping only, provided it has an open cross section at least equal to the circular vent pipe required. Listed transition fittings shall be used.

7-11.3 Size of Vent Piping.

7-11.3.1 Main Vent. The drain piping for each water closet shall be vented by a 1½-in. (40-mm) minimum diameter vent or by a rectangular vent of venting cross section equivalent to or greater than the venting cross section of a 1½-in. (40-mm) diameter vent. The vent shall be connected to the water closet drain by one of the following methods:

(a) A 1½-in. (40-mm) minimum diameter individual vent pipe or equivalent that is directly connected to the water closet drain piping within the distance allowed in 7-11.3.5 for 3-in. (75-mm) trap arms undiminished in size through the roof.

(b) A 1½-in. (40-mm) minimum diameter continuous vent or equivalent that is indirectly connected to the water closet drain piping within the distance allowed in 7-11.3.5 for 3-in.(75-mm) trap arms through a 2-in. (50-mm) wet-vented drain that carries the waste of not more than one fixture.

(c) Two or more vented drains, when at least one is wet-vented or 2-in. (50-mm) minimum diameter and each drain is separately connected to the water closet drain. At least one of the drains shall connect within the distance allowed in 7-11.3.5 for 3-in. (75-mm) trap arms.

7-11.3.2 Vent Pipe Areas. Each individually vented fixture with a 1½-in. (40-mm) or smaller trap shall be provided with a vent pipe equivalent in area to a 1¼-in. (32-mm) nominal pipe size. The main vent, water closet vent, relief vent, and the continuous vent of wet-vented systems shall have an area equivalent to 1½-in. (40-mm) nominal pipe size.

7-11.3.3 Common Vent. Where two fixture traps located within the distance allowed from their vent have their trap arms connected separately at the same level into an approved double fitting, an individual vent pipe shall be permitted to serve as a common vent without any increase in size.

7-11.3.4 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.

7-11.3.5 The distance of the fixture trap from the vent shall not exceed the values given in Table 7-11.3.5.

Table 7-11.3.5 Maximum Distance of Fixtures From Vent Trap

Size of Fixture Drain		Distance, Trap to Vent	
in.	(mm)	ft	(mm)
1¼	(32)	4 ft 6 in.	(1372)
1½	(40)	4 ft 6 in.	(1372)
2	(50)	5 ft	(1525)
3	(75)	6 ft	(1830)

7-11.4 Anti-Siphon Trap Vent. An anti-siphon trap vent shall be permitted to be used as a secondary vent system for plumbing fixtures protected by traps no larger than 1½ in. (40 mm) when installed in accordance with the manufacturer's recommendations and the conditions in 7-11.4.1 through 7-11.4.5.

7-11.4.1 No more than two fixtures individually protected by the anti-siphon trap vent shall be drained by a common 1½-in. (40-mm) drain.

7-11.4.2 Minimum drain size for three or more fixtures individually protected by the anti-siphon trap vent shall be 2 in. (50 mm).

7-11.4.3 A primary vent stack shall be installed to vent the water closet drain at the point of heaviest drainage fixture unit loading.

7-11.4.4 The anti-siphon trap vent shall be installed in a location that allows a free flow of air and shall be accessible for inspection, maintenance, and replacement. The sealing function shall be at least 6 in. (152 mm) above the top of the trap arm.

7-11.4.5 Materials for the anti-siphon trap vent shall be as follows:

(a) Cap and housing shall be listed acrylonitrile-butadiene-styrene, DWV grade.

(b) Stem shall be DWV grade nylon or acetal.

(c) Spring shall be stainless steel wire, Type 302.

(d) Sealing disc shall be neoprene, conforming to CISPI-HSN, *Specification for Neoprene Rubber Gaskets for HUB and Spigot Cast Iron Soil Pipe and Fittings*, and ASTM C 564, *Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings*, or FS ZZ-R-765B, *Silicone Rubber, Low and High Temperature and Tear Resistant, Conforming to Rubber, Silicone*, with 1971 Amendment 1, and MIL-L-10547E, *Liners, Case, and Sheet, Overwrap; Water-Vapor Proof or Waterproof, Flexible.*

7-11.5 Grade and Connections — Horizontal Vents. Each vent shall extend vertically from its fixture "T" or point of connection with the waste piping to a point not less than 6 in. (152 mm) above the extreme 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 above the centerline of the drain piping ahead (downstream) of the trap. Where required by structural conditions, vent piping shall be permitted to offset below the rim of the fixture at the maximum angle or height possible.

7-11.6 Vent Terminal.

7-11.6.1 Roof Extension. Each vent pipe shall extend through its flashing and terminate vertically, undiminished in size, not less than 2 in. (50 mm) above the roof. Vent openings shall not be less than 3 ft (914 mm) away from any motor-driven air intake that opens into habitable areas.

7-11.6.2 Flashing. The opening around each vent pipe shall be made watertight by an adequate flashing or flashing material.

7-11.7 Vent Caps. Vent caps, if provided, shall be of the removable type (without removing the flashing from the roof). When vent caps are used for roof space ventilation and the caps are identical to vent caps used for the plumbing system, plumbing system caps shall be identified with permanent markings.

7-12 Tests and Inspection.

7-12.1 Water System. All water piping in the water distribution system shall be subjected to a pressure test. The test shall be made by subjecting the system to air or water at 100 psi (690 kPa) for 15 minutes without loss of pressure.

7-12.2 Drainage and Vent System and Plumbing Fixtures. The waste and vent system shall be tested by one of the following three methods for evidence or indication of leakage:

(a) *Water Test.* Before plumbing fixtures are connected, all of 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. There shall be no evidence of leakage.

(b) *Air Test.* 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-mm) (manometer) water column air pressure test. If the system loses pressure, smoke shall be permitted to be pumped into the system to locate the leaks or soap suds shall be permitted to be spread on the exterior of the piping (bubble test).

(c) *Flood Level Test.* The manufactured home shall be in a level position, all fixtures shall be connected, and the entire system shall be filled with water to the rim of the water closet 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 without evidence of leaks. Then the system shall be unplugged and emptied. The waste piping above the level of the water closet bowl shall then be tested. There shall be 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.

7-12.3 Fixture Test. The plumbing fixtures and connections shall be subjected to a flow test by filling them with water and checking for leaks and retarded flow while they are being emptied.

7-12.4 Shower Compartments. Shower compartments and receptors shall be tested for leaks prior to being covered by finish material. Each pan shall be filled with water to the top of the dam for not less than 15 minutes without evidence of leakage.

Chapter 8 Heating, Cooling, and Fuel-Burning Systems

8-1 Scope. This chapter shall cover the heating, cooling, and fuel-burning equipment installed within, on, or external to a manufactured home.

8-2 Definitions. The following definitions shall apply to Chapter 8 only.

Accessible. Able to approach, access a fixture, connection, appliance, or equipment. Access shall be permitted to require the removal of an access panel, door, or similar obstruction.

Air Conditioner Blower Coil System. A comfort cooling appliance where the condenser section is placed external to the manufactured home and the evaporator section with circulating blower is attached to the manufactured home air supply duct system. Provision must be made for a return air system to the evaporator/blower section. Refrigerant connection between the two parts of the system is accomplished by tubing.

Air Conditioner Split System. A comfort cooling appliance where the condenser section is placed external to the manufactured home and the evaporator section is incorporated into the heating appliance or with a separate blower/coil section within the manufactured home. Refrigerant connection between the two parts of the system is accomplished by tubing.

Air Conditioning Condenser Section. That portion of a refrigerated air cooling or, in the case of a heat pump, heating system that includes the refrigerant pump (compressor) and the external heat exchanger.

Air Conditioning Evaporator Section. A heat exchanger used to cool or, in the case of a heat pump, heat air for use in comfort cooling, or heating, the living space.

Air Conditioning Self-Contained System. A comfort cooling appliance that combines the condenser section, evaporator, and air circulating blower into one unit with connecting ducts for the supply and return air systems.

Air Duct. Conduit or passageway for conveying air to or from heating, cooling, air conditioning, or ventilation equipment, but not including the plenum.

Automatic Pump (Oil Lifter). A pump, which is not an integral part of the oil-burning appliance, that automatically pumps oil from the supply tank and delivers the oil under a constant head to an oil-burning appliance.

Btu (British Thermal Units). The quantity of heat required to raise the temperature of 1 lb of water 1°F.

Btuh. British thermal units per hour.

Burner. A device used for the final conveyance of fuel or a mixture of fuel and air to the combustion zone.

Central Air Conditioning System. Either an air conditioning split system or an external combination heating/cooling system.

Class 0 Air Ducts and Air Connectors. Air ducts and air connectors having a fire hazard classification of zero when tested in accordance with UL 181, *Standard for Safety Factory-Made Air Ducts and Air Connectors.*

Class 1 Air Ducts and Air Connectors. Air ducts and air connectors having a flame spread rating of not over 25 without evidence of continued progressive combustion and a smoke developed rating of not over 50 when tested in accordance with UL 181, *Standard for Factory-Made Air Ducts and Air Connectors.*

Class 2 Air Ducts. Ducts of materials and connectors having a flame spread rating of not over 50 without evidence of continued progressive combustion and a smoke developed rating of not over 50 for the inside surface and not over 100 for the outside surface.

Clearance. The distance between the appliance, chimney vent, chimney, or vent connector or plenum and the nearest surface.

Connector-Gas Appliance. A flexible or semi-rigid connector used to convey fuel gas between a gas outlet and a gas appliance.

Energy Efficiency Ratio (*EER*). The ratio of the cooling capacity output of an air conditioner for each unit of power input:

$$EER = \frac{\text{capacity (Btuh)}}{\text{power input (watts)}}$$

External Combination Heating/Cooling System. A comfort conditioning system placed external to the manufactured home with connecting ducts to the manufactured home for the supply and return air systems.

Factory-Built Fireplace. A hearth, fire chamber, and chimney assembly composed of listed factory-built components assembled in accordance with the terms of listing to form a complete fireplace.

Fireplace Stove. A chimney-connected solid fuel-burning stove having part of its fire chamber open to the room.

Fuel Gas Piping System. The arrangement of piping, tubing, fittings, connectors, valves, and devices designed and intended to supply or control the flow of fuel gas to the appliance(s).

Fuel Oil Piping System. The arrangement of piping, tubing, fittings, connectors, valves, and devices designed and intended to supply or control the flow of fuel oil to the appliance(s).

Gas Clothes Dryer. A device used to dry wet laundry by means of heat derived from the combustion of fuel gases.

Gas Refrigerator. A gas-burning appliance designed to extract heat from a suitable chamber.

Gas Supply Connection. The terminal end or connection to which a gas supply connector is attached.

Gas Supply Connector, Manufactured Home. A listed, flexible connector designed to connect the manufactured home to the gas supply source.

Gas Vents. Factory-built vent piping and vent fittings, listed by an approved testing agency, that are assembled and used in accordance with the terms of their listings for conveying flue gases to the outside atmosphere.

Gas Vent, Type B. A gas vent for venting gas appliances with draft hoods and other gas appliances listed for use with Type B gas vents.

Gas Vent, Type BW. A gas vent for venting listed gas-fired vented wall furnaces.

Heat-Producing Appliance. All heating and cooking appliances and fuel-burning appliances.

Heating Appliance. An appliance for comfort heating or for domestic water heating.

Liquefied Petroleum Gases. The terms liquefied petroleum gases, LPG, and LP-Gas, as used in this standard, shall mean and include any material that is composed predominantly of any of the following hydrocarbons, or mixtures of hydrocarbons: propane, propylene butanes (normal butane or isobutane), and butylenes.

Plenum. An air compartment that is part of an air-distributing system, to which one or more ducts or outlets are connected.

Plenum, Furnace Supply. A plenum that is attached directly to, or is an integral part of, the air supply outlet of the furnace.

Plenum, Furnace Return. A plenum that is attached directly to, or is an integral part of, the return inlet of the furnace.

Quick-Disconnect Device. A hand-operated device that provides a means for connecting and disconnecting a gas supply or for connecting gas systems, and which is equipped with an automatic means to shut off the gas supply when the device is disconnected.

Readily Accessible. Direct access without the necessity of removing any panel, door, or similar obstruction.

Roof Jack. That portion of a manufactured home heater flue or vent assembly, including the cap, insulating means, flashing, and ceiling plate, located in and above the roof of a manufactured home.

Sealed Combustion System Appliance. An appliance that by its inherent design is constructed so that all air supplied for

combustion the appliance's combustion system, and all products of combustion are completely isolated from the atmosphere of the space where it is installed.

Water Heater. An appliance for heating water for domestic purposes other than space heating.

8-3 Minimum Standards. Heating, cooling, and fuel-burning appliances and systems in manufactured homes shall be free of defects and conform to applicable standards in Table 8-3 unless otherwise specified in this standard. *(See Section 1-4.)* When more than one standard is referenced, compliance with any one such standard shall meet the requirements of this standard.

Table 8-3 Minimum Standards

Appliances	Referenced Standards
Central Cooling Air Conditioners	UL 465-seventh edition-1984 with revisions through December 24, 1987
Liquid Fuel-Burning Heating Appliances for Manufactured Homes and Recreational Vehicles	UL 307A-seventh edition-1995
Electric Air Heaters	UL 1025-second edition-1987 with revisions July 13, 1989, February 6, 1990, and December 3, 1991
Electric Baseboard Heating Equipment	UL 1042-fourth edition-1995
Electric Central Air Heating Equipment	UL 1096-fourth edition-1986 with revisions July 16, 1986 and January 30, 1988
Gas-Burning Heating Appliances for Mobile Homes and Recreational Vehicles	UL 307B-fourth edition-1995
Gas Clothes Dryers, Vol. 1, Type 1 Clothes Dryers	ANSI Z 21.5.1-1995
Gas Fired Absorption Summer Air Conditioning Appliances	ANSI Z 21.40.1-1981, with Addendum Z 21.40.1a-1982
Gas-Fired Central Furnaces [Except Direct Vent System Central Furnaces]	ANSI Z 21.47-1993
Household Cooking-Gas Appliances	ANSI Z 21.1-1996
Refrigerators Using Gas Fuel	ANSI Z 21.19-1990, with Addendum ANSI Z 21.19a-1992
Gas Water Heaters, Vol. 1, Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less	ANSI Z 21.10.1-1993
Heat Pumps	559-fourth edition-1985 as amended through Sept. 6, 1985
Household Electric Storage Tank Water Heaters	UL 174-ninth edition-1995
Ferrous Pipe and Fittings	
Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless	ASTM A 53-1996
Standard Specification for Electric-Resistance-Welded Coiled Steel Tubing for Gas and Fuel Oil Lines	ASTM A 539-90a
Pipe Threads, General Purpose (In.)	ASME B 1.20.1-1983
Welding and Seamless Wrought Steel Pipe	ASME B 36.10M-1995
Nonferrous Pipe, Tubing, and Fittings	
Standard Specification for Seamless Copper Water Tube	ASTM B 88-1995
Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service	ASTM B 280-1995
Metal Connectors for Gas Appliances	ANSI Z 21.24-1993
Manually Operated Gas Valves for Appliances, Appliance Connector Valves, and Hose End Valves	ANSI Z 21.15-1992
Standard for Gas Supply Connectors for Manufactured Homes	IAPMO TSC 9-1984
Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tubes	ASTM B 251-1993
Standard Specification for Seamless Copper Pipe, Standard Sizes	ASTM B 42-1993
Direct Vent Central Furnaces	ANSI Z 21.64-1990, with Addendum ANSI Z 21.64a-1992

(continued)

Table 8-3 *(Continued)*

Appliances	Referenced Standards
Miscellaneous	
Factory-Made Air Ducts and Connectors	UL 181-ninth edition-1996
Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use	UL 109-fifth edition-1993
Pigtails and Flexible Hose Connectors for LP-Gas	UL 569-seventh edition-1995
Roof Jacks for Manufactured Homes and Recreational Vehicles	UL 311-eighth edition-1994
Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems	ANSI Z 21.22-1986, with Addendum ANSI Z 21.22a-1990
Automatic Gas Ignition Systems and Components	ANSI Z 21.20-1993
Automatic Valves for Gas Appliances	ANSI Z 21.21-1995
Gas Appliance Thermostats	ANSI Z 21.23-1993
Gas Vents	UL 441-ninth edition-1996
Standard for the Installation of Oil-Burning Equipment	NFPA 31, 1997
The following sections are applicable: 1-1, 1-2, 1-3, 1-4 except 1-4.1, 1-5.1, 1-5.2, 1-5.4.2, 1-5.4.3, 1-5.5, 1-5.6, 1-6, 1-7.2 except 1-7.2.4, 1-8, 1-9, 1-10.1, 3-1.1, 3-1.3, 3-1.4, 3-1.5, 3-1.6, 3-10, 4-1.3, 4-1.4, 4-1.5, 4-2, 4-3 except 4-3.2, 4-4 except 4-4.2, 4-4.5.4, 4-4.6, 4-4.7, 4-4.9, and 4-4.10 Appendices B, C, and E	
National Fuel Gas Code	NFPA 54, 1996
Standard for the Installation of Warm Air Heating and Air Conditioning Systems	NFPA 90B, 1996
The following sections are applicable: 2-2.4, 2-3.6, Table 3-1.3, Section B, 4-1.6	
Standard for the Storage and Handling of Liquefied Petroleum Gases	NFPA 58, 1995 edition
Flares for Tubing	SAE J 533, 1992
Chimneys, Factory-Built Residential Type and Building Heating Appliance	UL 103-ninth edition, 1995
Factory-Built Fireplaces	UL 127-sixth edition with revisions January 4, 1989, June 10, 1991, and June 29, 1992
Room Heaters, Solid-Fuel Type	UL 1482-fifth edition-1996
Fireplace Stoves	UL 737-eighth edition-1996
Unitary Air-Conditioning and Air-Source Heat Pump Equipment	ARI 210/240-1989
AGA Requirements for Gas Connectors for Connection of Fixed Appliances for Outdoor Installation, Park Trailers and Manufactured (Mobile) Homes to the Gas Supply	No. 3-87

8-4 Fuel Supply Systems.

8-4.1 LP-Gas System Design and Service Line Pressure.

8-4.1.1 Systems shall be of the vapor-withdrawal type.

8-4.1.2 Gas at a pressure not over 14 in. water column (½ psi) shall be delivered from the system into the gas supply connection.

8-4.2 LP-Gas Containers.

8-4.2.1 Maximum Capacity. No more than two containers with an individual water capacity of no more than 105 lb (48 kg) [approximately 45 lb (20 kg) LP-Gas capacity] shall be installed on or in a compartment of any manufactured home.

8-4.2.2 Construction of Containers. Containers shall be constructed and marked in accordance with the specifications for LP-Gas Containers of the U.S. Department of Transportation (DOT) or *Rules for Construction of Pressure Vessels 1986, ASME Boiler and Pressure Vessel Code*, Section VIII. Division 1 ASME containers shall have a design pressure of at least 312.5 psig.

8-4.2.2.1 Container supply systems shall be arranged for vapor withdrawal only.

8-4.2.2.2 Container openings for vapor withdrawal shall be located in the vapor space when the container is in service, or shall be provided with a suitable internal withdrawal tube that communicates with the vapor space on or near the highest point in the container when it is mounted in a service position, with the vehicle on a level surface. Containers shall be permanently and legibly marked in a conspicuous manner on the outside to show the correct mounting position and the position of the service outlet connection. The method of mounting-in-place shall be such as to minimize the possibility of an incorrect positioning of the container.

8-4.2.3 Location of LP-Gas Containers and Systems.

8-4.2.3.1 LP-Gas containers shall not be installed, nor shall provisions be made for installing or storing any LP-Gas container, even temporarily, inside any manufactured home.

Exception: Listed, completely self-contained hand torches, lanterns, or similar equipment with containers having a maximum water capacity of no more than 2½ lb (1.1 kg) [approximately 1 lb (.45 kg) LP-Gas capacity].

8-4.2.3.2 Containers, control valves, and regulating equipment, when installed, shall be mounted on the "A" frame of the manufactured home, or installed in a compartment that is vaportight to the inside of the manufactured home and accessible only from the outside. The compartment shall be ventilated at top and bottom to facilitate diffusion of vapors. The compartment shall be ventilated with two vents having an aggregate area of not less than 2 percent of the floor area of the compartment, and shall open unrestricted to the outside atmosphere. The required 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 not more than 12 in. (305 mm) below the ceiling level of the compartment. All vents shall have an unrestricted discharge to the outside atmosphere. Access doors or panels of compartments shall not be equipped with locks or require special tools or knowledge to open.

8-4.2.3.3 Permanent and removable fuel containers shall be securely mounted to prevent jarring loose, slipping, or rotating, and the fastenings shall be designed and constructed to withstand static loading in any direction equal to twice the weight of the tank and attachments when filled with fuel, using a safety factor of not less than four based on the ultimate strength of the material to be used.

8-4.2.4 LP-Gas Container Valves and Accessories.

8-4.2.4.1 Valves in the assembly of a two-cylinder system shall be arranged so that replacement of containers can be made without shutting off the flow of gas to the appliance(s). This provision shall not imply the requirement of an automatic change-over device.

8-4.2.4.2 Shutoff valves on the containers shall be set into a recess of the container to prevent possibility of their being struck if the container is dropped upon a flat surface during transit, storage, and while being moved into final utilization. Shutoff valves also shall be permitted to be protected by 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 (1220 mm). Construction shall be such that the blow will not be transmitted to the valve.

8-4.2.4.3 Regulators shall be connected directly to the container shutoff valve outlets, or mounted securely by means of a support bracket, and connected to the container shutoff valve or valves with listed high-pressure connections. If the container is permanently mounted, the connector shall be as required above or with a listed semi-rigid tubing connector.

8-4.2.5 LP-Gas Safety Devices.

8-4.2.5.1 DOT containers shall be provided with safety relief devices, as required by the regulations of the U.S. Department of Transportation. ASME containers shall be provided with relief valves in accordance with 2-3.2 of NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases.* Safety relief valves shall have direct communication with the vapor space of the vessel.

8-4.2.5.2 The delivery side of the gas pressure regulator shall be equipped with a safety relief device set to discharge at a pressure not less than two times, and not more than three times, the delivery pressure of the regulator.

8-4.2.5.3 Systems mounted on the "A" frame assembly shall be so located that the safety relief devices discharge into the open air no less than 3 ft (914 mm) horizontally from any opening into the manufactured home below the level of such discharge.

8-4.2.5.4 Safety relief valves located within liquefied petroleum gas container compartments shall be permitted to be less than 3 ft (914 mm) from openings, provided the bottom vent of the compartment is at the same level or lower than the bottom of any opening into the vehicle, or the compartment is not located on the same wall plane as the opening(s) and is at least 2 ft (610 mm) horizontally from such openings.

8-4.2.6 LP-Gas System Enclosure and Mounting.

8-4.2.6.1 Housings and enclosures shall be designed to provide proper ventilation at least equivalent to that specified in 8-4.2.3.2.

8-4.2.6.2 Doors, hoods, domes, or portions of housings and enclosures required to be removed or opened for replacement of containers shall incorporate means for clamping the containers firmly in place and preventing them from becoming loose during transit.

8-4.2.6.3 Provisions shall be incorporated in the assembly to hold the containers firmly in position and prevent their movement during transit.

8-4.2.6.4 Containers shall be mounted on a substantial support or a base secured firmly to the vehicle chassis. Neither the container nor its support shall extend below the manufactured home frame.

8-4.3 Oil Tanks.

8-4.3.1 Installation. Oil tanks and listed automatic pumps (oil lifters) 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 (2440 mm) above the appliance oil control and the bottom of the tank is no less than 18 in. (457 mm) above the appliance oil control.

8-4.3.2 Auxiliary Oil Storage Tank. Oil supply tanks affixed to a manufactured home shall be so located as to require filling and draining from the outside and shall be readily accessible for inspection. If the fuel supply tank is located in a compartment of a manufactured home, the compartment shall be ventilated at the bottom to permit diffusion of vapors and insulated from the structural members of the body. Tanks so installed shall be provided with an outside fill and vent pipe and an approved liquid-level gauge.

8-4.3.3 Shutoff Valve. A readily accessible, approved, manual shutoff valve shall be installed at the outlet of an oil supply tank. The valve shall be installed to close against the supply.

8-4.3.4 Fuel Oil Filters. All oil tanks shall be equipped with an approved 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.

8-5 Gas Piping Systems.

8-5.1 General. The requirements of Section 8-5 shall govern the installation of all fuel-gas piping attached to any manufactured home. The gas piping supply system shall be designed for a pressure no more than 14 in. (3.4 kPa) water column (½ psi) and no less than 7 in. (1.7 kPa) water column (¼ psi). The manufacturer shall indicate in his written installation instructions the design pressure limitations for safe and effective operation of the gas piping system. None of the requirements listed in Section 8-5 shall apply to the piping supplied as a part of an appliance. All exterior openings around piping, ducts, plenums, or vents shall be sealed to resist the entrance of rodents.

8-5.2 Materials. All materials used for the installation, extension, alteration, or repair of any gas piping system shall be new and free from defects or internal obstructions. It shall not be permitted to repair defects in gas piping or fittings. Inferior or defective materials shall be removed and replaced with acceptable material. The system shall be made of materials having a melting point of not less than 1450°F, except as provided in 8-5.5. The gas piping system shall consist of one or more of the materials described in 8-5.2.1 through 8-5.2.4.

8-5.2.1 Steel or wrought-iron pipe shall comply with ANSI Standard B 36.10, *Welded and Seamless Wrought Steel Pipe.* Threaded brass pipe in iron pipe sizes shall be permitted to be used. Threaded brass pipe shall comply with ASTM B 43, *Standard Specification for Seamless Red Brass Pipe, Standard Sizes.*

8-5.2.2 Fittings for gas piping shall be wrought iron, malleable iron, steel, or brass (containing not more than 75 percent copper).

8-5.2.3 Copper tubing shall be annealed type, Grade K or Grade L, conforming to ASTM B 88, *Standard Specification for Seamless Copper Water Tube,* or shall comply with ASTM B 280, *Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.* Copper tubing shall be internally tinned.

8-5.2.4 Steel tubing shall have a minimum wall thickness of 0.032 in. (0.8 mm) for tubing of ½-in. (15-mm) diameter and smaller and 0.049 in. (1.2 mm) for diameters ½-in. (15-mm) and larger. Steel tubing shall be constructed in accordance with ASTM A 539, *Standard Specification for Electric-Resistance-Welded Coiled Steel Tubing for Gas and Fuel Oil Lines,* and shall be externally corrosion-protected.

8-5.3 Piping Design. Each manufactured home requiring fuel gas for any purpose shall be equipped with a natural gas piping system acceptable for LP-Gas. Where fuel-gas piping is to be installed in more than one section of an expandable or multiple-unit home, the design and construction of the crossover(s) shall be in accordance with 8-5.3.1 through 8-5.3.7.

8-5.3.1 All points of crossover shall be readily accessible from the exterior of the home.

8-5.3.2 The connection(s) between units shall be made with a connector(s) listed for exterior use or direct plumbing sized in accordance with 8-5.4. A shutoff valve of the nondisplaceable rotor type conforming to ANSI Z21.15, *Manually Operated Gas Valves for Appliances, Appliances Connector Valves and Hose End Valves,* suitable for outdoor use, shall be installed at each crossover point upstream of the connection when listed connectors are used.

8-5.3.3 The connection(s) shall be permitted to be made by a listed quick-disconnect device that is designed to provide a positive seal of the supply side of the gas system when such device is separated.

8-5.3.4 The flexible connector, direct plumbing pipe, or "quick-disconnect" device shall be provided with protection from mechanical and impact damage and shall be located to minimize the possibility of tampering.

8-5.3.5 For gas line crossover connections made with either hard pipe or flexible connectors, the crossover point(s) shall be capped on the supply side to provide a positive seal and covered on the other side with a suitable protective covering.

8-5.3.6 Suitable protective coverings for the connection device(s), when separated, shall be permanently attached to the device or flexible connector.

8-5.3.7 When a quick-disconnect device is installed, a tag of 3-in. × 1 3.4-in. (76-m × 44-mm) minimum size made of etched, metal-stamped, or embossed brass; stainless steel; anodized or alclad aluminum not less than 0.020-in. (0.5-mm) thick; or other approved material [e.g., 0.005-in. (0.1-mm) plastic laminates] shall be permanently attached on the exterior wall adjacent to the access to the "quick-disconnect" device. Each tag shall be legibly inscribed, in letters no smaller than ¼-in. (6-mm) high, with the following statement:

DO NOT USE TOOLS TO SEPARATE THE "QUICK-DISCONNECT" DEVICE.

8-5.4 Gas Pipe Sizing. Gas piping systems shall be sized so that the pressure drop to any appliance inlet connection from any gas supply connection, when all appliances are in operation at maximum capacity, is not more than 0.5-in. (.12-kPa) water column, as determined on the basis of test or in accordance with Table 8-5.4. When determining gas pipe sizing in Table 8-5.4, gas shall be assumed to have a specific gravity of 0.65 and be rated at 1000 Btu/ft^3 (.293 kW). The natural gas supply connection(s) shall be no less than the size of the gas piping, but shall be no smaller than ¾-in. (19-mm) nominal pipe size.

8-5.5 Joints for Gas Pipe. All pipe joints in the piping system, unless welded or brazed, shall be threaded joints that comply with ANSI/ASME B1.20.1, *Pipe Threads, General Purpose (Inch).* Right and left nipples or couplings shall not be used. Unions, if used, shall be of ground-joint type. The material used for welding or brazing pipe connections shall have a melting temperature in excess of 1000°F (538°C).

8-5.6 Joints for Tubing.

8-5.6.1 Tubing joints shall be made with either a single or a double flare of 45 degrees in accordance with SAE-J533b, *Flares for Tubing,* or with other listed vibration-resistant fittings, or joints shall be permitted to be brazed with material having a melting point exceeding 1000°F (538°C). Metallic ball-sleeve compression-type tubing fittings shall not be used.

8-5.6.2 Steel tubing joints shall be made with a double flare in accordance with SAE-J533b, *Flares for Tubing.*

8-5.7 Pipe Joint Compound. Screw joints shall be made tight with listed pipe joint compound that is insoluble in liquefied

Table 8-5.4 Maximum Capacity of Different Sizes of Pipe and Tubing in Thousands of Btuh of Natural Gas for Gas Pressures of 0.5 Psig or Less, and a Maximum Pressure Drop of 1/2-in. Water Column

Iron Pipe Sizes — Length										
ID	10 ft	20 ft	30 ft	40 ft	50 ft	60 ft	70 ft	80 ft	90 ft	100 ft
¼ in.	43	29	24	20	18	16	15	14	13	12
⅜ in.	95	65	52	45	40	36	33	31	29	27
½ in.	175	120	97	82	73	66	61	57	53	50
¾ in.	360	250	200	170	151	138	125	118	110	103
1 in.	680	465	375	320	285	260	240	220	215	195
Tubing — Length										
OD	10 ft	20 ft	30 ft	40 ft	50 ft	60 ft	70 ft	80 ft	90 ft	100 ft
¼ in.	27	18	15	13	11	10	9	9	8	8
⅜ in.	56	38	31	26	23	21	19	18	17	16
½ in.	113	78	62	53	47	43	39	37	34	33
¾ in.	197	136	109	93	83	75	69	64	60	57
1 in.	280	193	155	132	117	106	98	91	85	81

For SI units:
1000 Btu = .293 kW, 1 ft = .305 m
1 psig = 6.894 kPa, 1-in. water column = 0.249 kPa

petroleum gas. Pipe joint compound shall be applied to the male threads only.

8-5.8 Concealed Tubing. Tubing shall not be run inside walls, floors, partitions, or roofs. 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.

8-5.9 Concealed Joints. Piping or tubing joints shall not be located in any floor, wall partition, or similar concealed construction space.

8-5.10 Gas Supply Connections. When gas appliances are installed, at least one gas supply connection shall be provided on each home. The connection shall not be located beneath an exit door. Where more than one connection is provided, the piping system shall be sized to provide adequate capacity from each supply connection.

8-5.11 Identification of Gas Supply Connections. Each manufactured home shall have permanently affixed to the exterior skin, at or near each gas supply connection or the end of the pipe, a tag of 3-in. × 1¾-in. (76-mm × 44-mm) minimum size, made of etched, metal-stamped, or embossed brass; stainless steel; anodized or alclad aluminum not less than 0.020-in. (.5-mm) thick, or other approved material [e.g., 0.005-in. (.1-mm) plastic laminates], with the information shown in Figure 8-5.11.

The connector capacity indicated on this tag shall be equal to or greater than the total Btuh rating of all intended gas appliances.

8-5.12 LP-Gas Supply Connectors.

8-5.12.1 A listed LP-Gas flexible connector conforming to UL 569, *Standard for Pigtails and Flexible Hose Connectors for LP-Gas,* or equivalent, shall be supplied when LP-Gas cylinder(s) and regulator(s) are supplied.

Combination LP-Gas and Natural Gas Systems

This gas piping system is designed for use of either liquefied petroleum gas or natural gas.

NOTICE: BEFORE TURNING ON GAS, BE CERTAIN APPLIANCES ARE DESIGNED FOR THE GAS CONNECTED AND ARE EQUIPPED WITH CORRECT ORIFICES. SECURELY CAP THIS INLET WHEN NOT CONNECTED FOR USE.

When connecting to lot outlet, use a listed gas supply connector for mobile homes rated at ☐ 100,000 Btuh or more; ☐ 250,000 Btuh or more.

Before turning on gas, make certain all gas connections have been made tight, all appliance valves are turned off, and any unconnected outlets are capped.

After turning on gas, test gas piping and connections to appliances for leakage with soapy water or bubble solution, and light all pilots.

Figure 8-5.11 Identification of gas supply connections.

8-5.12.2 Appliance Connections. All gas-burning appliances shall be connected to the fuel piping. Materials such as those provided in 8-5.2 or listed appliance connectors shall be used. Listed appliance connectors, when used, shall not run through walls, floors, ceilings, or partitions, except for cabinetry, and shall be 3 ft (914 mm) or less in length or, in the case of cooking appliances, 6 ft (1830 mm) or less. Aluminum connectors shall not be used outdoors. A manufactured home containing a combination LP-Gas and natural gas system shall be permitted to be provided with a gas outlet to supply exterior appliances, when installed in accordance with 8-5.12.2.1 through 8-5.12.2.4.

8-5.12.2.1 No portion of the completed installation shall project beyond the wall of the manufactured home.

8-5.12.2.2 The outlet shall be provided with an approved quick-disconnect device designed to provide a positive seal on the supply side of the gas system when the appliance is disconnected.

A shutoff valve of the nondisplaceable rotor type conforming to ANSI Z21.15, *Manually Operated Gas Valves,* shall be installed immediately upstream of the quick-disconnect device. The complete device shall be provided as part of the original installation.

8-5.12.2.3 Protective caps or plugs for the "quick-disconnect" device, when disconnected, shall be permanently attached to the manufactured home adjacent to the device.

8-5.12.2.4 A tag shall be permanently attached to the outside of the exterior wall of the manufactured home, as close as possible to the gas supply connection. The tag shall indicate the type of gas and the Btuh capacity of the outlet and shall be legibly inscribed with the following statement:

THIS OUTLET IS DESIGNED FOR USE WITH PORTABLE GAS APPLIANCES WHOSE TOTAL INPUT DOES NOT EXCEED _____ BTUH. REPLACE PROTECTIVE COVERING OVER CONNECTOR WHEN NOT IN USE.

8-5.12.3 Valves. A shutoff valve shall be installed in the fuel piping at each appliance inside the manufactured home structure, upstream of the union or connector, in addition to any valve on the appliance, and shall be arranged so as to be accessible for the servicing of the appliance and removal of its components. The shutoff valve shall be located within 6 ft (1830 mm) of a cooking appliance, and within 3 ft (914 mm) of any other appliance. A shutoff valve shall be permitted to serve more than one appliance if located in accordance with these requirements. Shutoff valves shall be of the nondisplaceable rotor type and conform to ANSI Z21.15, *Manually Operated Gas Valves.*

8-5.12.4 Gas Piping System Openings. All openings in the gas piping system shall be made gastight with threaded pipe plugs or pipe caps.

8-5.12.5 Electrical Ground. Gas piping shall not be used for an electrical ground.

8-5.12.6 Couplings. Pipe couplings and unions shall be used to join sections of threaded piping. Right and left nipples or couplings shall not be used.

8-5.12.7 Hangers and Supports. All gas piping shall be adequately supported by galvanized or equivalently protected metal straps or hangers at intervals of not more than 4 ft (1220 mm). Solid iron-pipe gas supply connection(s) shall be rigidly anchored to a structural member within 6 in. (152 mm) of the supply connection(s).

Exception: Where adequate support and protection is provided by structural members.

8-5.12.8 Testing for Leakage.

8-5.12.8.1 Before appliances are connected, piping systems shall stand a pressure of at least 6 in. mercury or 3 psi gauge (21 kPa gauge) for a period of not less than 10 minutes without showing any drop in pressure. Pressure shall be measured with a mercury manometer or slope gauge calibrated so as to be read in increments of not greater than one-tenth pound, or be measured with an equivalent device. The source of normal operating pressure shall be isolated before the pressure tests are performed. Before a test is begun, the temperature of the ambient air and of the piping shall be approximately the same, and constant air temperature shall be maintained throughout the test.

8-5.12.8.2 After appliances are connected, the piping system shall be pressurized to no less than 10 in. water column (2.5 kPa), nor more than 14 in. water column (3.5 kPa), and the appliance connections shall be tested for leakage with soapy water or bubble solution.

8-6 Oil Piping Systems.

8-6.1 General. The requirements of Section 8-6 shall govern the installation of all liquid fuel piping attached to any manufactured home. None of the requirements listed in Section 8-6 shall apply to the piping in the appliance(s).

8-6.2 Materials. All materials used for the installation, extension, alteration, or repair of any oil piping systems shall be new and free from defects or internal obstructions. The system shall be made of materials having a melting point of not less than 1450°F (788°C), except as provided in 8-6.4 and 8-6.5. Oil piping systems shall consist of one or more of the materials described in 8-6.2.1 through 8-6.2.4.

8-6.2.1 Steel or wrought-iron pipe shall comply with ANSI B 36.10, *Welded and Seamless Wrought Steel Pipe.* Threaded copper or brass pipe in iron pipe sizes shall be permitted to be used.

8-6.2.2 Fittings for oil piping shall be wrought iron, malleable iron, steel, or brass (containing not more than 75 percent copper).

8-6.2.3 Copper tubing shall be annealed type, Grade K or Grade L, conforming to ASTM B 88, *Standard Specification for Seamless Copper Water Tube,* or shall comply with ASTM B 280, *Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.*

8-6.2.4 Steel tubing shall have a minimum wall thickness of 0.032 in. (0.8 mm) for diameters up to ½ in. (15 mm) and 0.049 in. (1.2 mm) for diameters ½ in. (15 mm) and larger. Steel tubing shall be constructed in accordance with ASTM A 539, *Specification for Electric-Resistance-Welded Coiled Steel Tubing for Gas and Fuel Oil Lines,* and shall be externally corrosion-protected.

8-6.3 Size of Oil Piping. The minimum size of all fuel-oil tank piping connecting outside tanks to the appliance shall be no smaller than ⅜-in. (9-mm) OD copper tubing or ¼-in. (6-mm) IPS. If No. 1 fuel oil is used with a listed automatic pump (fuel lifter), copper tubing shall be sized as specified by the pump manufacturer.

8-6.4 Joints for Oil Piping. All pipe joints in the piping system, unless welded or brazed, shall be threaded joints that comply with ASME B1.20.1, *Pipe Threads, General Purpose (Inch).* The material used for brazing pipe connections shall have a melting temperature in excess of 1000°F (538°C).

8-6.5 Joints for Tubing. Joints in tubing shall be made with either a single or double flare of the degree recommended by the tubing manufacturer by means of listed tubing fittings, or shall be brazed with materials having a melting point in excess of 1000°F (538°C).

8-6.6 Pipe Joint Compound. Threaded joints shall be made tight with listed pipe joint compound applied to the male threads only.

8-6.7 Couplings. Pipe couplings and unions shall be used to join sections of threaded pipe. Right and left nipples or couplings shall not be used.

8-6.8 Grade of Piping. Fuel-oil piping installed in conjunction with gravity feed systems to oil heating equipment shall slope in a gradual rise upward from a central location to both the oil tank and the appliance in order to eliminate air locks.

8-6.9 Strap Hangers. All oil piping shall be adequately supported by galvanized or equivalently protected metal straps or hangers at intervals of not more than 4 ft (1220 mm). Solid iron-pipe oil supply connection(s) shall be rigidly anchored to a structural member within 6 in. (152 mm) of the supply connection(s).

Exception: Where adequate support and protection is provided by structural members.

8-6.10 Testing for Leakage. Before setting the system in operation, tank installations and piping shall be checked for oil leaks with fuel oil of the same grade that will be burned in the appliance. No other material shall be used for testing fuel oil tanks and piping. Tanks shall be filled to maximum capacity for the final check for oil leakage.

8-7 Heat-Producing Appliances.

8-7.1 Heat-producing appliances and vents, and the roof jacks and chimneys necessary for their installation in manufactured homes, shall be listed or certified by a nationally recognized testing agency for use in manufactured homes.

8-7.1.1 A manufactured home shall be provided with a comfort heating system.

8-7.1.1.1 When a manufactured home is designed to contain a heating appliance, the heating appliance shall be installed by the manufacturer of the manufactured home in compliance with applicable sections of this chapter.

8-7.1.1.2 When a manufactured home is designed for field application of an external heating or combination heating/cooling appliance, preparation of the manufactured home for this external application shall comply with the applicable sections of this chapter.

8-7.1.2 Gas- and oil-burning comfort heating appliances shall have a flue loss of not more than 25 percent, and a thermal efficiency of not less than that specified in nationally recognized standards. *(See Section 8-3.)*

8-7.2 Fuel-burning, heat-producing appliances and refrigeration appliances shall be of the vented type and shall vent to the outside.

Exception: Ranges and ovens.

8-7.3 Fuel-burning appliances shall not be converted from one fuel to another fuel unless converted in accordance with the terms of their listing and the appliance manufacturer's instructions.

8-7.4 Performance Efficiency.

8-7.4.1 All automatic electric storage water heaters installed in manufactured homes shall have a standby loss not exceeding 4 watts/ft^2 (43 watts/m^2) of tank surface area. The method of test for standby loss shall be as described in Section 4.3.1 of ANSI C72.1, *Household Automatic Electric Storage Type Water Heaters.*

8-7.4.2 All gas- and oil-fired automatic storage water heaters shall have a recovery efficiency, *(E)* and a standby loss, *(S)* in accordance with Table 8-7.4.2. The method of test of *E* and *S* shall be as described in Section 2.7 of ANSI Z21.10.1, *Gas Water Heaters, Vol. I, Storage Water Heaters with Input/Ratings of 75,000 Btu Per Hour or Less,* with addendums ANSI Z21.10.1a and ANSI Z21.10.1b, except that for oil-fired units. CF = 1.0, Q = total gallons of oil consumed and H = total heating value of oil in Btu/gallon.

Table 8-7.4.2 Recovery Efficiency

Storage Capacity in Gallons	Recovery Efficiency *(E)*	Standby Loss *(S)*
Less than 25 (95 L)	At least 75 percent	Not more than 7.5 percent
25 (95 L) up to 35 (132 L)	00	Not more than 7 percent
35 (132 L) or more	00	Not more than 6 percent

8-7.5 Each space heating, cooling, or combination heating and cooling system shall be provided with at least one readily adjustable automatic control for regulation of living space temperature. The control shall be placed a minimum of 3 ft (914 mm) from the vertical edge of the appliance compartment door. It shall not be located on an exterior wall or on a wall separating the appliance compartment from a habitable room.

8-7.6 Oil-Fired Heating Equipment. All oil-fired heating equipment shall conform to the requirements for liquid fuel-burning heating appliances in UL 307A, *Liquid Fuel-Burning Heating Appliances for Manufactured Homes and Recreational Vehicles,* and shall be installed in accordance with NFPA 31, *Standard for the Installation of Oil-Burning Equipment.*

Exception: Regardless of the requirements of the above-referenced standards, or any other referenced standards, the following shall not be required:

(a) External switches or remote controls that shut off the burner or the flow of oil to the burner

(b) An emergency disconnect switch to interrupt electric power to the equipment under conditions of excessive temperature

8-8 Exhaust Duct System and Provisions for the Future Installation of a Clothes Dryer.

8-8.1 Clothes Dryers.

8-8.1.1 All gas and electric clothes dryers shall be exhausted to the outside by a moisture/lint exhaust duct and termination fitting. When the clothes dryer is supplied by the manufacturer, the exhaust duct and termination fittings shall be completely installed by the manufacturer. If the exhaust duct system is subject to damage during transportation, it shall not be required to be completely installed at the factory if the following apply:

(a) The exhaust duct system is connected to the clothes dryer.

(b) A moisture/lint exhaust duct system is roughed in, and installation instructions are provided in accordance with 8-8.2(c) or 8-8.3.

8-8.1.2 A clothes dryer moisture/lint exhaust duct shall not be connected to any other duct, vent, or chimney.

8-8.1.3 The exhaust duct shall not terminate beneath the manufactured home.

8-8.1.4 Moisture/lint exhaust ducts shall not be connected with sheet metal screws or other fastening devices that extend into the interior of the duct.

8-8.1.5 Moisture/lint exhaust duct and termination fittings shall be installed in accordance with the appliance manufacturer's printed instructions.

8-8.2 Provisions for Future Installation of a Gas Clothes Dryer. A manufactured home shall be permitted to be provided with "stubbed-in" equipment at the factory to accommodate future installation of a gas clothes dryer by the owner, provided it complies with the following provisions:

(a) The "stubbed-in" gas outlet shall be provided with a shutoff valve, the outlet of which is closed by a threaded pipe plug or cap.

(b) The "stubbed-in" gas outlet shall be permanently labeled to identify it for use only as the supply connection for a gas clothes dryer.

(c) A moisture/lint duct system consisting of a complete access space (hole) through the wall or floor cavity shall be provided, and a cap or cover on the interior and exterior of the cavity that is secured in such a manner that it can be removed by a common household tool, shall be provided. The cap or cover in place shall limit air infiltration and shall be designed to resist the entry of water or rodents. The manufacturer shall not be required to provide the moisture/lint exhaust duct or the termination fitting. The manufacturer shall provide written instructions to the owner on how to complete the exhaust duct installation in accordance with the provisions of 8-8.1.1 through 8-8.1.5.

8-8.3 Provisions for Future Installation of Electric Clothes Dryers. When wiring is installed to accommodate future installation of an electric clothes dryer by the owner, the manufacturer shall comply with the following provisions:

(a) The manufacturer shall provide a roughed-in, moisture/lint exhaust duct system consisting of a complete access space (hole) through the wall or floor cavity, and a cap or cover on the interior and exterior of the cavity that is secured in such a manner that it can be removed by the use of common household tools. The cap or cover in place shall limit air filtration and shall be designed to resist the entry of water or rodents into the home. The manufacturer shall not be required to provide the moisture/lint exhaust duct or the termination fitting.

(b) The manufacturer shall install a receptacle for future connection of the dryer.

(c) The manufacturer shall provide written instructions on how to complete the exhaust duct installation in accordance with the provisions of 8-8.1.1 through 8-8.1.5.

8-9 Installation of Appliances.

8-9.1 The installation of each appliance shall conform to the terms of its listing and the manufacturer's instructions. The installer shall leave the manufacturer's instructions attached to the appliance. Every appliance shall be secured in place to avoid displacement. For the purpose of servicing and replacement, each appliance shall be both accessible and removable.

8-9.2 Heat-producing appliances shall be so located that no doors, drapes, or other such material can be placed or swung closer to the front of the appliance than the clearances specified on the labeled appliances.

8-9.3 Clearances surrounding heat-producing appliances shall not be less than the clearances specified in the terms of their listings.

8-9.3.1 Prevention of Storage. The area surrounding heat-producing appliances installed in areas with interior or exterior access shall be framed in or guarded with noncombustible material such that the distance from the appliance to the framing or guarding material is not greater than 3 in. (76 mm), or the appliance shall be installed in compliance with 8-9.3.2. When clearance required by the listing is greater than 3 in. (76 mm), the guard or frame shall not be closer to the appliance than the distance provided in the listing.

8-9.3.2 Clearance spaces surrounding heat-producing appliances shall not be required to be framed in or guarded with noncombustible material when in compliance with the following:

(a) A space is designed specifically for a clothes washer or dryer.

(b) Dimensions surrounding the appliance do not exceed 3 in. (76 mm).

(c) The manufacturer affixes a 3-in. × 5-in. (76-mm × 127-mm) adhesive-backed, plastic, laminated label or the equivalent to a clearly visible location on the side of the alcove or compartment containing the appliance, or to the appliance itself, that reads as follows:

WARNING

THIS COMPARTMENT IS NOT TO BE USED AS A STORAGE AREA. STORAGE OF COMBUSTIBLE MATERIALS OR CONTAINERS ON OR NEAR ANY APPLIANCE IN THIS COMPARTMENT MAY CREATE A FIRE HAZARD. DO NOT STORE SUCH MATERIALS OR CONTAINERS IN THIS COMPARTMENT.

8-9.4 All fuel-burning appliances shall be installed to provide for the complete separation of the combustion system from the interior atmosphere of the manufactured home. Combustion air inlets and flue gas outlets shall be listed or certified as components of the appliance. The required separation shall be permitted to be obtained by the following:

(a) The installation of direct-vent system (sealed combustion system) appliances; or

(b) The installation of appliances within enclosures so as to separate the appliance combustion system and venting system from the interior atmosphere of the manufactured home. There shall not be any door, removable access panel, or other opening into the enclosure from the inside of the manufactured home. Any opening for ducts, piping, wiring, and so on, shall be sealed.

Exception: Ranges, ovens, illuminating appliances, clothes dryers, solid fuel-burning fireplaces, and solid fuel-burning fireplace stoves.

8-9.5 A forced-air appliance and its return-air system shall be designed and installed so that negative pressure created by the air-circulating fan cannot affect its own, or another appliance's, combustion air supply or act to mix products of combustion with circulating air.

8-9.5.1 The air-circulating fan of a furnace installed in an enclosure with another fuel-burning appliance shall be operable only when any door or panel covering an opening in the fur-

nace fan compartment, or in a return air plenum or duct, is in the closed position.

Exception: This requirement shall not apply if both appliances are direct-vent system (sealed combustion system) appliances.

8-9.5.2 If a warm-air appliance is installed within an enclosure to conform to 8-9.4(b), each warm-air outlet and each return-air inlet shall extend to the exterior of the enclosure. Ducts, if used for that purpose, shall not have any opening within the enclosure and shall terminate at a location exterior to the enclosure.

8-9.5.3 Cooling coils installed as a portion of, or in connection with, any forced-air furnace shall be installed on the downstream side unless the furnace is specifically otherwise listed.

8-9.5.4 An air conditioner evaporator section shall not be located in the air discharge duct or plenum of any forced-air furnace unless the manufactured home manufacturer has complied with certification required in Section 6-11.

8-9.5.5 If a cooling coil is installed with a forced-air furnace, the coil shall be installed in accordance with its listing. When a furnace coil unit has a limited listing, the installation shall be in accordance with that listing.

8-9.5.6 When an external heating appliance or combination cooling/heating appliance is to be field-installed, the home manufacturer shall make provisions for the proper location of the connections to the supply and return air systems. The manufacturer shall not be required to provide the cooling/heating appliances. Provisions for connection to the home's supply and return air system made by the manufacturer shall include all fittings and connection ducts to the main duct and return air system such that the installer is only required to provide the following:

(a) The appliance

(b) Any appliance connections to the home

(c) The connecting duct between the external appliance and the fitting installed on the home by the manufacturer

Exception: The requirement for manufacturer preparations for connections to the supply and return air systems shall not apply to supply or return air systems designed only to accept external cooling (i.e., self-contained air conditioning systems, etc.).

8-9.5.7 The installation of a self-contained air conditioner comfort cooling appliance shall meet the following requirements:

(a) Installation on a duct common with an installed heating appliance shall require the installation of an automatic damper or other means to prevent the cooled air from passing through the heating appliance.

Exception to (a): The heating appliance is certified or listed for such application and the supply system is intended for such an application.

(b) The installation shall prevent the flow of heated air into the external cooling appliance and its connecting ducts to the manufactured home supply and return air system during the operation of the heating appliance installed in the manufactured home.

(c) The installation shall prevent simultaneous operation of the heating and cooling appliances.

8-9.6 Vertical Clearance above Cooking Top. Ranges shall have a vertical clearance above the cooking top of not less than 24 in. (610 mm). *(See Section 3-4.)*

8-9.7 Solid fuel-burning, factory-built fireplaces, and fireplace stoves listed for use in manufactured homes shall be installed in manufactured homes in accordance with 8-9.7. A fireplace or fireplace stove shall not be considered as a heating facility for determining compliance with Chapter 6.

8-9.7.1 A solid fuel-burning fireplace or fireplace stove shall be equipped with integral door(s) or shutter(s) designed to close the fireplace or fireplace stove fire chamber opening, and shall include complete means for venting through the roof, a combustion air inlet, a hearth extension, and means to securely attach the fireplace or the fireplace stove to the manufactured home structure. The installation shall conform to 8-9.7.1.1 through 8-9.7.1.7.

8-9.7.1.1 A listed, factory-built chimney, designed to be attached directly to the fireplace or fireplace stove, shall be used. The listed, factory-built chimney shall be equipped with, and contain as part of its listing, a termination device(s) and a spark arrester(s).

8-9.7.1.2 A fireplace or fireplace stove, air intake assembly, hearth extension, and chimney shall be installed in accordance with the terms of their listings and their manufacturer's instructions.

8-9.7.1.3 The combustion air inlet shall conduct the air directly into the fire chamber and shall be designed to prevent material from the hearth dropping onto the area beneath the manufactured home.

8-9.7.1.4 The fireplace or fireplace stove shall not be installed in a sleeping room.

8-9.7.1.5 The hearth extension shall be of noncombustible material not less than $\frac{3}{8}$-in. (10-mm) thick. The hearth shall extend at least 16 in. (406 mm) in front of and 8 in. (203 mm) beyond each side of the fireplace or fireplace stove opening. Furthermore, the hearth shall extend over the entire surface beneath a fireplace stove, or beneath an elevated or overhanging fireplace.

8-9.7.1.6 The label on each solid fuel-burning fireplace and solid fuel-burning fireplace stove shall include the following wording:

FOR USE WITH SOLID FUEL ONLY.

8-9.7.1.7 The chimney shall extend at least 3 ft (914 mm) above the part of the roof through which it passes and at least 2 ft (610 mm) above the highest elevation of any part of the manufactured home within 10 ft (3050 mm) of the chimney. Portions of the chimney and termination that exceed an elevation of 13½ ft (4115 mm) above ground level shall be permitted to be designed to be removed for transporting the manufactured home.

8-10 Venting, Ventilation, and Combustion Air.

8-10.1 The venting required by 8-7.2 shall be accomplished by one or more of the following methods:

(a) An integral vent system listed or certified as part of the appliance

(b) A venting system consisting entirely of listed components, including roof jack, installed in accordance with the

terms of the appliance listing and the appliance manufacturer's instructions

8-10.2 Venting and combustion air systems shall be installed in accordance with 8-10.2.1 through 8-10.2.3.

8-10.2.1 Components shall be securely assembled and properly aligned at the factory in accordance with the appliance manufacturer's instructions. Vertical or horizontal sections of a fuel-fired heating appliance venting system that extend beyond the roof line or outside the wall line shall be permitted to be installed at the site. Sectional venting systems shall be listed for such applications and installed in accordance with the terms of their listings and manufacturers' instructions. In cases where sections of the venting system are removed for transportation, a label shall be permanently attached to the appliance that includes the following statement:

SECTIONS OF THE VENTING SYSTEM HAVE NOT BEEN INSTALLED. WARNING — DO NOT OPERATE THE APPLIANCE UNTIL ALL SECTIONS HAVE BEEN ASSEMBLED AND INSTALLED IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

8-10.2.2 Draft hood connectors shall be firmly attached to draft hood outlets or flue collars by sheet metal screws or by equivalent effective mechanical fasteners.

8-10.2.3 Every joint of a vent, vent connector, exhaust duct, and combustion air intake shall be secure and in alignment.

8-10.3 Venting systems shall not terminate underneath a manufactured home.

8-10.4 Venting system terminations shall be not less than 3 ft (914 mm) from any motor-driven air intake discharging into habitable areas.

8-10.5 The area where cooking appliances are located shall be ventilated by a metal duct, or by listed mechanical ventilating equipment discharging outside the home that is installed in accordance with the terms of listing and the manufacturer's instructions. The metal duct shall be permitted to be single-wall; not less than 12.5 in.^{2} (8064 mm^2) in cross-sectional area, with minimum dimension of 2 in. (51 mm); located above the appliance(s) and terminating outside the manufactured home. Gravity or mechanical ventilation shall be installed within a horizontal distance of not more than 10 ft (3050 mm) from the vertical front of the appliance(s).

8-10.6 Mechanical ventilation that exhausts directly to the outside atmosphere from the living space of a home shall be equipped with an automatic or manual damper. Operating controls shall be provided such that mechanical ventilation can be separately operated without directly energizing other energy-consuming devices.

8-11 Instructions. Operating instructions shall be provided with each appliance. These instructions shall include directions and information covering the proper use and efficient operation of the appliance and its proper maintenance.

8-12 Marking.

8-12.1 Information on clearances, input rating, lighting, and shutdown shall be attached to the appliances with the same permanence as the nameplate, and shall be so located that it is easily readable when the appliance is properly installed or shut down for transporting of the manufactured home.

8-12.2 Each fuel-burning appliance shall bear permanent markings designating the type(s) of fuel for which it is listed.

8-13 Accessibility. Every appliance shall be accessible for inspection, service, repair, and replacement without removing permanent construction. For these purposes, inlet piping supplying the appliance shall not be considered permanent construction. Sufficient space shall be available to enable the operator to observe the burner, control, and ignition means while starting the appliance.

8-14 Appliances, Cooling.

8-14.1 Every air conditioning unit or combination air conditioning and heating unit shall be listed or certified by a nationally recognized testing agency for the application for which the unit is intended, and shall be installed in accordance with the terms of its listing.

8-14.1.1 Mechanical air conditioners shall be rated in accordance with ARI Standard 210/240, *Unitary Air Conditioning and Air Source Heat Pump Equipment,* and certified by ARI or another nationally recognized testing agency capable of providing follow-up service.

8-14.1.1.1 Electric motor-driven unitary air-cooled air conditioners and heat pumps in the cooling mode with rated capacity less than 65,000 Btuh (19045 watts), when rated at the ARI standard rating conditions in ARI Standard 210/240, *Unitary Air Conditioning and Air Source Heat Pump Equipment,* shall have seasonal energy efficiency (SEER) values not less than 10 for split systems and 9.7 for single package systems.

8-14.1.1.2 Air-cooled heat pumps in the heating mode shall be certified to comply with all the requirements of ARI Standard 210/240, *Unitary Air Conditioning and Air Source Heat Pump Equipment,* with HSPF efficiencies of not less than 6.8 for split systems and 6.6 for single package systems. Electric motor-driven vapor compression heat pumps with supplemental electrical resistance heat shall be sized to provide by compression at least 60 percent of the calculated annual heating requirements for the manufactured home being served. A control shall be provided and set to prevent operation of supplemental electrical resistance heat at outdoor temperatures above 40°F (4°C), except for defrost operation.

8-14.1.1.3 Electric motor-driven vapor compression heat pumps with supplemental electric-resistance heat of cooling capacity less than 65,000 Btuh (19045 watts), conforming to ARI Standard 210/240, *Unitary Air Conditioning and Air Source Heat Pump Equipment,* shall have a cooling mode SEER of at least 10 for split systems and 9.7 for single package systems.

8-14.1.2 Gas-fired absorption air conditioners shall be listed or certified in accordance with ANSI Z21.40.1, *Gas-Fired Absorption Summer Air Conditioning Appliances,* with Addendum 1a.

8-14.1.3 Direct refrigerating systems serving any air conditioning or comfort cooling system installed in a manufactured home shall employ a type of refrigerant that ranks no lower than Group 5 in *UL Classification of Comparative Life Hazard of Various Chemicals.*

8-14.1.4 When a cooling or heat pump coil and air conditioner blower are installed with a furnace or heating appliance, they shall be tested and listed in combination for heating and safety performance by a nationally recognized testing agency.

8-14.1.5 Cooling or heat pump indoor coils and outdoor sections shall be certified, listed, and rated in combination for capacity and efficiency by a nationally recognized testing agency(ies). Rating procedures shall be based on U.S. Department of Energy test procedures.

8-14.2 Installation and Instructions.

8-14.2.1 The installation of each appliance shall conform to the terms of its listing as specified on the appliance and in the manufacturer's instructions. The installer shall include the manufacturer's installation instructions in the manufactured home. Appliances shall be secured in place to avoid displacement and movement from vibration and road shock.

8-14.2.2 Operating instructions shall be provided with the appliance.

8-14.3 Fuel-burning air conditioners also shall comply with Section 8-7.

8-14.4 The appliance rating plate shall be located so that it is easily readable when the appliance is properly installed.

8.14.5 Every installed appliance shall be accessible for inspection, service, repair, and replacement without removing permanent construction.

8-15 Circulating Air System.

8-15.1 Supply System.

8-15.1.1 Supply ducts and any dampers contained therein shall be made from galvanized steel, tin-plated steel, or aluminum, or shall be listed in accordance with UL 181, *Factory-Made Air Ducts and Connectors*, Class 0, or Class 1 air ducts and air connectors. Class 1 air ducts and air connectors shall be located at least 3 ft (914 mm) from the furnace bonnet or plenum. Air connectors shall not be used for exterior manufactured home duct connection. A duct system integral with the structure shall be of durable construction that can be demonstrated to be equally resistant to fire and deterioration. Ducts constructed from sheet metal shall be in accordance with Table 8-15.1.1.

Table 8-15.1.1 Minimum Metal Thickness for Ducts[1]

Duct Type	Diameter 14 in. (356 mm) or less	Width over 14 in. (356 mm)
Round	0.013 (0.33 mm)	0.016 (0.41 mm)
Enclosed rectangular	0.013 (0.33 mm)	0.016 (0.41 mm)
Exposed rectangular	0.016 (0.41 mm)	0.019 (0.48 mm)

[1] When "nominal" thicknesses are specified, 0.003 in. (0.08 mm) shall be added to these "minimum" metal thicknesses.

8-15.1.1.1 Furnace supply plenums shall be constructed of metal that extends a minimum of 3 ft (914 mm) from the heat exchanger measured along the centerline of airflow.

8-15.1.2 Sizing of Ducts for Heating.

8-15.1.2.1 Ducts shall be so designed that when a labeled, forced-air furnace is installed and operated continuously at its normal heating air circulating rate in the manufactured home, with all registers in the full open position, the static pressure measured in the casing shall not exceed 90 percent of that shown on the label of the appliance. For upflow furnaces, the static pressure shall be taken in the duct plenum. For external heating or combination heating/cooling appliances, the static pressure shall be taken at the point used by the agency listing or certifying the appliance.

8-15.1.2.2 When an evaporator coil specifically designed for the particular furnace is installed between the furnace and the duct plenum, the total static pressure shall be measured downstream of the coil in accordance with the appliance label, and shall not exceed 90 percent of that shown on the label of the appliance.

8-15.1.2.3 When any other listed air-cooler coil is installed between the furnace and the duct plenum, the total static pressure shall be measured between the furnace and the coil and shall not exceed 90 percent of that shown on the label of the furnace.

8-15.1.2.4 The minimum dimension of any branch duct shall be at least 1½ in. (38 mm), and the minimum dimension of any main duct shall be at least 2½ in. (64 mm).

8-15.1.3 Sizing of Ducts.

8-15.1.3.1 The manufactured home manufacturer shall certify the capacity of the air-cooling supply duct system for the maximum allowable output of ARI-certified central air conditioning systems. The certification shall be at operating static pressure of 0.3 in. (75 Pa) of water or greater. *(See Section 6-11.)*

8-15.1.3.2 The refrigerated air cooling supply duct system, including registers, shall be capable of handling at least 300 cfm (0.14 m^3/s) per 10,000 Btuh (2930 watts) with a static pressure no greater than 0.3 in. (75 Pa) of water when measured at room temperature. In the case of the application of external self-contained comfort cooling appliances or the cooling mode of combination heating/cooling appliances, either the external ducts between the appliance and the manufactured home supply system shall be considered part of, and shall comply with the requirements for, the refrigerated air cooling supply duct system, or the connecting duct between the external appliance and the mobile supply duct system shall be a part of the listed appliance. The minimum dimension of any branch duct shall be at least 1½ in. (40 mm), and the minimum dimension of any main duct shall be at least 2½ in. (64 mm).

8-15.1.4 Airtightness of Supply Duct Systems. A supply duct system shall be considered substantially airtight when the static pressure in the duct system, with all registers sealed and with the furnace air circulator at high speed, is at least 80 percent of the static pressure measured in the furnace casing, with its outlets sealed and the furnace air circulator operating at high speed. For the purpose of 8-15.1 and 8-15.2, pressures shall be measured with a water manometer or equivalent device calibrated to read in increments not greater than 1/10 in. (50 Pa) water column.

8-15.1.5 Expandable or Multiple Manufactured Home Connections.

8-15.1.5.1 An expandable or multiple manufactured home shall be permitted to have ducts of the heating system installed in the various units. The points of connection shall be designed and constructed such that when the manufactured home is fully expanded or coupled, the resulting duct joint will conform to the requirements of 8-15.1.5.

8-15.1.5.2 Installation instructions for supporting the crossover duct from the manufactured home shall be provided for on-site installation. The duct shall not be in contact with the ground.

8-15.1.6 Air supply ducts shall be insulated with material having an effective thermal resistance (R) of not less than 4, unless they are within manufactured home insulation having a minimum effective value of R-4 for floors, or R-6 for ceilings.

8-15.1.7 Supply and return ducts exposed directly to outside air, such as those under chassis crossover ducts or ducts connecting external heating, cooling, or combination heating/cooling appliances, shall be insulated with material having a minimum thermal resistance of R-4, with a continuous vapor barrier having a perm rating of not more than 1 perm. Where ducts are exposed underneath the manufactured home, they shall comply with 8-15.1.5.2.

8-15.2 Return Air Systems.

8-15.2.1 Return Air Openings. Provisions shall be made to permit the return of circulating air from all rooms and living spaces, except toilet room(s), to the circulating air supply inlet of the furnace.

8-15.2.2 Duct Material. Return ducts and any diverting dampers contained therein shall be in accordance with 8-15.2.2.1 through 8-15.2.2.5.

8-15.2.2.1 Portions of return ducts directly above the heating surfaces, or closer than 2 ft (610 mm) from the outer jacket or casing of the furnace, shall be constructed of metal in accordance with 8-15.1.1, or shall be listed Class 0 or Class 1 air ducts.

8-15.2.2.2 Return ducts shall be constructed of 1-in. (25-mm) (nominal) wood boards (flame spread index of not more than 200), other suitable material no more flammable than 1-in. (25-mm) board, or in accordance with 8-15.1.1.

8-15.2.2.3 The interior of combustible ducts shall be lined with noncombustible material at points where there is a danger from incandescent particles dropped through the register or furnace, such as directly under floor registers and the bottom return of a furnace.

8-15.2.2.4 Factory made air ducts and air connectors used for connecting external heating, cooling, or combination heating/cooling appliances to the supply system and return air system of a manufactured home shall be listed by a nationally recognized testing agency. Ducts applied to external heating appliances or combination heating/cooling appliances supply system outlets shall be constructed of metal in accordance with 8-15.1.1, or shall be listed Class 0 or Class 1 air ducts for those portions of the duct closer than 2 ft (610 mm) from the outer casing of the appliance. Air connectors shall not be used in exterior locations.

8-15.2.2.5 Ducts applied to external appliances shall be resistant to deteriorating environmental effects including, but not limited to, ultraviolet rays, cold weather, or moisture, and shall be resistant to insects and rodents.

8-15.2.3 Sizing. The cross-sectional areas of the return air duct shall not be less than 2 in.^{2} (1290 mm^2) for each 1000 Btuh (293 watts) input rating of the appliance. Dampers shall not be placed in a combination fresh air intake and return air duct arranged so that the required cross-sectional area will not be reduced at all possible positions of the damper.

8-15.2.4 Permanent, Unclosable Openings. Living areas not served by return air ducts, or which are 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 not less than 1 in.^{2} (645 m^2) for every 5 ft^2 (4645 cm^2) of total living area closed off from the furnace by the door or partition serviced by that opening. Undercutting doors connecting the closed-off space shall be permitted to be used as a means of providing return air area. However, in the event that doors are undercut, they shall be undercut a minimum of 2 in. (50 mm), and no more than 2½ in. (64 mm), as measured from the top surface of the floor decking to the bottom of the door, and no more than one half of the free air area so provided shall be counted as return air area.

8-15.3 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 subjected to deterioration under long exposures to temperatures up to 200°F (93°C) and to conditions of high humidity, excessive moisture, or mildew.

8-15.4 Supports. Ducts shall be securely supported.

8-15.5 Registers or Grilles. Fittings connecting the registers or grilles to the duct system shall be constructed of metal or material that complies with the requirements of Class 0 or Class 1 air ducts or air connectors in accordance with UL 181, *Factory Made Air Ducts and Connectors.* Air supply terminal devices (registers) when installed in kitchens, bedrooms, and bathrooms shall be equipped with adjustable dampers. Registers or grilles shall be constructed of metal or conform with the following:

(a) Registers or grilles shall be made of a material classified 94V-0 or 94V-1 when tested as described in UL 94, *Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.*

(b) Registers or grilles shall resist, without structural failure, a 200-lb (90.7-kg) concentrated load on a 2-in. (50-mm) diameter disc applied to the most critical area of the exposed face of the register or grille. For this test, the register or grille shall be at a temperature of not less than 165°F (74°C), and shall be supported in accordance with the manufacturer's instructions.

Chapter 9 Electrical Systems

9-1 Scope.

9-1.1 This chapter and Part A of Article 550 of NFPA 70, *National Electrical Code,* shall apply to the electrical conductors and equipment installed within or on manufactured homes, and the conductors that connect manufactured homes to a supply of electricity.

9-1.2 In addition to the requirements of this standard and Article 550 of NFPA 70, *National Electrical Code*, the applicable portions of other articles of the *National Electrical Code* that cover electrical installations in manufactured homes shall be followed. Wherever the requirements of this standard differ from the requirements of the *National Electrical Code*, this standard shall apply.

9-1.3 The provisions of this standard shall apply to manufactured homes intended for connection to a wiring system nominally rated 120/240 volts, 3-wire ac, with grounded neutral.

9-1.4 All electrical materials, devices, appliances, fittings, and other equipment shall be listed or labeled by an approved testing agency and shall be connected in an approved manner when in service.

9-1.5 Aluminum conductors, aluminum alloy conductors, and aluminum core conductors such as copper-clad aluminum shall not be acceptable for use in branch-circuit wiring in manufactured homes.

9-2 Definitions. The following definitions shall apply to Chapter 9 only.

Accessible (as Applied to Equipment). Admitting close approach; not guarded by locked doors, elevation, or other effective means. *(See definition of Readily Accessible.)*

Accessible Wiring Methods. Capable of being removed or exposed without damaging the manufactured home structure or finish, or not permanently closed in by the structure or finish of the manufactured home. *(See definitions of Concealed and Exposed Live Parts.)*

Air Conditioning or Comfort Cooling Equipment. All equipment intended or installed for the purpose of processing the treatment of air so as to control simultaneously its temperature, humidity, cleanliness, and distribution to meet the requirements of the conditioned space.

Appliance. Utilization equipment, generally other than industrial, normally built in standardized sizes or types, that is installed or connected as a unit to perform one or more functions, such as clothes washing, air conditioning, food mixing, deep frying, and so on.

Appliance, Fixed. An appliance that is fastened or otherwise secured at a specific location.

Appliance, Portable. An appliance that is actually moved or can easily be moved from one place to another in normal use. For the purpose of this standard, the following major appliances shall be considered portable if cord-connected: refrigerators, clothes washers, dishwashers without booster heaters, or other similar appliances.

Appliance, Stationary. An appliance that is not easily moved from one place to another in normal use.

Attachment Plug, Plug Cap, Cap. A device that, by insertion in a receptacle, establishes connection between the conductors of the attached flexible cord and the conductors connected permanently to the receptacle.

Bonding. The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.

Branch Circuit. The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s). A device not approved for branch circuit protection, such as a thermal cutout or motor overload-protective device, is not considered as the overcurrent device protecting the circuit.

Branch-Circuit Appliance. A branch circuit supplying energy to one or more outlets to which appliances are to be connected; such circuits are to have no permanently connected lighting fixtures not a part of an appliance.

Branch Circuit, General Purpose. A branch circuit that supplies a number of outlets for lighting and appliances.

Branch Circuit, Individual. A branch circuit that supplies only one utilization equipment.

Cabinet. An enclosure designed either for surface or flush mounting and provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.

Circuit Breaker. A device designed to open and close a circuit by nonautomatic means, and to open the circuit automatically on a predetermined overload of current without injury to itself when properly applied within its rating.

Concealed. Rendered inaccessible by the structure or finish of the manufactured home. Wires in concealed raceways are considered concealed, even though they may become accessible by withdrawing them. *(See definition of Accessible Wiring Methods.)*

Connector, Pressure (Solderless). A device that establishes a connection between two or more conductors, or between one or more conductors, and a terminal by means of mechanical pressure and without the use of solder.

Dead Front (as Applied to Switches, Circuit-Breakers, Switchboards, and Distribution Panelboard). Designed, constructed, and installed so that no current-carrying parts are normally exposed on the front.

Demand Factor. The ratio of the maximum demand of a system, or part of a system, to the total connected load of a system or the part of the system under consideration.

Device. A unit of an electrical system that is intended to carry, but not utilize, electrical energy.

Disconnecting Means. A device, group of devices, or other means by which the conductors of a circuit can be disconnected from their source of supply.

Enclosed. Surrounded by a case that will prevent a person from accidentally contacting live parts.

Equipment. A general term, including material, fittings, devices, appliances, fixtures, apparatus, and the like, used as a part of, or in connection with, an electrical installation.

Exposed Live Parts. Capable of being inadvertently touched or approached nearer than a safe distance by a person. The term is applied to parts not suitably guarded, isolated, or insulated. *[See definitions of Accessible (as Applied to Equipment) and Concealed.]*

Exposed Wiring Method. On or attached to the surface or behind panels designed to allow access. *(See definition of Accessible Wiring Methods.)*

Externally Operable. Capable of being operated without exposing the operator to contact with live parts.

Feeder Assembly. The overhead or under-chassis feeder conductors, including the grounding conductor, together with the necessary fittings and equipment, or a power supply cord approved for manufactured home use, that are designed for the purpose of delivering energy from the source of electrical

supply to the distribution panelboard within the manufactured home.

Fitting. An accessory, such as a locknut, bushing, or other part of a wiring system, that is intended primarily to perform a mechanical rather than an electrical function.

Ground. A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and earth, or to some conducting body that serves in place of the earth.

Grounded. Connected to earth or to some conducting body that serves in place of the earth.

Grounded Conductor. A system or circuit conductor that is intentionally grounded.

Grounding Conductor. A conductor used to connect equipment or the grounded circuit of a wiring system to a grounding electrode or electrodes.

Guarded. Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach or contact by persons or objects to a point of danger.

Isolated. Not readily accessible to persons unless special means for access are used.

Laundry Area. An area containing, or designed to contain, either a laundry tray, clothes washer, and/or clothes dryer.

Lighting Outlet. An outlet intended for the direct connection of a lampholder, a lighting fixture, or a pendant cord terminating in a lampholder.

Manufactured Home Accessory Building or Structure. Any awning, cabana, ramada, storage cabinet, carport, fence, windbreak, or porch established for the use of the occupant of the manufactured home upon a manufactured home lot.

Manufactured Home Service Equipment. The equipment containing the disconnecting means, overcurrent protective devices, receptacles, or other means for connecting a manufactured home feeder assembly.

Outlet. A point on the wiring system at which current is taken to supply utilization equipment.

Panelboard. A single panel or group of panel units designed for assembly in the form of a single panel; including buses, automatic overcurrent protective devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall or partition and accessible only from the front.

Raceway. An enclosed channel of metal or nonmetallic materials designed expressly for holding wires, cables, or busbars, with additional functions as permitted in NFPA 70, *National Electrical Code.* Raceways include, but are not limited to, rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquidtight flexible conduit, flexible metallic tubing, flexible metal conduit, electrical nonmetallic tubing, electrical metallic tubing, underfloor raceways, cellular concrete floor raceways, cellular metal floor raceways, surface raceways, wireways, and busways.

Raintight. Constructed or protected so that exposure to a beating rain will not result in the entrance of water under specified field test conditions.

Readily Accessible. Capable of being reached quickly for operation, renewal, or inspection, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs, and so on. *[See definition of Accessible (as Applied to Equipment).]*

Receptacle. A contact device installed at an outlet for the connection of a single attachment plug. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is a single device containing two or more receptacles.

Receptacle Outlet. An outlet where one or more receptacles are installed.

Utilization Equipment. Equipment that utilizes electric energy for mechanical, chemical, heating, lighting, or similar purposes.

Voltage (of a Circuit).* The greatest root-mean-square (effective) difference of potential between any two conductors of the circuit concerned.

Weatherproof.* Constructed or protected so that exposure to the weather will not interfere with successful operation.

9-3 Power Supply.

9-3.1 The power supply to the manufactured home shall be a feeder assembly consisting of not more than one listed 50-ampere manufactured home power-supply cord or permanently installed circuit. A manufactured home that is factory-equipped with gas or oil-fired central heating equipment and cooking appliances shall be permitted to be provided with a listed manufactured home power-supply cord rated 40 amperes.

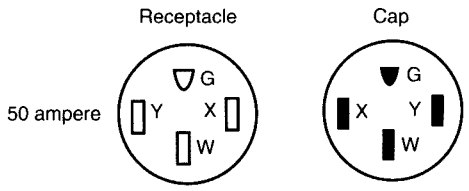
9-3.2 If the manufactured home has a power-supply cord, it shall be permanently attached to the distribution panelboard or to a junction box permanently connected to the distribution panelboard, with the free end terminating in an attachment plug cap.

9-3.3 Cords with adapters and pigtail ends, extension cords, and similar items shall not be attached to, or shipped with, a manufactured home.

9-3.4 A listed clamp or the equivalent shall be provided at the distribution panelboard knockout to afford strain relief for the cord to prevent strain from being transmitted to the terminals when the power-supply cord is handled in its intended manner.

9-3.5 The cord shall be of a listed type with four conductors, one of which shall be identified by a continuous green color or a continuous green color with one or more yellow stripes for use as the grounding conductor.

9-3.6 The attachment plug cap shall be a 3-pole, 4-wire, grounding type, rated 50 amperes, 125/250 volts with a configuration as shown in Figure 9-3.6 and intended for use with the 50-ampere, 125/250-volt receptacle configuration shown in Figure 9-3.6. It shall be molded of butyl rubber, neoprene, or other approved materials that have been found suitable for the purpose, and shall be molded to the flexible cord so that it adheres tightly to the cord at the point where the cord enters the attachment plug cap. If a right-angle cap is used, the configuration shall be so oriented that the grounding member is farthest from the cord.



50-ampere 125/250-volt receptacle and attachment plug cap configurations, 3-pole, 4-wire, grounding types used for manufactured home supply cords and manufactured home parks. Complete details of the 50-ampere cap and receptacle can be found in the *American National Standard Dimensions of Caps, Plugs and Receptacles, Grounding Type* (ANSI C73.17-1972).

Figure 9-3.6 Receptacle and attachment plug cap configurations.

9-3.7 The overall length of a power-supply cord, measured from the end of the cord, including bared leads, to the face of the attachment plug cap, shall not be less than 21 ft (6.4 m) and shall not exceed 36½ ft (11.1 m). The length of cord from the face of the attachment plug cap to the point where the cord enters the manufactured home shall not be less than 20 ft (6.1 m).

9-3.8 The power supply cord shall bear the following marking: "For use with manufactured homes — 40 amperes" or "For use with manufactured homes — 50 amperes."

9-3.9 Where the cord passes through walls or floors, it shall be protected by means of conduits and bushings or the equivalent. The cord shall be permitted to be installed within the manufactured home walls, provided a continuous raceway is installed from the branch-circuit panelboard to the underside of the manufactured home floor. The raceway shall be permitted to be rigid conduit, electrical metallic tubing, or polyethylene (PE), polyvinyl chloride (PVC), or acrylonitrile-butadiene-styrene (ABS) plastic tubing, having a minimum wall thickness of nominal ⅛ in. (3 mm).

9-3.10 Permanent provisions shall be made for the protection of the attachment plug cap of the power-supply cord and any connector cord assembly or receptacle against corrosion and mechanical damage if such devices are in an exterior location while the manufactured home is in transit.

9-3.11 Where the calculated load exceeds 50 amperes or where a permanent feeder is used, the supply shall be by means of the following:

(a) One mast weatherhead installation, installed in accordance with Article 230 of NFPA 70, *National Electrical Code,* containing four continuous, insulated, color-coded feeder conductors, one of which shall be an equipment grounding conductor;

(b) An approved raceway from the disconnecting means in the manufactured home to the underside of the manufactured home, with provisions for the attachment of a suitable junction box or fitting to the raceway on the underside of the manufactured home. The manufacturer shall provide in his written installation instructions the proper feeder conductor sizes for the raceway and the size of the junction box to be used; or

(c) Service equipment installed on the manufactured home in accordance with Article 230 of NFPA 70, *National Electrical Code,* and the following:

1. The service equipment is installed in a manner acceptable to the authority having jurisdiction;

2. Exterior equipment, or the enclosure in which it is installed, shall be weatherproof and installed in accordance with Article 373-2 of NFPA 70, *National Electrical Code.* Conductors shall be suitable for use in wet locations;

3. The neutral conductor shall be connected to the system grounding conductor on the supply side of the main disconnect in accordance with Articles 250-23, 250-25, and 250-53 of NFPA 70, *National Electrical Code;*

4. The manufacturer shall include in its written installation instructions one method of grounding the service equipment at the installation site;

5. The minimum size grounding electrode conductor shall be specified in the instructions; and

6. A red warning label shall be mounted on or adjacent to the service equipment. The label shall state the following:

WARNING — DO NOT PROVIDE ELECTRICAL POWER UNTIL THE GROUNDING ELECTRODE IS INSTALLED AND CONNECTED (SEE INSTALLATION INSTRUCTIONS).

9-4 Disconnecting Means and Branch-Circuit Protective Equipment.

9-4.1 The branch-circuit equipment shall be permitted to be combined with the disconnecting means as a single assembly. Such a combination shall be permitted to be designated as a distribution panelboard. If a fused distribution panelboard is used, the maximum fuse size for the mains shall be plainly marked, with lettering at least ¼-in. (6-mm) high and visible when fuses are changed. *(See Article 110-22 of NFPA 70, National Electrical Code, concerning identification of each disconnecting means and each service, feeder, or branch circuit at the point where it originated, and the type marking needed.)*

9-4.2 Plug fuses and fuseholders shall be tamper-resistant, Type S, enclosed in dead-front fuse panelboards. Electrical distribution panelboards containing circuit breakers shall also be dead-front type.

9-4.3 Disconnecting Means. A single disconnecting means shall be provided in each manufactured home consisting of a circuit breaker, or a switch and fuses and their accessories installed in a readily accessible location near the point of entrance of the supply cord or conductors into the manufactured home. The main circuit breakers or fuses shall be plainly marked "Main." This equipment shall contain a solderless type of grounding connector or bar for the purposes of grounding, with sufficient terminals for all grounding conductors. The neutral bar termination of the grounded circuit conductors shall be insulated.

9-4.4 The disconnecting equipment shall have a rating suitable for the connected load. The distribution equipment, either circuit breaker or fused type, shall be located a minimum of 24 in. (610 mm) from the bottom of such equipment to the floor level of the manufactured home.

9-4.5 A distribution panelboard employing a main circuit breaker shall be rated 50 amperes and employ a 2-pole circuit breaker rated 40 amperes for a 40-ampere supply cord, or 50 amperes for a 50-ampere supply cord. A distribution panelboard employing a disconnect switch and fuses shall be rated 60 amperes and shall employ a single 2-pole, 60-ampere fuse-

holder with 40- or 50-ampere main fuses for 40- or 50-ampere supply cords, respectively. The outside of the distribution panelboard shall be plainly marked with the fuse size.

9-4.6 The distribution panelboard shall not be located in a bathroom or any other inaccessible location, but shall be permitted just inside a closet entry if the location is such that a clear space of 6 in. (152 mm) from any easily ignitable materials is maintained in front of the distribution panelboard and the distribution panelboard door can be extended to its full open position (at least 90 degrees). A clear working space at least 30 in. (762 mm) wide and 30 in. (762 mm) in front of the distribution panelboard shall be provided. This space shall extend from the floor to the top of the distribution panelboard.

9-4.7 Branch-circuit distribution equipment shall be installed in each manufactured home and shall include overcurrent protection for each branch circuit consisting of either circuit breakers or fuses.

9-4.7.1 The branch circuit overcurrent devices shall be rated in accordance with the following:

(a) Not more than the circuit conductors; and

(b) Not more than 150 percent of the rating of a single appliance rated 13.3 amperes or more that is supplied by an individual branch circuit; but

(c) Not more than the overcurrent protection size marked on the air conditioner or other motor-operated appliance.

9-4.8 A 15-ampere multiple receptacle shall be permitted where connected to a 20-ampere laundry circuit.

9-4.9 Where circuit breakers are provided for branch-circuit protection, 240-volt circuits shall be protected by 2-pole common or companion trip, or handle-tied, paired circuit breakers.

9-4.10 A 3-in. by 1¾-in. (76-mm by 44-mm) minimum size tag made of etched, metal-stamped, or embossed brass, stainless steel, anodized or alclad aluminum not less than 0.020 in. (.5 mm) thick, or other approved material [e.g., 0.005-in. (.13-mm) plastic laminates] shall be permanently affixed on the outside, adjacent to the feeder assembly entrance and shall read as follows:

THIS CONNECTION FOR 120/240-VOLT, 3-POLE, 4-WIRE, 60-HZ, _____-AMPERE SUPPLY.

The correct ampere rating shall be marked in the blank space.

9-4.11 When a home is provided with installed service equipment, a single disconnecting means for disconnecting the branch-circuit conductors from the service entrance conductors shall be provided in accordance with Part F of Article 230 of NFPA 70, *National Electrical Code*. The disconnecting means shall be listed for use as service equipment. The disconnecting means shall be permitted to be combined with the disconnect required by 9-4.3. The disconnecting means shall be rated not more than the ampere supply or service capacity indicated on the tag required by 9-4.10.

9-4.12 When a home is provided with installed service equipment, the electrical nameplate required by 9-4.10 shall read as follows:

THIS CONNECTION FOR 120/240-VOLT, 3-POLE, 3-WIRE, 60-HZ, _____-AMPERE SUPPLY.

The correct ampere rating shall be marked in the blank space.

9-5 Branch Circuits Required. The number of branch circuits required shall be determined in accordance with 9-5(a) through 9-5(c).

(a) *Lighting.* Based on 3-volt-amperes per sq ft times outside dimensions of the manufactured home (coupler excluded) divided by 120 volts times 15 or 20 amperes to determine number of 15- or 20-ampere lighting area circuits.

Example:

$$\frac{3 \times \text{Length} \times \text{Width}}{120 \times 15 \text{ (or } 20)} = \text{No. of 15- (or 20-) ampere circuits}$$

(b) *Small Appliances.* For the small appliance load in kitchens, pantries, dining rooms, and breakfast rooms of manufactured homes, two or more 20-ampere appliance branch circuits, in addition to the branch circuit specified in Section 9-5(a), shall be provided for all receptacle outlets in these rooms, and such circuits shall have no other outlets. Receptacle outlets supplied by at least two appliance receptacle branch circuits shall be installed in the kitchen.

(c) *General Appliances (Including Furnace, Water Heater, Range, and Central or Room Air Conditioner, Etc.).* There shall be one or more circuits of adequate rating in accordance with the following:

1. The ampere rating of fixed appliances shall not be over 50 percent of circuit rating if lighting outlets (receptacles, other than kitchen, dining area, and laundry, considered as lighting outlets) are on same circuit.

2. For fixed appliances on a circuit without lighting outlets, the sum of rated amperes shall not exceed the branch-circuit rating. Motor loads or other continuous duty loads shall not exceed 80 percent of the branch circuit rating.

3. The rating of a single cord- and plug-connected appliance on a circuit having no other outlets shall not exceed 80 percent of the circuit rating.

4. The rating of a range branch circuit shall be based on the range demand as specified for ranges in 9-11.2(e). *(For central air conditioning, see Article 440 of NFPA 70, National Electrical Code.)*

5. Where a laundry area is provided, a 20-ampere branch circuit shall be provided to supply laundry receptacle outlets. This circuit shall have no other outlets. *[See 9-6.4(g).]*

9-6 Receptacle Outlets.

9-6.1 All receptacle outlets shall be in accordance with the following:

(a) Of grounding type

(b) Installed according to Section 210-7 of NFPA 70, *National Electrical Code*

(c) Except when supplying specific appliances, be parallel-blade, 15- or 20-ampere, 125-volt, either single or duplex

9-6.2 All 120-volt, single-phase, 15- and 20-ampere receptacle outlets, including receptacles in light fixtures, installed outdoors in compartments accessible from the outdoors, in bathrooms, and within 6 ft (1830 mm) of a kitchen sink to serve counter-top surfaces, shall have ground-fault circuit protection for personnel. Feeders supplying branch circuits shall be permitted to be protected by a ground-fault circuit-interrupter in lieu of the provision for such interrupters specified above.

Exception: Receptacles dedicated for washers and dryers, also located in a bathroom.

9-6.3 There shall be an outlet of the grounding type for each cord-connected fixed appliance installed.

9-6.4 Receptacle Outlets Required. Except in the bath, closet, and hall areas, receptacle outlets shall be installed at wall spaces 2 ft (610 mm) wide or more so that no point along the floor line is more than 6 ft (1830 mm) measured horizontally from an outlet in that space. In addition, a receptacle outlet shall be installed in the following locations:

(a) Over or adjacent to counter tops in the kitchen [at least one on each side of the sink if countertops are on each side and are 12 in. (305 mm) or over in width]

(b) Adjacent to the refrigerator and freestanding gas-range space. A duplex receptacle shall be permitted to serve as the outlet for a countertop and a refrigerator

(c) At countertop spaces for built-in vanities

(d) At countertop spaces under wall-mounted cabinets

(e) In the wall at the nearest point to where a bar-type counter attaches to the wall

(f) In the wall at the nearest point where a fixed room divider attaches to the wall

(g) In laundry areas within 6 ft (1830 mm) of the intended location of the laundry appliance(s)

(h) At least one receptacle outlet outdoors

(i) Adjacent to bathroom basins or integral with the light fixture over the bathroom basin

9-6.5 Receptacle outlets shall not be required in the following locations:

(a) In the wall space occupied by built-in kitchen or wardrobe cabinets

(b) In the wall space behind doors that can be opened fully against a wall surface

(c) In room dividers of the lattice type that are less than 8 ft (2438 mm) long, not solid, and within 6 in. (152 mm) of the floor

(d) In the wall space afforded by bar-type counters

9-6.6 Receptacle outlets shall not be installed in or within reach [30 in. (762 mm)] of a shower or bathtub space.

9-6.7 Receptacle outlets shall not be installed above electric baseboard heaters.

9-7 Fixtures and Appliances.

9-7.1 Electrical materials, devices, appliances, fittings, and other equipment installed, intended for use in, or attached to the manufactured home shall be approved for the application and shall be connected in an approved manner when in service. Facilities shall be provided to securely fasten appliances when the manufactured home is in transit. *(See Section 9-9.)*

9-7.2 Specifically listed pendant-type fixtures or pendant cords shall be permitted in manufactured homes.

9-7.3 Where a lighting fixture is installed over a bathtub or in a shower stall, it shall be of the enclosed and gasketed type listed for wet locations. *[See also Article 410-4(d) of NFPA 70, National Electrical Code.]*

9-7.4 The switch for shower lighting fixtures and exhaust fans located over a tub or in a shower stall shall be located outside the tub or shower space. *(See 9-6.4.)*

9-7.5 Any combustible wall or ceiling finish exposed between the edge of a fixture canopy, or pan, and an outlet box shall be covered with noncombustible or limited-combustible material.

9-7.6 Every appliance shall be accessible for inspection, service, repair, or replacement without removal of permanent construction.

9-8 Wiring Methods and Materials.

9-8.1 Except as specifically limited in this section, the wiring methods and materials specified in NFPA 70, *National Electrical Code,* shall be used in manufactured homes.

9-8.2 Nonmetallic outlet boxes shall be permitted only with nonmetallic cable or nonmetallic raceways.

9-8.3 Nonmetallic cable located 15 in. (381 mm) or less above the floor, if exposed, shall be protected from physical damage by covering boards, guard strips, or raceways. Cable likely to be damaged by stowage shall be so protected in all cases.

9-8.4 Nonmetallic sheathed cable shall be secured by staples, straps, or similar fittings designed and installed so as not to injure any cable. Cable shall be secured in place at intervals not exceeding 4½ ft (1370 mm) and shall be within 12 in. (305 mm) from every cabinet, box, or fitting.

9-8.5 Metal-covered and nonmetallic cables shall be permitted to pass through the centers of the wide side of 2-in. × 4-in. (50-mm × 100-mm) studs. However, they shall be protected where they pass through 2-in. × 2-in. (50-mm × 50-mm) studs or at other studs or frames where the cable or armor would be less than 1¼ in. (32 mm) from the inside or outside surface of the studs where the wall covering materials are in contact with the studs. Steel plates on each side of the cable, or a tube, with not less than No. 16 MSG wall thickness shall be required to protect the cable. These plates or tubes shall be securely held in place.

9-8.6 Where metallic faceplates are used, they shall be effectively grounded.

9-8.7 If the range, clothes dryer, or similar appliance is connected by metal-covered cable or flexible metal conduit, a length of not less than 3 ft (914 mm) of free cable or conduit shall be provided to permit moving the appliance. Type NM or Type SE cable shall not be used to connect a range or a dryer. This shall not prohibit the use of Type NM or Type SE cable between the branch circuit overcurrent-protective device and a junction box or range or dryer receptacle.

9-8.8 Threaded rigid metal conduit or intermediate metal conduit shall be provided with a locknut inside and outside the box and a conduit bushing shall be used on the inside. Rigid nonmetallic conduit or electrical nonmetallic tubing shall be permitted. Inside ends of the conduit shall be reamed.

9-8.9 Switches shall be rated as follows:

(a) For lighting circuits, switches shall have a 10-ampere, 120- to 125-volt rating, or higher if needed for the connected load.

(b) For motors or other loads, switches shall have ampere or horsepower ratings, or both, adequate for loads controlled. (An "ac general-use" snap switch shall be permitted to control

a motor 2 horsepower or less, with full-load current not over 80 percent of the switch ampere rating.)

9-8.10 At least 6 in. (152 mm) of free conductor shall be left at each outlet box.

Exception: Where conductors are intended to loop without joints.

9-8.11 When outdoor or under-chassis line-voltage wiring is exposed to moisture or physical damage, it shall be protected by rigid metal conduit or intermediate metal conduit. The conductors shall be suitable for wet locations. Electrical metallic tubing or rigid nonmetallic conduit shall be permitted to be used when closely routed against frames and equipment enclosures.

9-8.12 The cables or conductors shall be Type NMC, TW, or equivalent.

9-8.13 Outlet boxes of dimensions less than those required in Table 370-16(a) of NFPA 70, *National Electrical Code*, shall be permitted, provided the box has been tested and approved for the purpose.

9-8.14 Boxes, fittings, and cabinets shall be securely fastened in place and shall be supported from a structural member of the home, either directly or by using a substantial brace. Snap-in type boxes provided with special wall or ceiling brackets that securely fasten boxes in walls or ceilings shall be permitted.

9-8.15 Outlet boxes shall fit closely to openings in combustible walls and ceilings and shall be flush with such surfaces.

9-8.16 Appliances having branch-circuit terminal connections that operate at temperatures higher than 140°F (60°C) shall have circuit conductors as described in 9-8.16.1 and 9-8.16.2.

9-8.16.1 Branch-circuit conductors having an insulation suitable for the temperature encountered shall be permitted to be run directly to the appliance.

9-8.16.2 Conductors having an insulation suitable for the temperature encountered shall be run from the appliance terminal connections to a readily accessible outlet box placed at least 1 ft (305 mm) from the appliance. These conductors shall be in a suitable raceway that shall extend for at least 4 ft (1220 mm).

9-8.17 A substantial brace for securing a box, fitting, or cabinet shall be as described in NFPA 70, *National Electrical Code*, Article 370-23(d), or the brace, including the fastening mechanism to attach the brace to the home structure, shall withstand a force of 50 lb (22.7 kg) applied to the brace at the intended point(s) of attachment for the box in a direction perpendicular to the surface where the box is installed.

9-8.18 Outlet boxes shall fit closely to the openings in combustible walls and ceilings, with a maximum of a ⅛-in. (3-mm) gap. They shall be flush with the finish surface or project therefrom.

9-8.19 Where the sheathing of NM cable has been cut or damaged and visual inspection reveals that the conductor and its insulation has not been damaged, it shall be permitted to repair the cable sheath with electrical tape that provides equivalent protection to the sheath.

9-9 Grounding.

9-9.1 General. Grounding of both electrical and nonelectrical metal parts in a manufactured home shall be through connection to a grounding bus in the manufactured home distribution panelboard. The grounding bus shall be grounded through the green-colored conductor in the supply cord or the feeder wiring to the service ground in the service-entrance equipment located adjacent to the manufactured home location. Neither the frame of the manufactured home nor the frame of any appliance shall be connected to the grounded circuit conductor (neutral) in the manufactured home.

9-9.2 Insulated Neutral.

9-9.2.1 The grounded circuit conductor (neutral) shall be insulated from the grounding conductors and from equipment enclosures and other grounded parts. The grounded circuit terminals (neutral) in the distribution panelboard and in ranges, clothes dryers, counter-mounted cooking units, and wall-mounted ovens shall be insulated from the equipment enclosure. Bonding screws, straps, or buses in the distribution panelboard or in appliances shall be removed and discarded. However, where service equipment is installed in the manufactured home, the neutral conductors and the ground bus shall be permitted to be connected in the distribution panel.

9-9.2.2 Connections of ranges and clothes dryers with 120/240-volt, 3-wire ratings shall be made with 4-conductor cord and 3-pole, 4-wire, grounding-type plugs, or by Type AC cable, Type MC cable, or conductors enclosed in flexible metal conduit. For 120-volt-rated devices, a 3-conductor cord and a 2-pole, 3-wire, grounding-type plug shall be permitted.

9-9.3 Equipment Grounding Means.

9-9.3.1 The green-colored insulated grounding wire in the supply cord or permanent feeder wiring shall be connected to the grounding bus in the distribution panelboard or disconnecting means.

9-9.3.2 In the electrical system, all exposed metal parts, enclosures, frames, lamp fixture canopies, and so forth, shall be effectively bonded to the grounding terminal or enclosure of the distribution panelboard.

9-9.3.3 Cord-connected appliances, such as washing machines, clothes dryers, refrigerators, and the electrical system of gas ranges shall be grounded by means of an approved cord with grounding conductor and grounding-type attachment plug.

9-9.4 Bonding of Noncurrent-Carrying Metal Parts.

9-9.4.1 All exposed noncurrent-carrying metal parts that are able to become energized shall be effectively bonded to the grounding terminal or enclosure of the distribution panelboard. A bonding conductor shall be connected between each distribution panelboard and an accessible terminal on the chassis.

9-9.4.2* Grounding terminals shall be of the solderless type and listed as pressure-terminal connectors recognized for the wire size used. Star washers or other approved paint-penetrating fittings shall be used to bond terminals to the chassis or other coated areas. The bonding conductor shall be solid or stranded, insulated or bare, and shall be No. 8 copper minimum, or equal. The bonding conductor shall be routed so as not to be exposed to physical damage.

9-9.4.3 Metallic gas, water, and waste pipes and metallic air-circulating ducts shall be considered bonded if they are con-

nected to the terminal on the chassis *(see Section 9-9)* by clamps, by solderless connectors, or by suitable grounding-type straps.

9-9.4.4 Any metallic roof and exterior covering shall be considered bonded if in accordance with the following:

(a) The metal panels overlap one another and are securely attached to the wood or metal frame parts by metallic fasteners; and

(b) If the lower panel of the metallic exterior covering is secured by metallic fasteners at a cross member of the chassis by two metal straps per manufactured home unit or section at opposite ends. The bonding strap material shall be a minimum of 4 in. (102 mm) in width of material equivalent to the skin or a material of equal or better electrical conductivity. The straps shall be fastened with paint-penetrating fittings, such as screws and star washers or equivalent.

9-10 Electrical Testing.

9-10.1 Dielectric Strength Test. The wiring of each manufactured home shall be subjected to a 1-minute, 900-volt to 1079-volt, dielectric strength test (with all switches closed) between live parts and the manufactured home ground and neutral and the manufactured home ground. Alternatively, the test shall be permitted to be performed at 1080 volts to 1250 volts for 1 second. This test shall be performed after branch circuits are complete and after fixtures or appliances are installed.

Exception: Fixtures or appliances that are listed shall not be required to withstand the dielectric strength test.

9-10.2 Each manufactured home shall be subjected to the following tests:

(a) An electrical continuity test to ensure that metallic parts are properly bonded;

(b) An operational test to demonstrate that all equipment, except water heaters and electrical furnaces, are connected and in working order; and

(c) Electrical polarity checks to determine that connections have been properly made. Visual verification shall be an acceptable check.

9-11 Calculations.

9-11.1 The following method shall be employed in computing the supply cord and distribution-panelboard load for each feeder assembly for each manufactured home and shall be based on a 3-wire, 120/240-volt supply with 120-volt loads balanced between the two legs of the 3-wire system.

(a) *Lighting and Small Appliance Load:*

Lighting Volt-Amperes: Length times width of manufactured home (outside dimensions exclusive of coupler) times 3 volt-amperes per sq ft; e.g., length × width × 3 = lighting volt-amperes. Lighting circuits shall be permitted to serve built-in gas ovens with electric service only for lights, clocks, or timers, or listed cord-connected garbage disposal units.

Small Appliance Volt-Amperes: Number of circuits times 1500 volt-amperes for each 20-ampere appliance receptacle circuit (see definition of "Appliance, Portable"); e.g., Number of circuits × 1500 = small appliance volt-amperes.

Total Volt-Amperes: Lighting volt-amperes plus small appliance = total volt-amperes.

First 3000 total volt-amperes at 100 percent plus remainder at 35 percent = volt-amperes to be divided by 240 volts to obtain current (amperes) per leg.

(b) The total load for determining power supply shall be the sum of the following:

1. Lighting and small appliance load as calculated in 9-11.1(a); and

2. Nameplate amperes for motors and heater loads (exhaust fans, air conditioners, and electric, gas, or oil heating). Omit smaller of air conditioning and heating, except include blower motor if used as air-conditioner evaporator motor. Where an air conditioner is not installed and a 40-ampere power-supply cord is provided, allow 15 amperes per leg for air conditioning; and

3. 25 percent of current of largest motor in 9-11.1(b)2; and

4. Total of nameplate amperes for disposal, dishwasher, water heater, clothes dryer, wall-mounted oven, and cooking units. Where the number of these appliances exceeds three, use 75 percent of total; and

5. Derive amperes for freestanding range (as distinguished from separate ovens and cooking units) by dividing the values in Table 9-11.1(b)5 by 240 volts; ands

Table 9-11.1(b)5 Amperes

Nameplate Rating	Use
10,000 watts or less	80 percent of rating volt-amperes
10,001 to 12,500 watts	8000 volt-amperes
12,501 to 13,500 watts	8400 volt-amperes
13,501 to 14,500 watts	8800 volt-amperes
14,501 to 15,500 watts	9200 volt-amperes
15,501 to 16,500 watts	9600 volt-amperes
16,501 to 17,500 watts	10,000 volt-amperes

6. If outlets or circuits are provided for other than factory-installed appliances, include the anticipated load.

(c) The following example is given to illustrate the application of this method of calculation:

Example. A manufactured home is 70 ft × 10 ft and has two portable appliance circuits, a 1000-volt-ampere, 240-volt heater, a 200-volt-ampere, 120-volt exhaust fan, a 400-volt-ampere, 120-volt dishwasher, and a 7000-volt-ampere electric range. *[See Table 9-11.1(c).]*

9-11.2 The following is an optional method of calculation for lighting and appliance loads for manufactured homes served by a single, 3-wire, 120/240-volt set of feeder conductors with an ampacity of 100 or greater. The total load for determining the feeder ampacity shall be permitted to be computed in accordance with Table 9-11.2 instead of the method previously specified. Feeder conductors whose demand load is determined by this optional calculation shall be permitted to have the neutral load determined by Section 220-22 of NFPA 70, *National Electrical Code.* The loads identified in Table 9-11.2 as "other load" and as "Remainder of other load" shall include the following:

(a) 1500 volt-amperes for each 2-wire, 20-ampere small appliance branch circuit and each laundry branch circuit specified

Table 9-11.1(c) Calculation of Anticipated Load

Lighting and Small Appliance Load	Volt-Amperes
Lighting and small appliance load	2100
Small appliance 1500 × 2	3000
Laundry 1500 × 2	1500
Total	6600
1st 3000 volt-amperes at 100 percent	3000
Remainder (6600–3000) at 35 percent	1260
Total	4260

$$\frac{4260 \text{ volt-amperes}}{240 \text{ volts}} = 17.75 \text{ amperes per leg}$$

	Amperes per leg A	Amperes per leg B
Lighting and small appliances	17.75	17.75
Heater, 240-volt 1000/240 volt	4.2	4.2
Fan 120-volt $\frac{200 \text{ volt-amperes} \times 1290}{120 - \text{volt}}$	2.08	
Dishwasher 120-volt 400 volt-amperes/120 volt		3.3
Range (7000 volt-amperes × .8)/ 240 volts	23.3	23.3
Totals	47.33	48.55

NOTE: Based on the higher current calculated for either leg, use one 50-A supply cord.

(b) 3 volt-amperes per sq ft for general lighting and general-use receptacles

(c) Nameplate rating of all fixed appliances, ranges, wall-mounted ovens, counter-mounted cooking units, clothes dryers, and water heaters

(d) Nameplate ampere or kVA rating of all motors and of all low-power-factor loads

(e) The largest of the following:

1. Air conditioning load

2. The 65-percent of nameplate rating of the central electric space-heating load

3. The 65-percent of nameplate rating of the load of fewer than four separately controlled electric space-heating units

4. The connected load of four or more separately controlled electric space-heating units

Table 9-11.2 Optional Calculation for Manufactured Homes With 110-Ampere or Larger Service

Load (in kW or kVA)	Demand Factor (Percent)
Air-conditioning and cooling, including heat-pump compressors	100%
Central electric space heating	65%
Fewer than 4 separately controlled electric space-heating units	65%
1st 10 kW of all other load	100%
Remainder of other load	40%

9-12 Wiring of Expandable Units and Multi-Wide Units.

9-12.1 Expandable or multi-wide manufactured homes shall use approved and listed fixed-type wiring methods and materials for connecting such units to each other.

9-12.2 Expandable or multiple-unit manufactured homes not having permanently installed feeders that are to be moved from one location to another shall be permitted to have disconnecting means with branch-circuit protective equipment in each unit when so located that after assembly or joining together of units the requirements of Section 9-3 will be met.

9-13 Outdoor Outlets, Fixtures, Air-Conditioning Equipment, Etc.

9-13.1 Outdoor fixtures and equipment shall be listed for outdoor use. If located on the underside of the home or located under roof extensions or similarly protected locations, outdoor fixtures and equipment shall be listed for use in damp locations.

9-13.2 A manufactured home provided with a branch circuit designed to energize heating and/or air-conditioning equipment located outside the manufactured home shall have a metal tag permanently affixed in a location adjacent to the outlet that reads as follows:

THIS CONNECTION IS FOR AIR-CONDITIONING EQUIPMENT RATED AT NOT MORE THAN _____ AMPERES, AT _____ VOLTS, 60 HZ. A DISCONNECT SHALL BE LOCATED WITHIN SIGHT OF THE APPLIANCE.

The correct voltage and ampere ratings shall be given. The tag shall not be less than 0.020-in. (0.5-mm), etched brass, stainless steel, anodized or alclad aluminum or equivalent, or other approved material [e.g., 0.005-in. (0.1-mm) plastic laminates]. The tag shall be not less than 3 in. × 1¾ in. (76 mm × 44 mm) minimum size.

9-14 Painting. Metal raceways and sheath of nonmetallic cable shall be permitted to be painted during the painting or staining of the manufactured home. Provisions shall be made to ensure that no paint is applied to the individual wires so the color coding is not obliterated by the paint.

Exception: Metal raceways shall not be permitted to be painted where grounding continuity would be reduced.

9-15 Polarization.

9-15.1 The white conductor shall be employed for the grounded (neutral) circuit conductors only and shall be connected to the white terminal or lead on receptacle outlets and fixtures. The grounded conductor shall be the unswitched wire in switched circuits.

Exception: A cable containing an insulated conductor with a white or natural gray outer finish shall be permitted for single-pole, 3-way, or 4-way switch loops where the white or natural gray conductor is used for the supply to the switch, but not as a return conductor from the switch to the switched outlet. In these applications, reidentification of the white or natural gray conductor shall not be required.

9-15.2 If the identified (white) conductor of a cable is used for other than grounded conductors or for other than switch loops as explained above (for a 240-volt circuit, for example), the conductor shall be finished in a color other than white at each outlet where the conductors are visible and accessible.

9-15.3 Green-colored wires or those that are green with yellow stripes shall be used for grounding conductors only.

9-16 Examination of Equipment for Safety. The examination or inspection of equipment for safety in accordance with this standard shall be conducted under uniform conditions and by organizations properly equipped and qualified for experimental testing, inspections of the run of goods at factories, and service-value determinations through field examinations.

Chapter 10 Transportation

10-1 Scope. This chapter shall cover the general requirements for designing the structure of the manufactured home to fully withstand the adverse effects of transportation shock and vibration without degradation of the integrated structure or of its component parts, and the specific requirements pertaining to the transportation system and its relationship to the structure.

10-2 Definitions. The following definitions shall apply to Chapter 10 only.

Chassis. The entire transportation system comprising the following subsystems: drawbar and coupling mechanism, frame, running gear assembly, and lights.

Drawbar and Coupling Mechanism. The rigid assembly (usually an A frame) where the coupling mechanism is mounted that connects the manufactured home's frame to the towing vehicle.

Frame. The fabricated, rigid substructure that provides considerable support to the affixed manufactured home structure, both during transport and on-site, and provides a platform for securement of the running gear assembly and the drawbar and coupling mechanism.

Highway. Includes all roads and streets to be legally used in transporting the manufactured home.

Lights. Those safety lights and their associated wiring required by applicable U.S. Department of Transportation regulations.

Running Gear Assembly. The subsystem consisting of suspension springs, axles, bearings, wheels, hubs, tires, and brakes, with their related hardware.

Transportation System. *(See definition of "Chassis.")*

10-3 General Requirements.

10-3.1 The manufactured home shall be designed, in terms of its structural, plumbing, mechanical, and electrical systems, to fully withstand the cumulative effect of highway transportation shock and vibration during its intended life. *(See 4-3.3 and 4-5.1.)*

10-3.2 Particular attention shall be given to maintaining watertight integrity and conserving energy by ensuring that structural components in the roof and walls (and their interfaces with vents, windows, doors, etc.) are capable of resisting highway shock and vibration forces during primary and subsequent secondary transportation moves.

10-3.3 Either of the following shall be accepted in place of an engineering analysis:

(a) Documented technical data of suitable highway tests that were conducted to simulate transportation loads and conditions

(b) Acceptable documented evidence of actual transportation experience that meets the intent of this chapter

10-4 Specific Requirements.

10-4.1* System Requirements. The entire system (frame, drawbar and coupling mechanism, running gear assembly, and lights) shall be designed and constructed as an integrated, balanced, and durable unit that is safe and suitable for its specified use during the intended life of the manufactured home. In operation, the transportation system, supporting the manufactured home structure and its contents, shall effectively respond to the control of the braking while traveling at applicable towing vehicle tracking and highway speeds and in normal highway traffic conditions.

10-4.2 System Component Requirements.

10-4.2.1 Drawbar. The drawbar shall be constructed of sufficient strength, rigidity, and durability to safely withstand those dynamic forces experienced during highway transportation. It shall be securely fastened to the manufactured home frame either by a continuous weld or by bolting.

10-4.2.2 Coupling Mechanism. The coupling mechanism, usually of the socket type, shall be securely fastened to the drawbar in such a manner as to ensure safe and effective transfer of the maximum loads, including dynamic loads, between the manufactured home structure and the hitch-assembly of the towing vehicle. The coupling shall be equipped with a manually operated mechanism so adapted as to prevent disengagement of the unit while in operation. The coupling shall be designed so that it can be disconnected, regardless of the angle of the manufactured home to the towing vehicle. With the manufactured home parked on level ground, the center of the socket of the coupler shall not be less than 20 in. (508 mm) or more than 26 in. (660 mm) from ground level.

10-4.2.3 Chassis. The chassis, in conjunction with the manufactured home structure, shall be designed and constructed to effectively sustain the designed loads consisting of the dead load plus a minimum of 3 lb/ft^2 (143 Pa) floor load (e.g., freestanding range, refrigerator, and loose furniture) and the superimposed dynamic load resulting from highway movement, but shall not be required to exceed twice the dead load. The integrated design shall be capable of ensuring the rigidity and structural integrity of the complete manufactured home structure and ensuring against deformation of structural or finish members during the intended life of the home.

10-4.2.4 Running Gear Assembly.

10-4.2.4.1 As part of the chassis, the running gear assembly shall be designed to perform as a balanced system in order to effectively sustain the designed loads set forth in 10-4.2.3 and to provide for durable, dependable, safe mobility of the manufactured home. It shall be designed to accept shock and vibration from the highway and the towing vehicle and to effectively dampen these forces so as to protect the manufactured home structure from damage and fatigue. The components of the running gear assembly shall be designed to facilitate routine maintenance, inspection, and replacement.

10-4.2.4.2 Location of the running gear assembly shall be determined by documented engineering analysis, taking into

account the gross weight (including all contents), total length of the manufactured home, the necessary coupling hitch weight, span distance, and turning radius. The coupling weight shall be not less than 12 percent nor more than 25 percent of the gross weight.

10-4.2.5 Spring Assemblies. Spring assemblies (springs, hangers, shackles, bushings, and mounting bolts) shall be capable of withstanding all the design loads, as outlined in 10-4.2.3, without exceeding maximum allowable stresses for design spring assembly life as recommended by the spring assembly manufacturer. The capacity of the spring system shall ensure that under maximum operating load conditions sufficient clearance shall be maintained between the tire and manufactured home frame or structure to permit unimpeded wheel movement and the changing of tires.

10-4.2.6 Axles. Axles and their connecting hardware shall be capable of withstanding all of the design loads outlined in 10-4.2.3 without exceeding maximum allowable stresses for design axle life as recommended by the axle manufacturer. The number of axles required to provide a safe tow and good ride characteristics shall be determined and documented by engineering analysis. Those alternatives listed in 10-3.3 shall be permitted to be accepted in place of such an analysis.

10-4.2.7 Hubs and Bearings. Hubs and bearings shall meet the requirements of 10-4.2.3 and good engineering practice. Both of these components shall be accessible for inspection, routine maintenance, and replacement of parts.

10-4.2.8 Tires, Wheels, and Rims. Tires, wheels, and rims shall meet the requirements of 10-4.2.3. Tires shall be selected for anticipated usage.

10-4.2.9 Brake Assemblies.

10-4.2.9.1 The number, type, size, and design of brake assemblies required to assist the towing vehicle in providing effective control and stopping of the manufactured home shall be determined and documented by engineering analysis. Those alternatives listed in 10-3.3 shall be permitted in place of such an analysis.

10-4.2.9.2 Brakes on the towing vehicle and the manufactured home shall be capable of ensuring that the maximum stopping distance from an initial velocity of 20 mph (32 km/h) does not exceed 40 ft (1219 cm) (U.S. Department of Transportation Regulations).

10-4.2.10 Lights and Associated Wiring. Highway safety electrical lights and associated wiring shall conform to applicable federal requirements in terms of location and performance. The manufacturer shall have the option of meeting this requirement by utilizing a temporary light/wiring harness provided by the manufactured home transportation carrier.

Chapter 11 Referenced Publications

11-1 The following documents or portions thereof are referenced within this standard as mandatory requirements and shall be considered part of the requirements of this standard. The edition indicated for each referenced mandatory document is the current edition as of the date of the NFPA issuance of this standard. Some of these mandatory documents might also be referenced in this standard for specific informational purposes and, therefore, are also listed in Appendix B.

11-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment*, 1997 edition.

NFPA 54, *National Fuel Gas Code*, 1996 edition.

NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases*, 1995 edition.

NFPA 70, *National Electrical Code*, 1996 edition.

NFPA 90B, *Standard for the Installation of Warm Air Heating and Air Conditioning Systems*, 1996 edition.

NFPA 220, *Standard on Types of Building Construction*, 1995 edition.

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

11-1.2 Other Publications.

11-1.2.1 AA Publications. Aluminum Association, 900 19th Street N.W., Suite 300, Washington , DC 20006.

AA-30, *Specification for Aluminum Structures Construction Manual Series*, Section 1, fifth edition, 1986.

Specifications and Guidelines for Aluminum Structures, Aluminum Design Manual, 1994.

11-1.2.2 AAMA Publications. American Architectural Manufacturers Association, 1827 Walden Office Square, Suite 104, Schaumburg, IL 60173.

AAMA 1503.1, *Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections*, 1988 edition.

AAMA 1701.2, *Primary Window and Sliding Glass Door: Voluntary Standard for Utilization in Manufactured Housing*, 1985 edition.

AAMA 1702.2, *Swinging Exterior Passage Doors: Voluntary Standard for Utilization in Manufactured Housing*, 1985 edition.

AAMA 1704, *Voluntary Standard: Egress Window Systems for Utilization in Manufactured Housing*, 1985 edition.

11-1.2.3 AFPA Publications. American Forest and Paper Association, 1111 19th Street N.W., Suite 800, Washington, DC 20036.

National Design Specifications for Wood Construction, 1997.

AFPA *Wood Structural Design Data*, 1989, Revised 1992.

AFPA PS-20-70, *Span Tables for Joists and Rafters*, 1993.

AFPA *Design Values for Joists and Rafters, American Softwood Lumber Standard Sizes*, 1993.

11-1.2.4 AISC Publication. American Institute of Steel Construction, One East Wacker Drive, Suite 3100, Chicago, IL 60601.

AISC-S335, *Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design*, 1989.

11-1.2.5 AISI Publication. American Iron and Steel Institute, 1101 17th Street, N.W., Washington, DC 20036.

AISI-SG 673, *Specification for the Design of Cold-Formed Steel Structural Members*, 1986 edition, with 1989 Addendum.

11-1.2.6 AITC Publication. American Institute of Timber Construction, 7012 S. Revere Pkwy., Suite 140, Englewood, CO 80112.

AITC A 190.1, *Wood Products — Structural Glued Laminated Timber*, 1992.

11-1.2.7 ANSI Publications. American National Standards Institute, 11 West Street, New York, NY 10036.

ANSI A 112.18.1M, *Plumbing Fixture Fittings*, 1996.

ANSI A 112.19.7M, *Whirlpool Bathtub Appliances*, 1995.

ANSI A 112.21.3M, *Hydrants for Utility and Maintenance Use*, 1985.

ANSI A 135.4, *Basic Hardboard*, 1995.

ANSI A 135.5, *Prefinished Hardboard Paneling*, 1995.

ANSI A 135.6, *Hardboard Siding*, 1990.

ANSI A 208.1, *Wood Particleboard*, 1993.

ANSI B 36.10M, *Welded and Seamless Wrought Steel Pipe*, 1995.

ANSI Z 21.1, *Household Cooking Gas Appliances*, 1996.

ANSI Z 21.5.1, *Gas Clothes Dryers Volume I Type 1 Clothes Dryers*, 1995.

ANSI Z 21.10.1, *Gas Water Heaters, Volume I, Storage Water Heaters with Input/Ratings of 75,000 Btu per Hour or Less*, 1993.

ANSI Z 21.15, *Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves*, 1992.

ANSI Z 21.19, *Refrigerators Using Gas Fuel*, 1990.

ANSI Z 21.20, *Automatic Gas Ignition Systems and Components*, 1993.

ANSI Z 21.21, *Automatic Valves for Gas Appliances*, 1993.

ANSI Z 21.22, *Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems*, 1986.

ANSI Z 21.23, *Gas Appliance Thermostats*, 1993.

ANSI Z 21.24, *Metal Connectors for Gas Appliances*, 1993.

ANSI Z 21.40.1, *Gas-Fired Absorption Summer Air Conditioning Appliances*, 1981.

ANSI Z 21.47, *Gas-Fired Central Furnaces (Except Direct Vent Central Furnaces)*, 1993.

ANSI Z 21.64, *Direct Vent Central Furnaces*, 1990.

ANSI Z 34.1, *For Certification — Third-Party Certification Program*, 1993.

ANSI Z 97.1, *Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings*, 1984.

ANSI Z 124.1, *Plastic Bathtub Units*, 1995.

ANSI Z 124.2, *Plastic Shower Receptors and Shower Stalls*, 1995.

ANSI Z 124.3, *Plastic Lavatories*, 1995.

ANSI Z 124.4, *Plastic Water Closet Bowls and Tanks*, 1996.

ANSI Z 124.6, *Plastic Bathtub Units*, 1987.

11-1.2.8 APA Publications. American Plywood Association, P.O. Box 11700, Tacoma, WA 98411.

APA-E 30P, *APA Design/Construction Guide, Residential and Commercial*, 1996.

APA-H 815E, *Design and Fabrication of All-Plywood Beams*, Supp. 5, 1995.

APA-PRP-E-108Q, *Performance Standards and Policies for Structural Use Panels*, 1995.

APA PS-1-83, *Voluntary Product Standard, Construction and Industrial Plywood*, V99, 1995.

APA PS-2-96, *Performance Standard for Wood-Based Structural Use Panels*, 1996.

APA-S 812Q, *Design and Fabrication of Glued Plywood-Lumber Beams*, Supp. 2, 1996.

APA-S 811N, *Design and Fabrication of Plywood Curved Panels*, Supp. 1, 1995.

APA-U 813L, *Design and Fabrication of Plywood Stressed-Skin Panels*, Supp. 3, 1996.

APA-U 814H, *Design and Fabrication of Plywood Sandwich Panels*, Supp. 4, 1993.

APA-Y 510S, *Plywood Design Specification*, 1997.

11-1.2.9 ARI Publication. Air Conditioning and Refrigeration Institute, N. Fairfax Drive, Suite 425, Arlington, VA 22203.

ARI 210/240, *Unitary Air-Conditioning and Air-Source Heat Pump Equipment*, 1989.

11-1.2.10 ASCE Publications. American Society of Civil Engineers, 345 East 47th Street, New York, NY, 10017-2398.

ASCE 7, *Minimum Design Loads for Buildings and Other Structures*, 1995.

ASCE 8, *Design of Cold-Formed Stainless Steel Structural Members*, 1991.

ASCE 19, *Structural Applications of Steel Cables for Buildings*, 1996.

11-1.2.11 ASHRAE Publication. American Society of Heating, Refrigeration, and Air Conditioning Engineers, 1791 Tullie Circle, N.E., Atlanta, GA 30329.

ASHRAE Handbook of Fundamentals, 1993.

11-1.2.12 ASME Publications. American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.

ASME A 112.1.2, *Air Gaps in Plumbing Systems*, 1991.

ASME A 112.14.1, *Backwater Valves*, 1975, Revised 1990.

ASME A 112.19.1M, *Enameled Cast Iron Plumbing Fixtures*, 1987.

ASME A 112.19.2M, *Vitreous China Plumbing Fixtures*, 1995.

ASME A 112.19.3M, *Stainless Steel Plumbing Fixtures*, 1987.

ASME A 112.19.4M, *Porcelain Enameled Formed Steel Plumbing Fixtures*, 1994.

ASME A 112.19.5, *Trim for Water-Closet Bowls, Tanks, and Urinals*, 1979, Revised 1990.

ASME A 112.19.7M, *Whirlpool Bathtub Appliances*, 1995.

ASME A 112.19.8M, *Suction Fittings for Use in Swimming Pools, Wading Pools, Spas, Hot Tubs, and Whirlpool Bathtub Appliances*, 1987.

ASME A 112.21.3M, *Hydrants for Utility and Maintenance Use*, 1985.

ASME B 1.20.1, *Pipe Threads, General Purpose (Inch)*, 1983.

ASME B 16.3, *Malleable Iron Threaded Fittings Classes 150 and 300*, 1992.

ASME B 16.4, *Cast Iron Fittings Classes 125 and 250*, 1992.

ASME B 16.15, *Cast Bronze Threaded Fittings Classes 125 and 250*, 1988.