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**11.2.3 Clearance from Drain Outlet.** The drainage outlet and couplers shall be provided with a minimum clearance of one and one-half inches ( $1\frac{1}{2}$ " ) in any direction from all parts of the vehicle and with adequate unrestricted clearance directly in front of the drainage outlet.

**11.2.4 Liquid Waste Drain Outlet.** Each recreational vehicle may utilize a separate drain for discharging liquid waste which shall be one and one-half inch ( $1\frac{1}{2}$ " ) minimum diameter and shall be equipped with a cap securely fastened to the vehicle.

**11.2.4.1** The drain may terminate on the discharge side of the full-way valve on the waste holding tank into an approved three inch (3" ) fitting designed for this purpose.

**11.2.4.2** A minimum one and one-half inch ( $1\frac{1}{2}$ " ) drain may be utilized to drain a separate liquid waste holding tank.

**11.2.4.3** If drain outlet is less than eighteen inches (18" ) above the ground it shall terminate horizontally. If more than eighteen inches (18" ) above the ground it may terminate either vertically or horizontally.

### **11.2.5 Hose Couplers.**

**11.2.5.1** Hose couplers for drain outlets shall be a quick disconnect type not requiring any special tools or knowledge to make the connection or remove the drain hose.

**11 Fixture Connections.** Drainage piping shall be provided with inlet fittings for fixture connections, correctly located according to size and type of fixture to be connected.

## **11.4 Size of Drainage Piping.**

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

**11.4.1.1** One and one-half inch ( $1\frac{1}{2}$ " ) minimum diameter piping shall be required for one and not more than three individually vented fixtures.

**11.4.1.2** Two inch (2" ) minimum diameter piping shall be required for four or more fixtures individually vented.

## **11.5 Wet-Vented Drainage System.**

**11.5.1 Horizontal Piping.** All parts of a wet-vented drainage system, including the connected fixture drains, shall be horizontal except for the wet-vented vertical riser. Where required by structural design, wet-vented drain piping may be offset vertically when

other vented fixture drains or relief vents are connected to the drain piping below the vertical offsets.

**11.5.2 Size.** A wet-vented drain pipe shall be at least one pipe size larger than the largest connected trap or fixture drain. Not more than three fixtures may connect to a wet-vented drain system.

**11.5.3 Length of Trap Arm.** Fixture traps shall be located within the distance given in Table 2. Not more than one trap shall connect to a trap arm.

**Table 2**  
**Distance of Fixture Trap from Vent**

Size of Trap Arm (Inches)	Distance Trap to Vent
1¼	4 feet 6 inches
1½	4 feet 6 inches
2	5 feet 0 inches
3	6 feet 0 inches

## 11.6 Side-Vent Drainage System.

**11.6.1** A recreational vehicle that has no plumbing fixture(s) connected to the main drain other than a one- or two-compartment sink with drain opening(s) of not more than two inches (2") in diameter may be connected to a side-vent drainage system.

**11.6.2** Drainage and vent systems shall be constructed of approved or listed components with an approved baffle or directional type fixture tee.

**11.6.3** A baffle or diverter tee shall be used to connect the trap arm to the side vent system.

**11.6.4** "P" traps shall be one and one-fourth inch (1¼") minimum diameter installed as close to the sink as possible with the center of the outlet not more than six inches (6") from the bottom of the sink.

**11.6.5** The center of the vent offset through the outside wall shall be located as high as the structure will permit but not less than two and one-fourth inches (2¼") above the bottom of the sink to the center of the elbow.

## 11.7 Offsets and Branch Fittings.

**11.7.1 Changes in Direction.** Changes in direction of drainage

piping shall be made by the appropriate use of approved or listed fittings, and shall be of the following angles:

11½, 22½, 45, 60 or 90 degrees; or other approved or listed fittings, or combination of fittings with equivalent radius or sweep.

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

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

*Exception: A short-turn "TY" may be used as a final termination if it is mounted directly to a full-way termination valve on one side and has a quick disconnect on the other.*

**11.8 Slope of Horizontal Drainage Piping.** Horizontal drainage piping shall be run in practical alignment and have a uniform slope of not less than one-quarter inch (¼") per foot toward the recreational vehicle main drain outlet. Where it is impractical, due to the structural features or arrangement of any recreational vehicle, to obtain a slope of one-quarter inch (¼") per foot, the pipe or piping may have a slope of not less than one-eighth inch (⅛") per foot, when a full size cleanout is installed at the upper end.

**11.9 Waste Holding Tank.** Vehicles equipped with a waste-holding tank and a toilet shall have a mechanical seal or recirculating chemical toilet.

**11.9.1 Toilet connections** shall be three inch (3") minimum pipe size and shall extend vertically. The inlet fitting may extend downward into the tank not more than one and one-half inches (1½"). The toilet connection shall be designed to receive or conform in an approved shape to a closet flange of standard dimensions or other approved fitting.

**11.9.2 Drain opening** shall be a three inch (3") minimum pipe size outlet located at the lowest point in the tank and shall be fitted with a fullway valve.

11.9.3 Fullway valves referred to in 11.9.2 shall be designed for manual operation from outside the recreational vehicle and have no extension or activating device within the vehicle.

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

a. A one and one-quarter inch ( $1\frac{1}{4}$ " ) minimum diameter individual vent pipe extending undiminished in size through the roof.

b. A continuous vent serving as a drain from one additional fixture provided the drain portion is increased one pipe size larger than the connected trap arm.

c. Two or more vented drains when at least one is wet-vented and each drain is separately connected to the top of the tank.

11.9.5 Waste holding tanks shall be securely installed in such locations as to be removable for service, repair, or replacement without the necessity of removing permanent structural, mechanical, or electrical installations.

**11.10 Detachable Waste Holding System.** A recreational vehicle having a sink as its only plumbing fixture may have all its liquid waste discharge into a detachable waste holding tank.

11.10.1 The fixture strainer or tailpiece shall be permanently connected by five-eighth inch ( $\frac{5}{8}$ " ) minimum inside diameter listed drain pipe or listed flexible tubing to an inlet valve.

11.10.2 The fixture drain shall have a trap formed by an extension of the inlet pipe, of the detachable waste holding tank. The trap shall be so designed as to become effective when the tank contains liquid equal to no more than ten per cent (10%) of the capacity of the tank.

11.10.3 The inlet of the detachable waste holding tank shall have an attached cap for use during storage and/or transport of the tank.

11.10.4 Detachable waste holding tanks with an integral trap shall be vented by a minimum opening of three-sixteenth inch ( $\frac{3}{16}$ " ) diameter.

11.10.5 Detachable waste holding tanks with an integral trap shall be so designed as to prevent connection of the inlet valve to the tank unless the integral trap is installed.

11.10.6 Detachable waste holding tanks shall be so designed as to allow emptying only through the inlet or the vent.

## 12. Vents and Venting

**12.1 General.** Each plumbing fixture trap shall be protected against siphonage and back pressure, and air circulation shall be ensured throughout all parts of the drainage system by means of vents installed in accordance with the requirements of this Section and/or as otherwise required by this Standard.

### 12.2 Materials.

**12.2.1 Pipe.** Vent piping shall be standard weight galvanized steel, galvanized wrought iron, brass, copper tube DWV, listed plastic, or other approved or listed materials in Table 1.

**12.2.2 Fittings.** Appropriate fittings shall be used for all changes in direction, size or shape, and where pipes are joined. The material and design of fittings shall conform to Table 1.

**12.2.2.1** Listed rectangular tubing may be used for venting. Suitable listed transition fittings shall be used.

### 12.3 Size of Vent Piping.

**12.3.1 Individual Vents.** A one and one-quarter inch ( $1\frac{1}{4}$ " ) minimum diameter vent pipe shall be required for all individually vented fixtures with one and one-half inch ( $1\frac{1}{2}$ " ) or smaller traps. The continuous vent of wet-vented drainage systems shall be one and one-quarter inch ( $1\frac{1}{4}$ " ) minimum diameter.

**12.3.2 Common Vent.** When two fixture traps located within the distance allowed from their vent have their trap arms connected separately at the same level into an approved double fitting, an individual vent pipe may serve as a common vent without any increase in size.

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

### 12.4 Grades and Connections.

**12.4.1 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 six inches (6") 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

pipng may offset below the rim of the fixture at the maximum angle or height possible.

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

### 12.5 Vent Terminal.

**12.5.1 Roof Extension.** Each vent pipe which passes through the roof shall extend through its flashing, except as otherwise permitted in 11.6, and terminate vertically, undiminished in size, not less than two inches (2") above the roof. Vent openings shall not be less than 3 feet, 0 inch away from any motor-driven air intake that opens into habitable areas.

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

## 13. Tests and Inspection (Plumbing)

**13.1 Water Piping System.** All pressure 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 for 10 minutes without leakage or loss of pressure. An adequate and accurate pressure gage shall be used on all tests.

*Exception: A recreational vehicle that has no plumbing fixtures other than a single compartment sink with a drain opening of not more than two inches (2") shall be tested a minimum of 3 minutes.*

**13.2 Drainage and Vent System and Plumbing Fixtures.** The waste and vent system shall be subjected to one of the following tests without evidence of leaks.

**13.2.1 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.

**13.2.2 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 two inch (2") (manometer) water column air pressure test.

**13.2.3 Flood Level Test.** The recreational vehicle shall be in a level position; all fixtures shall be connected, and the entire system shall be filled with water to the flood level rim of the toilet bowl. (Tub and shower drains should be plugged.) After all trapped air has been released, the test shall be sustained for not less than 15 minutes. The waste piping above the level of the toilet shall be tested and show no indication of leakage when the high fixtures are filled with water and emptied simultaneously to obtain the maximum possible flow in the drain piping.

**13.3 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.

**13.3.1 Shower Stalls.** Shower stalls and receptors shall be tested for leaks prior to being covered by finished material. Each pan shall be filled with water to the top of the dam for not less than 15 minutes.

## APPENDIX TO PART I

## Applicable Standards

Table 3. Standards for Pipe &amp; Fittings

Description	ANSI	ASTM	FS	Other
<i>Nonmetallic Pipe and Fittings</i>				
Threaded Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 80 <sup>1</sup>	None	D 2465-68	None	NSF Std. 14
Socket-Type Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings Schedule 40 <sup>1</sup>	None	D 2468-68	None	NSF Std. 14
Socket-Type Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 80 <sup>1</sup>	None	D 2469-68	None	NSF Std. 14
Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe	B16.27-67	D 2609-68	None	NSF Std. 14
Standard Specification for Polyethylene (PE) Plastic Tubing	None	D2737-68aT	None	NSF Std. 14
Polybutylene (PB) Plastic Pipe (SDR-PR)	None	D2662-68	None	NSF Std. 14
Polybutylene (PB) Plastic Tubing	None	D2666-68	None	NSF Std. 14
ABS Plastic Pipe (SDR-PR and Class T)	B72.3-67	D1527-68 D2282-68	None	NSF Std. 14 CS 254-63
Flexible Polyethylene Plastic Pipe (SDR-PR)	B72.1-67	D2477-68 D2104-68 D2239-68	L-P-315a-1966	CS 255-63 NSF Std. 14
Polyethylene Pipe, Nonpressure	None	None	None	IAPMO TSC 7-62
Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR and Class T)	B72.2-67	D2241-68	None	CS 256-64 NSF Std. 14
Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cement and Adhesives for Potable Hot Water Systems	None	D2846-69	None	NSF Std. 14

Description	ANSI	ASTM	FS	Other
<i>Nonmetallic Pipe and Fittings (Continued)</i>				
Acrylonitrile-Butadiene-Styrene (ABS) Plastic Drain, Waste, and Vent Pipe and Fittings	None	D2661-68	L-P-322a-1966	CS 270-65 IAPMO PS-17-66 NSF Std. 14
Thermoplastic Materials, Pipe, Fittings, Valves, Traps and Joining Materials	None	None	None	NSF Std. 14
ABS Plastic Pipe Installation Standard	None	None	None	IAPMO IS 5-66
Solvent Cements for ABS Plastic Pipe and Fittings	None	D2235-67	None	NSF Std. 14
<i>Nonferrous Pipe and Fittings</i>				
Brass Fittings for Flared Copper Tube	B16.26-1967	None	None	None
Seamless Brass Tube	H36.1-1967	B153-67	WW-T-791(1)-1933	None
Seamless Red Brass Pipe	H27.1-1967	B43-66	WW-P-351a-1963	None
Brass or Bronze Flanges and Flanged Fittings, 150 and 300 Lbs.	B16.24-1962	None	None	None
Brass or Bronze Screwed Fittings, 125 and 250 Lbs.	B16.15-1964	None	WW-P-460c-1967	None
Cast-Bronze Solder-Joint Pressure Fittings	B16.18a-1967	None	None	None
General Requirements for Wrought Seamless Copper and Copper Alloy Pipe and Tube	H23.4-1967	B251-68a	None	None
Welded Red Brass (Copper Alloy 230) Water Tube	None	None	None	IAPMC PS 28-69
Welded Red Brass (Copper Alloy 230) Drainage Tube	None	None	None	IAPMO PS 29-69
Cast-Bronze Solder-Joint Drainage Fittings	B16.23-1960	None	None	None
Copper Pipe, Seamless, Standard Sizes	H26.1-1967	B42-66	WW-P-377d-1962	None
Copper Pipe, Threadless (TP)	H26.2-1967	B302-66a	None	None

Description	ANSI	ASTM	FS	Other
<i>Nonferrous Pipe and Fittings (Continued)</i>				
Seamless Copper Tube	H23.3-1967	B75-68	WW-T-797c-1963	None
Copper Water Tube, Types K, L, M	H23.1-1967	B88-66a	WW-T-799c-1967	None
Copper Drainage Tube, Type DWV	H23.6-1967	B306-66a	None	CS 229-60
Copper (Wrought) and Wrought Bronze Solder Joint Fittings	B16.22-1963	None	None	None
Flexible Copper Water Connectors	None	None	None	IAPMO PS 14-66
Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings	B16.29-1966	None	None	None
Pipe Nipples; Brass, Copper, Steel and Wrought Iron	None	None	WW-N-351b-1967	None
Unions, Brass or Bronze, 250 Lbs.	None	None	WW-U-516a-1967	None
Pipe Fittings, Bronze and Ferrous (Bushings, Plugs and Locknuts); Threaded	None	None	WW-P-471a (2)-1964	None
<i>Ferrous Pipe and Fittings</i>				
Cast Iron Soil Pipe and Fittings, Extra Heavy and Service Weights	A112.5.1-1968	A74-66	WW-P-401c-1967	CS 188-66
Cast Iron Water Pipe	A21.6-1964 & A21.8-1963	None	WW-P-421c-1967	None
Cast Iron Pipe, Drainage, Vent and Waste	None	None	WW-P-356a-1967	None
Cast Iron Pipe, Pressure (50 Lbs.) (Water)	None	None	WW-P-360a-1959	None

Description	ANSI	ASTM	FS	Other
<i>Ferrous Pipe and Fittings (Continued)</i>				
Cast Iron (Threaded) Pipe	A40.5-1943	None	WW-P-356a-1967	None
Cast Iron (Threaded) Fittings	B16.4-1963	None	WW-P-501d-1967	None
Cast Iron Drainage Fittings	B16.12-1965	None	WW-P-491b-1967	IAPMO PS-5-66
Galvanized Pipe and Fittings	None	None	WW-P-406b-1968	None
Malleable Iron Fittings (Threaded), 150 and 300 Lbs.	B16.3-1963	None	WW-P-521e-1964	None
Steel Pipe (Seamless and Welded, Black and Zinc Coated)	B36.1-1966 & B36.2-1966	A53-65	WW-P-404c(2)-1965	None
Stainless Steel Pipe	B36.19-1965	None	None	None
Union, Pipe Steel, or Malleable Iron, Threaded Pipe Connection 250 psi, WSP, 500 psi WOG (Cold, Nonshock)	None	None	WW-U-531c-1965	None
Unions: Malleable Iron or Steel, 300 Lbs.	None	None	WW-U-536(1)-1933	CS7-29
Wrought-Iron Pipe	E36.2-1966	A72-68	WW-P-441c(2)-1968	None
Valves, Cast iron, Gate, 125 and 250 Lbs. Threaded and Flanged	None	None	WW-V-58a(1)-1966	None
Pipe Fittings, Bronze and Ferrous (Bushings, Plugs and Locknuts); Threaded	None	None	WW-P-471a(2)-1964	None
Nipples, Pipe, Threaded	None	None	WW-N-351b-1967	CS 5-65

**Table 4**  
**Valves and Controls**

Description	ANSI	ASTM	FS	Other
Backflow Preventers in Plumbing Systems	A40.6-1943	None	None	IAPMO TSC-8-63
Valve, Bronze, Gate 125-150 Lbs.	None	None	WW-V-54c-1966	None
Valve, Cast Iron Gate	None	None	WW-V-58a-1966	None
Valves, Technical	None	None	None	NSF Std. 24
Relief Valves and Automatic Gas Shut-off Devices for Hot Water Supply Systems	Z21.22a-1965	None	None	None
Combination Check and Relief Valve	None	None	None	IAPMO TSC-8-66
Pressure Reducing and Regulating Valves	None	None	None	IAPMO PS 15-66
Valves, Bronze; Angle, Check and Globe, 125 and 150 Lbs., Threaded and Flanged	None	None	WW-V-51d-1967	None
Air Gaps in Plumbing Systems	A40.4-1942	None	None	IAPMO PS 23-66

**Table 5**  
**Plumbing Fixtures & Miscellaneous**

Description	ANSI	ASTM	FS	Other
<i>Plumbing Fixtures</i>				
Enameled Cast-Iron Plumbing Fixtures	None	None	None	None
Formed Metal, Porcelain-Enameled Sanitary Ware	None	None	None	NBS PS 5-66
Gel-Coated Glass-Fiber Reinforced Polyester Resin Bathtub	Z124.1-1967	None	None	None
Gel-Coated Glass-Fiber Reinforced Polyester Resin Shower Receptor and Shower Stall Units	Z124.2-1967	None	None	None
Plumbing Fixtures for Land Use	None	None	WW-P-541b(6)-1963	None
Prefabricated Shower Receptors and Stall Showers	None	None	None	IAPMO TSC-11-64 NSF Std. 24
Stainless Steel Plumbing Fixtures Designed for Residential Use	None	None	None	CS 243-62
Vitreous China Plumbing Fixtures	None	None	None	CS 20-63
Thermoplastic Lavatory and/or Lavatory Countertop Combinations	None	None	None	IAPMO TSC-16-67T
Mechanical Seal Toilet	None	None	None	IAPMO TSC-1-67 NSF Std. 24
Recirculating Chemical Toilet	None	None	None	IAPMO TSC-12-66 NSF Std. 24
Waste Holding Tanks	None	None	None	IAPMO TSC-2-1960 NSF Std. 24
Water Pumps — Hand-Electric	None	None	None	IAPMO TSC-14-66 NSF Std. 24

Description	ANSI	ASTM	FS	Other
<i>Plumbing Fixtures (Continued)</i>				
Water Storage Tanks	None	None	None	IAPMO TSC-4-1960 NSF Std. 24
Water Heaters, Gas Fired	Z21.10.1-1966	None	None	None
Detachable Waste Holding System	None	None	None	NSF Std. 24
Nonmetallic Prefabricated Combination Tank and Shower Pan Units for Recreational Vehicles	None	None	None	IAPMO TSC 17-69T
<i>Miscellaneous</i>				
Closet Flange	None	None	None	IAPMO TSC-5-63
Fixture Setting Compound	None	None	HH-C-536a-1954	IAPMO PS-20-65
Hand Actuated, Nonpressure Water Pump	None	None	None	IAPMO TSC-15-1966
Pressure Caps	None	None	None	IAPMO TSC-13-1966
Pressure Pumps and Systems	None	None	None	IAPMO TSC-14-1966
Tubing "P" Traps (20" Length Minimum)	None	None	None	IAPMO PS-2-66

### Notes to Tables 3, 4 and 5

Abbreviations used in Tables 3, 4 and 5 refer to standards as identified below and elsewhere in this Standard.

ANSI: American National Standards published by the *American National Standards Institute*, 1430 Broadway, New York, New York 10018. (Formerly American Standards Association and United States of America Standards Institute.)

ASME: Standards and Tentative Standards published by the *American Society of Mechanical Engineers*, 345 East 47th Street, New York, New York 10010.

ASTM: Standards and Tentative Standards published by the *American Society for Testing and Materials*, 1916 Race Street, Philadelphia, Pennsylvania 19103.

CS: Commercial Standards representing recorded voluntary recommendations of industry, issued by the *United States Department of Commerce* and obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

FS: Federal Specifications published by the *Federal Specifications Board* and obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

IAPMO: Standards and Tentative Standards TSC and UPC sponsored by *International Association of Plumbing and Mechanical Officials*, 5032 Alhambra Avenue, Los Angeles, California 90032. (Formerly Western Plumbing Officials Association.)

NBS PS: National Bureau of Standards (United States Department of Commerce), Product Standard and obtainable from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

NSF: Standards published by the *National Sanitation Foundation*, 2355 W. Stadium Boulevard, P.O. Box 1468, Ann Arbor, Michigan. 48106.

## Part II — Heating Systems

### 1. Introduction

1.1 Those members of the engineering profession and others associated with the design, manufacturing, installation, and inspection of recreational vehicle heating systems have been aware of the need for uniform technical standards leading to the safe use of this special type of equipment and related systems. They have also recognized that, because of conditions of transport and use, existing heating equipment standards for motor vehicles or for buildings are not completely applicable to recreational vehicles. It is with these factors in mind that Part II of this Standard has been developed.

1.2 Much of the material in Part II has been based on nationally recognized standards for heat producing appliances and fuel supply systems, including standards listed in the Appendix of this Part.

### 2. Scope

2.1 Part II of this Standard covers the heat producing appliances and fuel supply systems within or on recreational vehicles.

2.2 This Standard is not intended as a design specification or an instruction manual for untrained persons.

2.3 Wherever nationally recognized standards for heat producing appliances and fuel supply systems and this Part differ, the requirements of the latter shall apply.

2.4 The provisions of this Standard are not intended to prevent the use of any material, appliance, installation, device, arrangement, or method of construction not specifically prescribed herein, provided any such alternative has been approved or listed. The enforcement authority shall approve such alternate if the material, appliance, installation, device, arrangement, or method of construction is at least the equivalent of that prescribed by this Part, and may require tests or proof of compliance to substantiate any claims that may be made regarding the use of any such alternate.

### 3. Definitions

**Accessible:** When applied to a fixture connection, appliance, or equipment shall mean having access thereto, but which may require the removal of an access panel, door or similar obstruction.

**Air Duct:** Conduits or passageways for conveying air to or from heating, cooling, air conditioning or ventilation equipment, but not including the plenum.

**Appliance Branch Piping:** Any run of piping or tubing, and fittings, not a part of an appliance, that is used to convey fuel from the main piping manifold to a fuel-burning appliance.

**Approved:** Means acceptable to the authority having jurisdiction.

**Automatic Pump (Oil Lifter):** A pump, not an integral part of the oil-burning appliance, that automatically pumps oil from the supply tank and delivers the oil by gravity under a constant head to an oil-burning appliance.

**BTU. British Thermal Unit:** The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

**BTUH. British Thermal Units per Hour:**

**Burner:** A device for the final conveyance of fuel or a mixture of fuel and air to the combustion zone.

**Certified:** Means "listed" as defined herein.

**Clearance:** The distance between the appliance, chimney, vent, chimney or vent connector or plenum and the nearest surface.

**Connection — Gas Supply:** The terminal end or connection to which a gas supply connector is attached.

**Connector — Gas Appliance:** A listed connector used to convey fuel gas between a gas outlet and a gas appliance.

**Connector — Gas Supply:** Tubing or pipe connecting the recreational vehicle to the gas supply source.

**Control, Primary Safety:** The automatic safety control intended to prevent the abnormal discharge of fuel at the burner in case of ignition failure or flame failure.

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

**Heat Producing Appliance:** All heating and cooking appliances and all fuel-burning appliances.

**Heating Appliance:** An appliance for comfort heating of a recreational vehicle or for water heating.

**Labeled:** Equipment or materials to which has been attached a label, symbol, or other identifying mark of a nationally recognized testing laboratory that maintains periodic inspection of production of labeled equipment or materials and by whose labeling is indicated compliance with nationally recognized standards or tests to determine suitable usage in a specified manner.

**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 them: propane, propylene, butanes (normal butane or isobutane), and butylenes.

**Listed:** Equipment or materials included in a list published by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

**Main Gas Piping Manifold:** Gas piping which conveys gas from the gas supply connection to the first appliance branch piping.

**Plenum:** Air compartment or chamber to which one or more ducts are connected and which forms part of either the supply or return air systems.

**Roof Jack:** That portion of a venting system, including the cap, insulating means, flashing, and ceiling plate, located in and above the roof.

**Safety Shutoff Device:** A device that will shut off the gas supply to the controlled burner(s) in the event the source of ignition fails. This device may interrupt the flow of gas to main burner(s) only or to pilot(s) and main burner(s) under its supervision.

## 4. Fuel Supply Systems

### 4.1 LP-Gas Containers.

**4.1.1 Maximum Capacity.** When LP-Gas containers are provided, a recreational vehicle shall have:

a. Not more than two non-permanently mounted containers having maximum individual water capacities of 105 lbs. (approximately 45 lbs. LP-gas capacity), or

b. Not more than two permanently mounted containers having maximum total water capacity of 478 lbs. (approximately 200 lbs. LP-gas capacity).

**4.1.2 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 the Rules for Construction of Unfired Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code. ASME Containers constructed after December 31, 1967 shall have a design pressure of at least 312.5 psig.

### 4.1.3 Location of Containers.

**4.1.3.1** LP-gas containers shall not be installed, nor shall provisions be made for installing or storing any LP-gas container, even temporarily, inside any recreational vehicle except for listed, completely self-contained hand torches, lanterns, or similar equipment with containers having a maximum water capacity of not more than 2½ pounds.

**4.1.3.2** LP-gas containers with their control valves and pressure regulators shall be installed in compliance with one of the following:

a. In a recess or compartment that is vapor-tight to the inside of the recreational vehicle.

b. Mounted on the tongue of a travel or camping trailer as close to the hitch as practicable.

c. Mounted on the chassis of a motor home or chassis-mount camper, provided neither the container nor its support extends below the frame if the container is located ahead of the front axle or behind the rear axle of the recreational vehicle. Containers mounted elsewhere on the frame of a motor home or chassis-mount camper shall be installed in such a manner that the bottom of the tank and any connection thereto shall not be lower than the lowest horizontal axis of the nearest vehicle axle when the vehicle is fully loaded.

4.1.3.3 Container or container carriers shall be secured in place on the recreational vehicle by fastenings designed and constructed with a minimum safety factor of four, to withstand loading in any direction equal to twice the filled weight of the container, providing an overall safety factor of eight.

#### 4.1.4 Container Enclosures.

4.1.4.1 Compartments shall be ventilated at or near the top and at the extreme bottom to facilitate diffusion of vapors. The compartment shall be ventilated with at least two vents having an aggregate free area equal to one square inch for each 7 lbs. of the total LP-gas fuel capacity of the container(s). The vents shall be equally distributed between the floor and ceiling of the compartment. If the lower vent is located in the access door or wall, the bottom edge of the vent shall be flush with the floor level of the compartment. The top vent shall be located in the access door or wall with the bottom of the vent within 12 inches of the ceiling of the compartment. 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 to open.

4.1.4.2 Doors, hoods, domes, housings (or portions of housings), and enclosures required to be removed or opened for replacement of containers shall incorporate means for clamping them firmly in place and to prevent them from working loose during transit.

#### 4.1.5 Container Valves and Accessories.

4.1.5.1 Valves in a two-container assembly system shall be arranged so that replacement of containers can be made without shutting off the flow of gas to the appliance(s).

NOTE: This provision is not to be construed as requiring an automatic changeover device.

4.1.5.2 Container shutoff valves shall be protected as follows:

- a. By setting into a recess of the container to prevent possibility of their being struck if container is dropped upon a flat surface, or
- b. By a ventilated cap or collar, fastened to the container, capable of withstanding a blow from any direction equivalent to that of a 30-pound weight dropped 4 feet. Construction must be such that the blow will not be transmitted to the valve.

4.1.5.3 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 flexible connections. In the case of permanently mounted containers, listed semi-rigid tubing connections may be used.

#### 4.1.6 Safety Devices.

4.1.6.1 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 Basic Rule B.10 of ANSI Standard for the Storage and Handling of Liquefied Petroleum Gases (ANSI Z106.1 — 1969, NFPA No. 58 — 1969). Safety relief valves shall have direct communication with the vapor space of the vessel.

4.1.6.2 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.

4.1.6.3 Systems installed outside of a recreational vehicle shall be so located that discharge from safety relief devices shall be not less than three feet (3') horizontally away from any opening into the recreational vehicle below the level of such discharge. When a system is located in a recess vaportight to the inside, vent openings in such recess shall be not less than three feet (3') horizontally away from any opening into the recreational vehicle below the level of these vents.

#### 4.1.7 System Design and Service Line Pressure.

4.1.7.1 Systems shall be of the vapor-withdrawal type.

4.1.7.2 Vapor, at a pressure not over eighteen inches (18") water column, shall be delivered from the system into the gas supply connection.

4.1.7.3 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 which communicates with the vapor space in or near the highest point in the container when it is mounted in service position, with the vehicle on a level surface. 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.

#### 4.2 Oil Tanks.

4.2.1 Installation. Oil tanks installed for gravity flow of oil to heating equipment shall be installed so that the top of the tank is no higher than eight feet (8') above the appliance oil control and the bottom of the tank is no less than eighteen inches (18") above the appliance oil control. Listed automatic pumps (oil lifter) shall

be mounted no higher than eight feet (8') above the appliance oil control and not less than eighteen inches (18") above the appliance oil control.

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

**4.2.3 Tank Compartment.** If the fuel supply tank is located in a compartment of a recreational vehicle, the compartment shall be ventilated at the bottom to permit diffusion of vapors and shall be 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.

**4.2.4 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.

**4.2.5 Fuel Oil Filters.** All oil tanks, except for integrally mounted 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.

## 5. Piping Systems

### 5.1 Gas Piping Systems.

**5.1.1 General.** The requirements of this section shall govern the installation of all fuel gas piping attached to any recreational vehicle. None of the requirements listed in this Section shall apply to the piping supplied as a part of an appliance.

**5.1.2 Materials.** Materials used for the installation, extension, alteration, or repair of any gas piping system shall be new and free from defects or internal obstructions. It shall not be permissible 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 1,450° Fahrenheit, except as provided in 5.1.5 and 5.1.6, or of materials (used in piping or fittings) listed for the specific use intended. They may consist of one or more of the following materials, or any other material used in listed gas piping or fittings.

**5.1.2.1** Gas pipe shall be steel or wrought-iron pipe complying with the American National Standard Wrought-Steel and Wrought-Iron Pipe, B36.10 — 1959. Threaded copper or brass pipe in iron pipe sizes may be used.

**5.1.2.2** Fittings for gas piping shall be wrought iron, malleable iron, steel, or brass (containing not more than 75 percent copper).

**5.1.2.3** Copper tubing shall be annealed Type K or L, conforming to ASTM B88-66, or shall comply with the Specifications for Seamless Copper Tube for Refrigeration Field Service, ASTM B280-66. When used on systems designed for natural gas, such tubing shall be internally tinned.

**5.1.2.4** Seamless brass tubing shall be composed of not more than 75 percent copper (cartridge brass 70 percent) and shall have a minimum thickness of 0.030 inch.

**5.1.2.5** Steel tubing shall have a minimum wall thickness of 0.049 inch, conforming to ASTM A539-65, and be externally corrosion protected.

**5.1.2.6** Flexible non-metallic tubing shall be part of an assembly which is listed for the use intended.

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

**5.1.4 Gas Pipe Sizing.** Gas piping systems shall be sized so that the pressure drop to any appliance inlet connection from the gas supply connection or connections, when all appliances are in operation at maximum capacity, is not more than 0.5 inch water column when used with natural gas if the system is designed for both natural and LP-gas, or when used with LP-gas if the system is designed for LP-gas only. Conformance may be determined on the basis of test, or the gas piping system may be sized in accordance with Table 6 or other approved method. The natural gas supply connection shall be not less than three-quarter inch ( $\frac{3}{4}$ " nominal pipe size).

**5.1.5 Joints for Gas Pipe.** Pipe joints in the piping system, unless welded or brazed, shall be screw joints that comply with American National Standard Pipe Threads (except Dryseal) B2.1 — 1960. Right and left nipples or couplings shall not be used. Unions, if used, shall be of the ground joint type. The material used for welding or brazing pipe connections shall have a melting temperature in excess of 1,000° Fahrenheit.

**Table 6**  
**Sizing of Low-Pressure Gas Piping Systems**

COMBINATION LP-GAS — NATURAL GAS SYSTEM			LP-GAS-ONLY SYSTEM		
(Based on a Total Pressure Drop of 1/2 in. H <sub>2</sub> O)			(Based on a Total Pressure Drop of 1/2 in. H <sub>2</sub> O)		
Main Gas Manifold			Main Gas Manifold		
Total Appliance Input Name Plate Rating	Nominal Pipe Size (Inches)		Total Appliance Input Name Plate Rating	Nominal Pipe Size (Inches)	Tube o.d. (Inches)
No more than:			No more than:		
7,000 Btu/hr	1/4		11,000 Btu/hr	1/4	3/8
27,000 Btu/hr	3/8		42,000 Btu/hr	3/8	1/2
56,000 Btu/hr	1/2		88,000 Btu/hr	1/2	5/8
115,000 Btu/hr	3/4		183,000 Btu/hr	3/4	
220,000 Btu/hr	1		340,000 Btu/hr	1	
Branch Take-Offs			Branch Take-Offs		
Individual Appliance Input Name Plate Rating	Nominal Pipe Size (Inches)	Tube o.d. (Inches)	Individual Appliance Input Name Plate Rating	Nominal Pipe Size (Inches)	Tube o.d. (Inches)
No more than:			No more than:		
25,000 Btu/hr		3/8	2,500 Btu/hr		1/4
31,000 Btu/hr	1/4		39,000 Btu/hr		3/8
49,000 Btu/hr		1/2	49,000 Btu/hr	1/4	
64,000 Btu/hr	3/8		77,000 Btu/hr		1/2
95,000 Btu/hr		3/4	100,000 Btu/hr	3/8	
120,000 Btu/hr	1/2		150,000 Btu/hr		3/4
250,000 Btu/hr	3/4		190,000 Btu/hr	1/2	
			390,000 Btu/hr	3/4	

**5.1.6 Tubing Joints.** Tubing joints shall be made with a double flare of the proper degree or with connections, as recommended by the tubing manufacturer; by means of approved gas tubing fittings; or, joints may be brazed with material having a melting point exceeding 1,000° Fahrenheit. Metallic ball sleeve compression-type tubing fittings shall not be used.

**5.1.7 Pipe Joint Compound.** Screw joints shall be made up tight with approved pipe joint compound, insoluble in liquefied petroleum gas, and shall be applied to the male threads only.

**5.1.8 Concealed Tubing.** Tubing shall not be run inside walls, floors, partitions or roofs except that one-quarter inch ( $\frac{1}{4}$ " ) o.d. tubing may be concealed provided it is enclosed with a metallic covering of thickness equivalent to the thickness of the tubing enclosed. Where tubing passes through walls, floors, partitions, roofs, or similar installations, such tubing shall be protected by the use of grommets that shall snugly fit both the tubing and the hole through which the tubing passes.

**5.1.9 Concealed Joints.** Pipe or tubing joints shall not be located in any floor, wall, partition, or similar concealed construction space.

### **5.1.10 Location of Gas Supply Connection.**

**5.1.10.1** For LP-gas only systems the supply connection shall be located at the container location, or within fifteen feet (15') of the rear, on the left (road) side or at the rear, left of the longitudinal center of the vehicle, within eighteen inches (18") of the outside wall.

*Exception: A camping trailer not more than seventeen feet (17') in length, a motor home or a truck camper may have the gas supply connection located on either side.*

**5.1.10.2** For natural gas or combination LP-gas and natural gas systems, the supply connection shall be located within fifteen feet (15') of the rear, on the left (road) side or at the rear, left of the longitudinal center of the vehicle, within eighteen inches (18") of the outside wall.

*Exception: A camping trailer not more than seventeen feet (17') in length, a motor home or a truck camper may have the gas supply connection located on either side.*

**5.1.11 Identification of Gas Supply Connections.** Each recreational vehicle 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 inches by  $1\frac{3}{4}$  inches minimum size, made of etched, metal-stamped or embossed brass, stainless steel, anodized or alclad aluminum not less than 0.020 inch thick, or other approved material (e.g., 0.005 inch plastic laminates), which reads (as appropriate) either:

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

b. THIS GAS PIPING SYSTEM IS DESIGNED FOR USE OF EITHER LP-GAS OR NATURAL GAS. BEFORE TURNING ON GAS BE CERTAIN APPLIANCES ARE DESIGNED FOR THE GAS CONNECTED AND ARE EQUIPPED WITH CORRECT ORIFICES. Securely cap this inlet when not connected for use. After turning on gas, except after normal container replacement, test gas piping and connections to appliances for leakage with soapy water or bubble solution.

**5.1.12 Warning Relative to Motor Fuel and LP-Gas Refueling — Motor Homes, Truck Campers.** Each motor home or truck camper having exterior combustion air inlet(s) at a level below the roof shall have the following additional wording on the tag specified in 5.1.11:

**WARNING: ALL PILOT LIGHTS AND APPLIANCES SHALL BE TURNED OFF DURING REFUELING OF MOTOR FUEL TANKS AND/OR PERMANENTLY MOUNTED LP-GAS CONTAINERS.**

**5.1.13 Gas Supply Connectors.**

**5.1.13.1 Natural Gas.** A listed minimum one-half inch ( $\frac{1}{2}$ " nominal (ID) gas supply connector, with three-quarter inch ( $\frac{3}{4}$ " NPT terminal fittings, six feet in length, shall be supplied by the manufacturer when the fuel gas piping system is designed for the use of natural gas.

**5.1.13.2 LP-Gas.** A listed LP-gas flexible connector shall be supplied when the fuel gas piping system is designed for the use of LP-Gas and container(s) and regulator(.) are supplied.

**5.1.14 Appliance Connections.** All gas-burning appliances shall be connected to the fuel piping with materials as provided in 5.1.2 or with listed appliance connectors which do not pass through any wall, floor, ceiling or partition.

**5.1.15 Valves.** Shutoff valves and appurtenances used in connection with gas piping shall be of a type designed and approved for use on LP-gas.

**5.1.16 Gas Inlet Cap.** Suitable cap(s), to effectively close the gas inlet(s) when disconnected from the source of supply and not in use, shall be attached to the recreational vehicle.

**5.1.17 Electrical Ground.** Gas piping shall not be used for a grounding electrode (See Part III, 7.17.6 and 7.18.5).

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

**5.1.19 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 feet, except where adequate support and protection is provided by structural members. Solid-iron-pipe gas supply connection(s) shall be rigidly anchored to a structural member within six inches (6") of the supply connection(s).

### **5.1.20 Testing for Leakage**

**5.1.20.1 Before Appliances Are Connected.** Piping systems shall stand a pressure of at least six inches (6") mercury or three (3) PSI gage for a period of not less than ten (10) minutes without showing any drop in pressure. Pressure shall be measured with a mercury manometer or slope gage, or an equivalent device, calibrated so as to be read in increments of not greater than one-tenth (1/10) PSI. The source of pressure shall be isolated before the pressure tests are made.

**NOTE:** Before a test is begun, the temperature of the ambient air and of the piping should be approximately the same, and constant air temperature should be maintained throughout the test.

**5.1.20.2 After Appliances Are Connected.** When appliances are connected to the piping system the entire system shall be pressurized to not less than ten inches (10") nor more than fourteen inches (14") water column and the appliance connections tested for leakage with soapy water or bubble solution.

## **5.2 Oil Piping Systems**

**5.2.1 General.** The requirements of this section shall govern the installation of all liquid fuel piping attached to any recreational vehicle. None of the requirements listed in this Section shall apply to the piping in the appliance(s).

**5.2.2 Materials.** All materials used for the installation, extension, alteration, or repair of any oil piping system shall be new and free from defects or internal obstructions. The system shall be made of materials having a melting point of not less than 1,450° Fahrenheit except as provided in 5.2.4 and 5.2.5. They may consist of one or more of the following materials:

**5.2.2.1** Pipe shall be steel or wrought-iron pipe complying with American National Standard Wrought-Steel or Wrought-Iron Pipe, B36.10 — 1959. Threaded copper or brass pipe in iron pipe sizes may be used.

**5.2.2.2** Fittings for oil piping shall be wrought-iron, malleable iron, steel, or brass (containing not more than 75 percent copper).

5.2.2.3 Copper tubing shall be annealed Type K or L conforming to ASTM B-88-66 or shall comply with the specifications for Seamless Copper Tube for Refrigeration Field Service, ASTM E280 — 1966.

5.2.2.4 Seamless brass tubing shall have a minimum wall thickness of 0.030 inch.

5.2.2.5 Steel tubing shall have a minimum wall thickness of 0.049 inch, conforming to ASTM A539-65, and be externally corrosion protected.

**5.2.3 Size of Oil Piping.** The minimum size of all fuel oil tank piping connecting outside tanks to the appliance shall be not smaller than three-eighth inch ( $\frac{3}{8}$ " o.d. copper tubing or one-quarter inch ( $\frac{1}{4}$ " IPS. In those cases where No. 1 fuel is used with a listed automatic pump (fuel lifter), one-quarter inch ( $\frac{1}{4}$ " o.d. copper tubing may be used if specified by the pump manufacturer.

**5.2.4 Joints for Oil Pipe.** All pipe joints in the piping system, unless welded or brazed, shall be screw joints which comply with American National Standard Pipe Threads (except Dryseal), B2.1 — 1960. The material used for welding or brazing pipe connections shall have a melting temperature in excess of 1,000° Fahrenheit.

**5.2.5 Joints for Tubing.** Joints on tubing shall be made with double flare of the proper degree, as recommended by the tubing manufacturer, by means of approved tubing fittings. Joints may be brazed with materials having a melting point in excess of 1,000° Fahrenheit.

**5.2.6 Pipe Joint Compound.** Screw joints shall be made up tight with approved pipe joint compound, or other approved material, which shall be applied to the male threads only.

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

**5.2.8 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.

**5.2.9 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 feet, except where adequate support and protection is provided by structural members. Solid-iron-pipe oil supply connection(s) shall be rigidly anchored

to a structural member within six inches (6") of the supply connection(s).

**5.2.10 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 a maximum capacity for the final check for oil leakage.

## 6. Heat-Producing Appliances

**6.1 General.** Every heat-producing appliance used in recreational vehicles shall be listed by a nationally recognized testing laboratory for the application for which the appliance is intended. Fuel-burning appliances shall be specifically listed or labelled for installation in recreational vehicles.

**6.2 Fuel Conversion.** Fuel-burning appliances shall not be converted from one fuel to another unless converted in accordance with the terms of their listings.

### 6.3 Installations and Instructions.

**6.3.1** 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 provide the manufacturer's instructions in the recreational vehicle. Appliances shall be secured in place to avoid displacement and movement from vibration and road shock.

**6.3.2** Operating instructions shall be provided with the appliance.

**6.3.3** Fuel-burning heating appliances and refrigerators shall be of the vented-type and vented to the outside. In no case shall the vent of a gas-burning appliance terminate underneath the recreational vehicle.

**6.3.4** Fuel-burning heat-producing appliances, except ranges and illuminating appliances, shall be designed or installed to provide for a complete separation of the combustion system from the atmosphere of the recreational vehicle. Combustion air inlets and flue gas outlets shall be listed or certified as components of the appliance.

**6.3.5** A fuel-burning refrigerator shall be designed or installed to provide for complete separation of the combustion system from the atmosphere of the recreational vehicle. It shall be installed in accordance with the provisions of its approval and listing.

#### **6.4 Venting.**

**6.4.1** Vents, roof jacks, and special fittings supplied as component parts of an appliance shall be installed in conformity with the terms of their listing. A single wall metal vent shall not be used unless it is a component part of a listed appliance.

**6.4.2** Every joint of any vent or vent connector shall be secure, rigid, tight, and of approved design and workmanship.

#### **6.5 Marking.**

**6.5.1** Information on clearances, input ratings, lighting and shutdown shall be attached to the appliances with the same permanence as the nameplate, and so located that it is easily readable when the appliance is properly installed.

**6.5.2** Each fuel-burning appliance shall bear the appliance manufacturer's permanent marking designating the type(s) of fuel for which it is listed. If listed and installed for use with either LP-gas or natural gas, the appliance manufacturer's permanent instructions regarding conversion from one fuel to the other shall be supplied.

**6.6 Accessibility.** Every appliance shall be accessible for inspection, service, repair, and replacement without removing permanent construction. Sufficient room shall be available to enable the operator to observe the burner, control, and ignition means while starting the appliance.

**6.7 Location.** Heat-producing appliances shall be so located that doors, drapes, or other such material cannot be placed or swung closer to the front of the appliance than the clearances specified on the labelled appliances.

#### **6.8 Clearances.**

**6.8.1** Clearances between heat-producing appliances and adjacent surfaces shall be not less than as specified in the terms of their listing. Clearance spaces shall be framed in or guarded to prevent creation of storage space within the clearance specified.

**6.8.2 Ranges.** Ranges shall have a vertical clearance between the cooking top and combustible material or metal cabinets, in accordance with Table 7 or the terms of their listings.

Table 7

Type of Protection Provided to Combustible Material or Metal Cabinets above Range	Top Burner Rating (BTUH)	Oven Burner Rating (BTUH)	Vertical Clearance Required above Range Top (inches)
1. No protection provided.	Any combination, number, or input.	Any	30
2. $\frac{1}{4}$ -inch thick minimum asbestos mill-board covered with 28 U.S. gauge sheet metal extending 9 inches beyond the sides of the range and covering the entire bottom of the material to be protected extending over the top of range. In lieu of 28 gauge sheet metal, a hood, 28 U.S. gauge sheet metal, may be used. Hood shall be not less than the width of the range and shall be centered over the range and cover the entire bottom of the material to be protected.	Any combination, number, or input.	Any	24
3. Range hood, 28 U.S. gauge, with minimum 2-inch vertical sides and provided with a bead or flange around top of hood to provide a minimum $\frac{1}{4}$ -inch dead air space between hood and protected material. Hood shall be not less than the width of the range and shall be installed centered over range and cover the entire bottom of the material to be protected extending over the top of range.	Not more than four top burners — input not to exceed 6,000 BTUH each.	10,000	19 $\frac{1}{2}$
	Not more than four top burners — input not to exceed 9,000 BTUH each.	24,000	20 $\frac{3}{4}$
	Two rear burners — inputs not to exceed 9,000 BTUH each and two front burners, inputs not to exceed 12,000 BTUH each.	22,000	23 $\frac{1}{2}$
4. Same as No. 3, except no dead air space clearance provided.	Not more than four burners — input not to exceed 9,000 BTUH each.	22,000	23

## 6.9 Ventilation.

**6.9.1** The area in which any fuel-burning cooking appliance is located shall be ventilated by a gravity vent opening not less than twelve and one-half square inches (12.5 sq. in.) in cross-sectional area, located higher than the appliance, or, by mechanical ventilating equipment that is installed in accordance with the terms of its listing and the manufacturer's instructions. Gravity or mechanical ventilation shall be installed within a horizontal distance of not more than ten feet (10') from the vertical front of the appliance. Vent hood ducts shall be designed so that the duct outlet is located at such a point as to preclude the trapping of products of combustion. Ducts shall extend through the wall or roof to the outer air.

## 6.10 Air Ducts.

**6.10.1 Material.** Supply ducts shall be made of galvanized steel, tin-plated steel, or aluminum, or shall be listed Class I air ducts. A duct system integral with the structure may be acceptable if it is 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. Portions of return ducts directly above the heating surface of the appliance, or closer than 2 feet horizontally from the outer jacket or casing of the appliance, shall be constructed in accordance with the requirements of Table 8 or shall be listed Class I air ducts.

**Table 8**  
**Minimum Metal Thickness for Ducts\***

	Diameter	or	Width
	14 inches or less		Over 14 inches
Round Exposed	0.013 in.		0.016 in.
Enclosed Rectangular or Round	0.013 in.		0.016 in.
Exposed Rectangular	0.016 in.		0.019 in.

\*When "nominal" thicknesses are specified, 0.003 inch shall be added to these "minimum" metal thicknesses.

**6.10.2 Sizing of Ducts.** Ducts shall be designed so that when a labeled forced-air furnace is installed and operated continually at

its normal input rating in the recreational vehicle, with all registers in full open position, the static pressure measured in the duct plenum shall not exceed that shown on the label of the appliance. When an air-cooling coil is installed in the system, the total static pressure of the coil and the system shall not exceed that shown on the label of the appliance. The minimum dimension of any branch duct shall be at least one and one-half inches ( $1\frac{1}{2}$ " ) and of any main duct, two and one-half inches ( $2\frac{1}{2}$ " ).

**6.10.3 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 one inch (1" ) and shall be individually fastened. Tape or caulking compound may be used for sealing mechanically secure joints. Where used, tape or caulking compound shall not be subject to deterioration under long exposures to temperatures up to 200° Fahrenheit and to conditions of high humidity, excessive moisture, or mildew.

**6.10.4 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. Pressures shall be measured with a water manometer or equivalent device calibrated to read in increments not greater than one-tenth inch ( $1/10$ " ) water column.

**6.10.5 Supports.** Ducts shall be securely supported.

### 5.11 Circulating Air.

**6.11.1 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.

**6.11.2 Return Air Ducts.** The cross-sectional area of the return air duct shall not be less than 2 square inches for each 1,000 Btu per hour input rating of the appliance. Dampers shall not be placed in any return air duct, except that a diverting damper may be placed in a combination fresh air intake and return air duct so arranged that the required cross-sectional area will not be reduced at all possible positions of the damper.

**6.11.3 Permanent Unclosable Openings.** Living areas not served by return air ducts and closed off from the return opening of the furnace by doors, sliding partitions, or other means, shall

be provided with permanent unclosable openings in the doors or separating partitions to allow circulated air to return to the furnace. Such openings may be grilled or louvered. The net free area of each opening shall be not less than one square inch (1 sq. in.) for every five square feet (5 sq. ft.) of total living area closed off from the furnace by the door or partition serviced by that opening. Under-cutting doors connecting the closed-off area may 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 two inches (2") and no more than two and one-half inches (2½") and no more than one-half of the free air area so provided shall be considered as return air area.

## APPENDIX TO PART II

### Applicable Standards

**Table 9**  
**Standards for Air Conditioning and Heat-Producing**  
**Appliances and Equipment†**

Type	ANSI (Formerly ASA, USASI)	UL	Other
<i>Appliances</i>			
Liquid Fuel-Burning Heating Appliances for Mobile Homes and Recreational Vehicles.....		307(a) 1965	
Gas-Heating Appliances for Mobile Homes and Recreational Vehicles.....	Z21.44-1968* Z21.47-1968 Z21.48-1968*	307(b) 1965	
Clothes Dryers (Gas-Fired)....	Z21.5.1-1966	307(b) 1965	
Gas-Fired Gravity and Forced Air Central Furnaces.....	Z21.47-1968		
Gas-Fired Gravity and Fan Type Floor Furnaces.....	Z21.48-1968*		
Gas-Fired Gravity and Fan Type Sealed Combustion System Wall Furnaces.....	Z21.44-1968*		
Gas-Fired Illuminating Appliances.....	Z21.42-1963	307(b) 1965	
Domestic Gas Ranges, Free Standing.....	Z21.1.1-1968*	307(b) 1965	
Domestic Gas Ranges, Built-in Domestic Cooking Units....	Z21.1.2-1968*	307(b) 1965	
Refrigerators Using Gas-Fuel	Z21.19-1966*	307(b) 1965	
Automatic Storage Type Water Heaters with Input Less than 50,000 BTUH.....	Z21.10.1-1966	307(b) 1965	
Incinerator, Domestic Gas Fired (toilets).....	Z21.6-1968*		NSF-No. 24
<i>Ferrous Pipe and Fittings</i>			
Black and Hot Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses.....	B36.20-1966		ASTM A120-68 WW-P-406b (2) '68

Type	ANSI (Formerly ASA, USASI)	UL	Other
<i>Ferrous Pipe and Fittings (Continued)</i>			
Pipe Threads . . . . .	B2.1-1968		
Wrought-Steel and Wrought-Iron Pipe . . . . .	B36.10-1959		
<i>Nonferrous Pipe, Tubing and Fittings</i>			
Seamless Copper Water Tube . . . . .	H23.1-1967		ASTM B88-66
Seamless Copper Tube for Air Conditioning and Refrigeration Field Service . . . . .	H23.5-1967		ASTM B280-66
Metal Connectors for Gas Appliances . . . . .	Z21.24-1968*		
Manually Operated Gas Valves . . . . .	Z21.15-1966*		
Mobile Home Gas Connectors (Flexible Metal — Plastic Coated) . . . . .			IAPMO-TSC-9-63
Seamless Copper and Copper Alloy Pipe and Tube . . . . .	H23.4-1967		ASTM B251-67
Seamless Copper Pipe, Standard Sizes . . . . .	H26.1-1967		ASTM B42-66 WW-P-377d '62
<i>Miscellaneous</i>			
Air Ducts . . . . .		181-69	
Flame Tests of Flame-Resistant Fabrics . . . . .		214-55	
Tube Fittings for Flammable and Combustible Fluids and Refrigeration Service . . . . .		109-66	
LPG Containers and Accessories . . . . .			ASME, DOT
Pigtails, Expansion Coils and Flexible Hose Connectors for LP-Gas . . . . .		569-59	
Roof Jacks for Mobile Homes and Travel Trailers . . . . .		311-69	
Safety Devices — Appliances . . . . .	Z21.22-1965* Z21.20-1968 Z21.23-1968 (R) Z21.21-1968		
Gas Vents . . . . .	A131.2-1964	441-69	
Factory-Built Chimneys . . . . .	A131.1-1964	103-69	
Installation of Oil Burning Equipment . . . . .	Z95.1-1968		NFPA No. 31-1968
Installation of Gas Appliances and Gas Piping in Buildings . . . . .	Z21.30-1964		NFPA No. 54-1969
Storage and Handling of Liquefied Petroleum Gas . . . . .	Z106.1-1967		NFPA No. 58-1969

Type	ANSI (Formerly ASA, USASI)	UL	Other
Residence Type Warm Air Heating and Air Conditioning Systems . . . . .			NFPA No. 90B-1968
Chimneys, Fireplaces, and Venting Systems . . . . .	A52.1-1969		NFPA No. 211-1969
Standard Glossary of Terms Relating to Chimneys, Gas Vents, and Heat Producing Appliances . . . . .			NFPA No. 97M-1968

\*With Addenda

†Dates shown are latest editions at time of printing including the dates of any Addenda issued.

### Notes to Table 9

AGA: Standards and Tentative Standards, published by the *American Gas Association, Inc. Laboratories*, 8501 East Pleasant Valley Road, Cleveland (Independence), Ohio 44131.

ANSI: *American National Standards Institute* (formerly American Standards Association and United States of America Standards Institute), 1430 Broadway, New York, N. Y. 10018.

ASME: Standards and Tentative Standards published by the *American Society of Mechanical Engineers*, 345 East 47th Street, New York, N. Y. 10017.

ASTM: Standards and Tentative Standards published by the *American Society for Testing and Materials*, 1916 Race Street, Philadelphia, Pa. 19103.

DOT: Regulations published in the Federal Code of Regulations for the *Department of Transportation*. Title 49, Parts 171-190 of the CFR are applicable. Available from the U. S. Government Printing Office, Washington, D. C. 20234.

IAPMO: Standards published by the *International Association of Plumbing and Mechanical Officials*, 5032 Alhambra Avenue, Los Angeles, California 90032. (Formerly Western Plumbing Officials Association (WPOA)).

UL: Standards and Tentative Standards published by the *Underwriters' Laboratories, Inc.*, 207 East Ohio Street, Chicago, Illinois 60611.

NFPA: National Fire Protection Association, 60 Batterymarch Street, Boston, Mass. 02110.

## Part III — Electrical Systems

### 1. Introduction

**1.1** Electrical engineers associated with the design, manufacturing, installation, and inspection of recreational vehicle electrical systems have been aware of the need for uniform technical standards leading to the safe use of this special type of equipment. They have also recognized that because of conditions of transport and use, existing electrical equipment standards for motor vehicles or for buildings are not completely applicable to recreational vehicles. It is with these factors in mind that Part III of this Standard has been developed.

**1.2** Much of the material in Part III has been taken from, or is based on the National Electrical Code (American National Standard C1 — 1968) and standards listed in the Appendix of this Part.

### 2. Scope

**2.1** Part III of this Standard covers the electric conductors and equipment installed within or on recreational vehicles and also the conductors that connect them to a supply of electricity.

**2.2** This Standard is not intended as a design specification or an instruction manual for untrained persons.

**2.3** The provisions of this Standard are not intended to prevent the use of any material, appliance, installation, device, arrangement, or method of construction not specifically prescribed herein, provided any such alternative has been approved or listed. The enforcement authority shall approve such alternate if the material, appliance, installation, device, arrangement or method of construction is at least the equivalent of that prescribed by this Part, and may require tests or proof of compliance, to substantiate any claims that may be made regarding the use of any such alternate.

### 3. Definitions

**\*Accessible (as applied to equipment):** Admitting close approach because not guarded by locked doors, elevation or other effective means. (See **Readily Accessible**.)

\*Definition identical to that appearing in the National Electrical Code.

**Accessible (as applied to wiring methods):** Not permanently closed in by the structure or finish of the recreational vehicle; capable of being removed without disturbing the recreational vehicle structure or finish. (See **Concealed** and **Exposed**.)

**Air-Conditioning or Comfort Cooling Equipment:** All of that 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.

**\*Ampacity:** Current-carrying capacity expressed in amperes.

**\*Appliance:** Utilization equipment, generally other than industrial, normally built in standardized sizes or types which is installed or connected as a unit to perform one or more functions such as clothes washing, air conditioning, food mixing, deep frying, etc.

**\*Appliance — Fixed:** An appliance which 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.

NOTE: For the purpose of this Standard the following major appliances are considered portable if cord connected: Refrigerators, clothes washers, dishwashers without booster heaters, or other similar appliances.

**\*Appliance — Stationary:** An appliance which is not easily moved from one place to another in normal use.

**Approved:** Means acceptable to the authority having jurisdiction.

**\*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.

**\*Automatic:** Self-acting, operating by its own mechanism when actuated by some impersonal influence, as for example, a change in current strength, pressure, temperature, or mechanical configuration.

**\*Bonding Jumper:** A reliable conductor to assure the required electrical conductivity between metal parts required to be electrically connected.

**\*Bonding Jumper — Circuit:** The connections between portions of a conductor in a circuit to maintain required ampacity of the circuit.

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\*Definition identical to that appearing in the National Electrical Code.

**\*Branch Circuit:** That portion of a wiring system extending beyond the final overcurrent device protecting the circuit.

NOTE: 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 circuit supplying energy to one or more outlets to which appliances are to be connected; such circuits 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.

**\*Branch Circuit — Multiwire:** A circuit consisting of two or more ungrounded conductors having a potential difference between them and an identified grounded conductor having equal potential difference between it and each ungrounded conductor of the circuit and which is connected to the neutral conductor of the system.

**\*Cabinet:** An enclosure designed either for surface or flush mounting, and provided with a frame, mat or trim in which swinging doors are 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 recreational vehicle. Wires in concealed raceways are considered concealed, even though they may become accessible by withdrawing them.

#### **Conductor:**

**\*Bare:** A conductor having no covering or insulation whatsoever. (See **Conductor, Covered.**)

**\*Covered:** A conductor having one or more layers of non-conducting materials that are not recognized as insulation under the code. (See **Conductor, Bare.**)

**\*Insulated:** A conductor covered with material recognized as insulation.

\*Definition identical to that appearing in the National Electrical Code.

**\*Connector, Pressure (Solderless):** A device that establishes the 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.

**Converter:** A device which changes electrical energy from one form to another, as from alternating current to direct current.

**\*Cooking Unit, Counter-Mounted:** An assembly of one or more domestic surface heating elements for cooking purposes designed for flush mounting in, or supported by, a counter, and which assembly is complete with inherent or separately mountable controls and internal wiring. (See **Oven, Wall-Mounted.**)

**Dead Front (as applied to switches, circuit-breakers, switchboards, and distribution panelboards):** So designed, constructed and installed that no current-carrying parts are normally exposed on the front.

**\*Demand Factor:** The demand factor of any system, or part of a system, is the ratio of the maximum demand of the system, or part of a system, to the total connected load of the system, or of the part of the system under consideration.

**\*Device:** A unit of an electrical system that is intended to carry but not utilize electrical energy.

**Direct Current (DC):** A non-alternating flow of energy within a circuit having an electromotive force or potential (not exceeding 25 volts, for the purposes of this Standard).

**Disconnecting Means:** The necessary equipment usually consisting of circuit breaker or switch and fuses, and their accessories, located near the point of entrance of supply conductors in a recreational vehicle and intended to constitute the means of cutoff for the supply to that recreational vehicle.

NOTE: Receptacles used as disconnecting means shall be accessible (as applied to wiring methods) and capable of interrupting their rated current without hazard to the operator.

**Distribution Panelboard:** A single panel or group of panel units designed for assembly in the form of a single panel; including buses, and with or without switches and/or automatic overcurrent protective devices for the control of light, heat or power circuits of small individual as well as aggregate capacity; designed to be placed in a cabinet or cutout box placed in or against a wall or partition and accessible only from the front.

\*Definition identical to that appearing in the National Electrical Code.

**\*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 (as applied to live parts):** A live part that can be inadvertently touched or approached nearer than a safe distance by a person. It is applied to parts not suitably guarded, isolated, or insulated. (See Accessible and Concealed.)

**\*Exposed (as applied to wiring method):** Not concealed.

**\*Externally Operable (as applied to equipment that is enclosed in a case or cabinet):** Capable of being operated without exposing the operator to contact with live parts.

**\*Feeder:** A feeder is the circuit conductors between the service equipment, or the generator switchboard of an isolated plant, and the branch circuit overcurrent device.

**\*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 which 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.

**\*Grounding Conductor, Equipment:** A conductor used to connect the equipment being grounded to the service equipment enclosure.

**\*Isolated:** Not readily accessible to persons unless special means for access are used.

**Labeled:** Equipment or materials to which has been attached a label, symbol, or other identifying mark of a nationally recognized

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\*Definition identical to that appearing in the National Electrical Code.

testing laboratory that maintains periodic inspection of production of labeled equipment or materials and by whose labeling is indicated compliance with nationally recognized standards or tests to determine suitable usage in a specified manner.

**\*Lighting Outlet:** An outlet intended for the direct connection of a lampholder, a lighting fixture or a pendant cord terminating in a lampholder.

**Listed:** Equipment or materials included in a list published by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

**\*Nonautomatic:** The implied action requires personal intervention for its control.

**\*Outlet:** A point on the wiring system at which current is taken to supply utilization equipment.

**\*Oven, Wall Mounted:** A domestic oven for cooking purposes designed for mounting in or on a wall or other surface.

**Power Supply Assembly:** The conductors, including the grounding conductors, insulated from one another, the connectors, attachment plug caps, and all other fittings, grommets, or devices installed for the purpose of delivering energy from the source of electrical supply to the distribution panel within the recreational vehicle.

**Raceway:** Any channel for holding wires, cables, or bus bars that is designed expressly for, and used solely for, this purpose. Raceways may be of metal or insulating material and the term includes rigid metal conduit, flexible metal conduit, electrical metallic tubing, underfloor raceways, cellular metal floor raceways, surface metal raceways, wireways, and busways and rigid nonmetallic conduit.

**\*Raintight:** So constructed or protected that exposure to a beating rain will not result in the entrance of water.

**\*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, etc. (See **Accessible**.)

**\*Receptacle Outlet:** An outlet where one or more receptacles are installed.

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\*Definition identical to that appearing in the National Electrical Code.

**\*Receptacle (Convenience) Outlet:** A receptacle is a contact device installed at an outlet for the connection of an attachment plug and flexible cord.

**Transformer:** A device, which when used, will raise or lower the voltage of alternating current of the original source.

**\*Utilization Equipment:** Equipment that utilizes electric energy for mechanical, chemical, heating, lighting, or similar useful purposes.

**\*Ventilated:** Provided with a means to permit circulation of air sufficient to remove an excess of heat, fumes or vapors.

**Voltage (of a Circuit):** The greatest effective difference of potential between any two conductors of the circuit concerned.

**\*Watertight:** So constructed that moisture will not enter the enclosing case.

**\*Weatherproof:** So constructed or protected that exposure to the weather will not interfere with successful operation.

Raintight or watertight equipment may fulfill the requirements for "weatherproof". However, weather conditions vary and consideration should be given to conditions resulting from snow, ice, dust, or temperature extremes.

#### 4. Batteries and Direct-Current Power (Twelve Volts Nominal)

**4.1 Battery Circuits.** Battery circuits furnished and installed by the recreational vehicle manufacturer, other than those related to braking, are subject to this Standard. Circuits supplying lights subject to Federal or State regulations shall be in accordance with applicable government regulations but shall not be lower than provided by this Standard.

#### 4.2 Low-Voltage Wiring Materials.

**4.2.1** Copper conductors shall be used for low-voltage circuits.

**4.2.2** The insulation of low-voltage conductors used in battery and direct current circuits shall be rated at least 60°C.

**4.2.3** Conductors furnished and installed by the recreational vehicle manufacturer shall have a minimum of one thirty-second inch ( $\frac{1}{32}$ " ) of thermoplastic insulation or equal.

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\*Definition identical to that appearing in the National Electrical Code.

4.2.4 The insulation of outdoor or under-chassis wire shall be moisture and heat resistant, Type THW or equivalent.

4.2.5 Single-wire, low-voltage conductors shall be of the stranded type.

### 4.3 Low-Voltage Wiring Methods.

4.3.1 Conductors shall be protected against physical damage and shall be adequately supported. Where insulated conductors are clamped to the structure, the conductor insulation shall be supplemented by an additional wrap or layer of equivalent material, except that jacketed cables need not be so protected. Wiring shall be routed away from sharp edges, moving parts or heat sources.

4.3.2 Splices and connections shall be made in accordance with Society of Automotive Engineers (SAE) standards and recommended practices or equivalent.

4.3.3 Battery and direct-current circuits shall be physically separated by at least a one-half inch ( $\frac{1}{2}$ " ) gap, or other approved means, from circuits of a different power source. This may be accomplished by clamping, routing, or equivalent means which ensure permanent total separation.

4.4 **Battery Installations.** Storage batteries subject to the provisions of this Standard shall be securely attached to the vehicle and installed in an area which is ventilated directly to the exterior of the vehicle.

### 4.5 Overcurrent Protection.

4.5.1 Battery and direct-current circuit wiring shall be protected by overcurrent protective devices rated not in excess of the ampacity of copper conductors, as follows:

<u>Wire Size</u>	<u>Ampacity</u>	<u>Wire Type</u>
18	3	Stranded only
16	9	Stranded only
14	15	Stranded or solid
12	20	Stranded or solid
10	30	Stranded or solid

NOTE: For other allowable conductor ampacities, refer to the National Electrical Code (ANSI C1-1968), Table 310-12.

**4.5.2** Circuit breakers or fuses shall be of the listed or approved type, including automotive types conforming to the requirements of Society of Automotive Engineers (SAE) J554 — 1968 or Underwriters' Laboratories, Inc. Standard 275b. Fuseholders shall be clearly marked with maximum fuse size.

**4.5.3** Higher current-consuming direct-current appliances such as pumps, compressors, heater blowers and similar motor-driven appliances shall be installed in accordance with the manufacturer's instructions.

**4.5.4** The overcurrent protective device shall be installed in an accessible location on the vehicle as close as practical to the point where the power supply connects to the vehicle circuits. If located outside the recreational vehicle, the device shall be protected against weather and physical damage.

## **5. Combination Electrical Systems**

**5.1 General.** Vehicle wiring suitable for connection to a battery or direct-current supply source may be connected to a 120-volt source provided that the entire wiring system and equipment are rated and installed in full conformity to Section 7 of this Standard covering 120-volt electrical systems. Circuits fed from alternating-current transformers shall not supply direct-current appliances.

**5.2 Voltage Converters (120-volt Alternating Current to Low Voltage Direct Current).** The 120-volt alternating current side of voltage converters shall be wired in full conformity with the provisions of Section 7 of this Standard for 120-volt electrical systems. Converters supplied as an integral part of a listed appliance are not subject to the above. All converters and transformers shall be listed or approved by a nationally recognized testing laboratory.

**5.3 Dual-Voltage Fixtures or Appliances.** Fixtures or appliances having both 120-volt and low-voltage connections shall be listed or approved as dual voltage by a nationally recognized testing laboratory.

**5.4 Autotransformers.** Autotransformers are prohibited.

**5.5 Receptacles and Plug Caps.** When a recreational vehicle is equipped with separate external connections for a 120-volt alternating-current system and a battery or direct-current system, receptacles and plug caps shall be of different configurations.

## **5.6 Identification.**

**5.6.1** When a vehicle equipped with a battery or direct-current system has an external connection for low-voltage power, the receptacle shall have a configuration that will not accept 120-volt power. The vehicle shall have permanently affixed on the outside wall adjacent to the point of entrance of the power supply conductors a tag which reads:

**THIS CONNECTION IS FOR LOW-VOLTAGE BATTERY OR DIRECT CURRENT ONLY. DO NOT CONNECT TO 120 OR 240 VOLTS AC.**

**5.6.2** The tag shall be 3 inches by 1¾ inches minimum size, made of etched, metal-stamped or embossed brass, stainless steel, anodized or alclad aluminum not less than 0.020 inch thick, or other approved material (e.g., 0.005 inch plastic laminates).

## **6. Generator Installations**

**6.1 Mounting.** Generators shall be mounted in such a manner as to be effectively electrically bonded to the recreational vehicle chassis.

**6.2 Generator Protection.** Equipment shall be installed to ensure that the generator is disconnected when the vehicle is energized from an outside source and to ensure that the outside source is disconnected when the vehicle is energized by the generator. The generator field shall be protected by appropriately rated equipment which has been listed.

**6.3 Installation of Storage Batteries and Generators.** Storage batteries and internal-combustion-driven generator units (subject to the provisions of this Standard) shall be secured in place to avoid displacement from vibration and road shock and shall be installed in a compartment which is vapor-tight to the interior of the vehicle.

**6.4 Ventilation of Generator Compartments.** Compartments accommodating internal-combustion-driven generator units shall be provided with approved ventilation in accordance with instructions provided by the manufacturer of the generator unit.

**6.5 Location of Internal-Combustion-Engine Generator Exhaust.** Exhaust from generator internal-combustion engines shall not terminate adjacent to the vehicle gasoline tank filler spout inlet.

## 7. Nominal 120 or 120/240 Volt Systems

**7.1 General Requirements.** The electrical equipment and material of recreational vehicles indicated for connection to a wiring system nominally rated 120 volts, 2 wire with ground, or a wiring system nominally rated 120/240 volts, 3 wire with ground, shall be approved and installed in accordance with the requirements of the National Electrical Code (ANSI C1 — 1968).

**7.2 Materials and Equipment.** Electrical materials, devices, appliances, fittings and other equipment installed, intended for use in, or attached to the recreational vehicle shall be listed by a nationally recognized testing laboratory.

### 7.3 Circuit or Branch Circuits Required.

**7.3.1** The circuit or branch circuits required in a recreational vehicle shall conform to 7.14.1 and be determined in accordance with 7.3.1.1, 7.3.1.2 or 7.3.1.3.

**7.3.1.1** Recreational vehicles with not more than eight (8) lighting and receptacle outlets combined shall have either:

a. One general purpose circuit, 15 amperes, No. 14 AWG minimum, copper or listed equal, to supply these outlets, provided the total rating of fixed appliances connected to this circuit does not exceed five amperes or 600 watts, *or*

b. One general purpose circuit, 20 amperes, No. 12 AWG minimum, copper or listed equal, to supply these outlets, provided the total rating of fixed appliances connected to this circuit does not exceed nine amperes or 1,000 watts.

Vehicles wired in accordance with a. or b. shall not be equipped with electrical heating or cooking appliances.

**7.3.1.2** Recreational vehicles with more than eight (8) lighting and receptacle outlets combined shall have one appliance branch

circuit, 20 amperes, No. 12 AWG minimum, copper or listed equal, and either:

a. One branch circuit, 15 amperes, No. 14 AWG minimum, copper or listed equal, to supply these outlets, provided this circuit does not supply receptacles in the cooking and dining area(s) or electrical heating or cooking appliances, and provided the total rating of fixed appliances connected to this circuit does not exceed five amperes or 600 watts, or

b. One branch circuit, 20 amperes, No. 12 AWG minimum, copper or listed equal, to supply these outlets, provided this circuit does not supply receptacles in the cooking and dining area(s) or electrical heating or cooking appliances and provided the total rating of fixed appliances connected to this circuit does not exceed nine amperes or 1,000 watts.

**7.3.1.3 Calculations for Lighting and Appliance Load.** When 7.3.1.2 (relative to recreational vehicles with more than eight (8) lighting and receptacle outlets combined) is not applied, the following method shall be employed in computing the power supply or feeder assembly and distribution panelboard load for the recreational vehicle:

- A. *Lighting:* Length times width of vehicle (outside dimensions, exclusive of hitch and cab) times three watts per square foot, e.g.,  
 Length  $\times$  width  $\times$  3 = \_\_\_\_\_ lighting watts.
- B. *Small Appliance:* Number of circuits times 1,500 watts for each 20 ampere appliance receptacle circuit, e.g.,  
 Number of Circuits  $\times$  1,500 = \_\_\_\_\_ small appliance watts.
- C. *Total:* Lighting watts plus small appliance watts = \_\_\_\_\_ total watts.
- D. First 3,000 total watts at 100 per cent plus remainder at 35 per cent = \_\_\_\_\_ watts to be divided by voltage to obtain current (amperes) per leg.

Amperes per Leg	
A	B
Lighting and small appliance current (amperes) per leg (from D above) = _____	
E. Add name plate amperes for motors and heater loads (exhaust fans, air conditioners,* electric, gas, or oil heating*) = _____	
F. Add 25 per cent of amperes of largest motor in (E) = _____	

\*Omit smaller of these two except include blower motor if used as air conditioner evaporator motor.

G. Add name plate amperes for:\*\*

Disposal \_\_\_\_\_

Water Heater \_\_\_\_\_

Wall-Mounted Ovens \_\_\_\_\_

Cooking Units \_\_\_\_\_

TOTAL \_\_\_\_\_ = \_\_\_\_\_

H. Add amperes for free-standing range as distinguished from separate ovens and cooking units. Derive from following table by dividing watts by 230 volts.

Range	Name Plate Rating	Use
(Free standing range as distinguished from separate oven and cooking units)	10,000 w or less	80 per cent of rating
	10,001-12,500 w	8,000 w
	12,501-13,500 w	8,400 w
	13,501-14,500 w	8,800 w
	14,501-15,500 w	9,200 w
	15,501-16,500 w	9,600 w
	16,501-17,500 w	10,000 w

**Amperes per Leg**

A                      B

I. If outlets or circuits are provided for other than factory-installed major appliances, the anticipated load shall be added for each.

TOTAL = \_\_\_\_\_

When the total for Legs A and B are unequal, use the larger to determine the distribution panel and supply cord rating.

(Service amperes shall not exceed supply cord rating. See 7.7.1.5.)

\*\*When number of appliances is four or more use 75 per cent of total.

## 7.4 Receptacle Outlets Required.

7.4.1 Except in the bath and hall areas, receptacle outlets shall be installed at wall spaces two feet (2') wide or more, so that no point along the floor line is more than six feet (6'), measured horizontally, from an outlet in that space. Except as explained in the following, receptacle outlets are not required for wall spaces occupied by kitchen cabinets, wardrobe cabinets, built-in furniture, behind

doors which may open fully against a wall surface, or similar facilities. A receptacle outlet shall be installed:

a. Adjacent to counter tops in the kitchen (at least one on each side of the sink if counter tops are on each side and are twelve inches (12") or over in width).

b. Adjacent to the refrigerator and gas-range space, except when a gas-fired refrigerator or cooking appliance, requiring no external electrical connection, is factory installed.

c. Adjacent to counter top spaces (and built-in vanities) which cannot be reached from a receptacle required in 7.4.1. a by a cord of six feet (6') without crossing a traffic area, cooking appliance or sink.

**7.4.2** When installed adjacent to a bathroom lavatory, the receptacle outlet shall be a minimum of thirty inches (30") from the floor. The receptacle outlet may be contained in a listed lighting fixture. A receptacle outlet shall not be installed in a tub, shower enclosure, or combination shower compartment.

## **7.5 Distribution Panelboard.**

**7.5.1** A listed and appropriately rated distribution panelboard shall be used. The distribution panelboard shall be of the insulated neutral type, with the grounding bar attached to the metal frame of the panelboard or other approved grounding means.

**7.5.2** The distribution panelboard shall be installed in a readily accessible location and may be located in a closet.

**7.5.3** The distribution panelboard shall be of the dead-front type and shall consist of one or more circuit breakers or shall be Type S plug fuses. A main disconnecting means shall be provided where fuses are used or where more than two circuit breakers are employed.

## **7.6 Branch Circuit Protection.**

**7.6.1** The branch-circuit overcurrent devices shall be rated:

- a. Not more than the circuit conductors; and
- b. Not more than 150 per cent of the rating of a single appliance rated 10-amperes or more; but
- c. Not more than the fuse size marked on the air conditioner or other motor-operated appliance.

**7.6.2** A 20-ampere fuse or circuit breaker shall be considered adequate protection for fixture leads, cords, or portable appliances,

and No. 14 AWG (American Wire Gage) tap conductors, not over 6 feet long for recessed lighting fixtures.

7.6.3 If more than one outlet or load is on a branch-circuit, a 15-ampere receptacle shall be considered protected by a 20-ampere fuse or circuit breaker.

## 7.7 Power Supply Assembly.

### 7.7.1 General.

7.7.1.1 Recreational vehicles wired in accordance with 7.3.1.1.a. shall use a listed 15-ampere, or higher, main power supply assembly. (See 7.8.1, 7.8.1.2.a, and 7.8.2.)

7.7.1.2 Recreational vehicles wired in accordance with 7.3.1.1.b. shall use a listed 20-ampere, or higher, main power supply assembly. (See 7.8.1, 7.8.1.2.b, and 7.8.2.)

7.7.1.3 Recreational vehicles wired in accordance with 7.3.1.2 or 7.3.1.3 shall use a listed 30-ampere, or higher, main power supply assembly. (See 7.8.1, 7.8.1.2.c, and 7.8.2.)

7.7.1.4 In accordance with 7.3.1.3, any recreational vehicle with a rating in excess of 30-amperes, 115 volts, shall use a listed 40-ampere or 50-ampere 120/240 volt power supply assembly (C 73.17 — 1966 configuration). (See 7.8.1, 7.8.1.2.d, and 7.8.2.)

*Exception: When the calculated load of the recreational vehicle exceeds 30 amperes, 120 volts, a second power supply cord may be installed when permitted by the authority having jurisdiction. Where a two cord supply system is installed, they shall not be interconnected on either the line side or the load side. The grounding circuits and grounding means shall be electrically interconnected.*

### 7.7.1.5 Dual Supply Source.

a. Where a dual supply system, consisting of a generator and a power supply cord is installed, the feeder from the generator shall be protected by an overcurrent-protective device. Installation shall be in accordance with Sections 6.1 and 6.2.

b. Calculation of loads shall be in accordance with 7.3.1.3

c. The two supply sources need not be of the same capacity.

d. If the generator source exceeds 30-amperes, 115 volts, it may be wired either as a 120 volt system or a 120/240 volt system, providing an overcurrent-protective device of the proper rating is installed in the feeder.

e. The external-power-supply assembly may be less than the calculated load but not less than 30 amperes and shall have overcurrent protection not greater than the capacity of the external power supply assembly.

## 7.8 Means for Connecting to Power Supply.

**7.8.1 Assembly.** The power supply assembly or assemblies shall be factory supplied (see 7.8.1.a.) or factory installed when of the permanently connected type as specified in 7.8.1.b.

a. **Separable.** When a separable power supply assembly consisting of a cord with a female connector and molded attachment plug cap is provided, the vehicle shall be equipped with a permanently mounted, listed or approved, male-recessed-type motor base receptacle wired directly to the distribution panel by an approved wiring method. The attachment plug cap shall be of an approved or listed type. (See 7.7.1.1, 7.7.1.2, 7.7.1.3, 7.7.1.4.)

b. **Permanently Connected.** Each power supply assembly shall be connected directly to the terminals of the distribution panel or conductors within an approved junction box and provided with means to prevent strain from being transmitted to the terminals. The conductors between each junction box and the terminals of each distribution panel shall be equal to the ampacity of the power supply cord. The supply end of the assembly shall be equipped with an attachment plug of the type described in 7.8.1.2. Where the cord passes through the walls or floors, it shall be protected by means of conduit and bushings or equivalent.

**7.8.1.1 Cord.** The cord set shall be listed as suitable for use with recreational vehicles.\* The cord shall be not less than 20 feet as measured from the point of entrance to the recreational vehicle or the face of the motor base attachment plug nor more than 26½ feet in length overall to the face of the attachment plug at the supply end.

### 7.8.1.2 Plug Caps.

a. Recreational vehicles having only one 15-ampere branch circuit as permitted by 7.3.1.1.a. shall have an attachment-plug cap which shall be two-pole, three-wire, grounding type, rated 15-amperes, 125 volts, conforming to American National Standard C73.11 — 1966.

b. Recreational vehicles having only one 20-ampere branch circuit as permitted in 7.3.1.1.b. shall have an attachment-plug cap which shall be two-pole, three-wire, grounding type, rated 20-amperes, 125 volts, conforming to American National Standard C73.12 — 1966.

c. Recreational vehicles wired in accordance with 7.3.1.2 or 7.3.1.3 shall have an attachment-plug cap which shall be two-

\*Until such time as cord sets so listed become available, this requirement may be met by cord sets listed as suitable for use with travel trailers.

pole, three-wire, grounding type, rated 30-amperes, 125 volts, conforming to American National Standard C73.13 — 1966, intended for use with units rated at 30-amperes, 125 volts, for 120 volt systems.

d. Recreational vehicles having a power supply assembly rated 40-amperes or 50-amperes as permitted by 7.3.1.3 shall have a 3-pole, 4-wire grounding type attachment-plug cap rated 50-amperes, 125/250 volts, conforming to American National Standard C73.17 — 1966.

**7.8.2 Labeling at Electrical Entrance.** Each recreational vehicle shall have permanently affixed to the exterior skin at or near the point of entrance of the power supply cord(s) a tag 3 inches by 1¾ inches minimum size, made of etched, metal-stamped or embossed brass, stainless steel, anodized or alclad aluminum not less than .020 inch thick, or other approved material (e.g., 0.005 inch plastic laminates), which reads, as appropriate, either:

a. "This connection is for 110-125 volt AC, 60 Hz (Cycles) service. Do not connect to higher voltage" or

b. "This connection is for 3-wire 120/240 volt AC, 60 Hz (Cycles), \_\_\_\_\_ ampere service."

**7.8.3 Location.** The point of entrance of a power supply assembly shall be located within twenty-five feet (25') of the rear, on the left (road) side or at the rear, left of the longitudinal center of the vehicle, within eighteen inches (18") of the outside wall.

*Exception. A camping trailer not more than seventeen feet (17') in length, a motor home or a truck camper may have the electrical point of entrance located on either side, provided the drain outlet and gas connections are located on the same side.*

## 7.9 Wiring Methods.

**7.9.1.** Electrical metallic tubing, flexible metallic conduit, metal-clad cable, and nonmetallic sheathed cable with a grounding conductor, shall terminate by means of fittings, clamps or connectors approved for the purpose. Flexible metal conduit may be used as a grounding means where both the conduit and the fittings are approved for the purpose.

**7.9.2** Rigid metal conduit shall be provided with a locknut inside and outside the box, and a conduit bushing shall be used on the inside. Inside ends of the conduit shall be reamed.

**7.9.3** Nonmetallic outlet boxes are acceptable only with non-metallic sheathed cable.

**7.9.4** In walls and ceilings constructed of wood or other combustible material, outlet boxes and fittings shall be flush with the finished surface or project therefrom.

**7.9.5** Wall and ceiling outlets shall be mounted in accordance with Article 370 of the National Electrical Code (ANSI C1 — 1968).

*Exception: Snap-in type boxes or boxes provided with special wall or ceiling brackets that securely fasten boxes in walls or ceilings may be used.*

**7.9.6** The sheath of nonmetallic cable or the armor of metal-enclosed cable shall be continuous between outlet boxes and other enclosures.

**7.9.7** Metal-clad and nonmetallic cables may be passed through the centers of the wide side of 2 inch by 4 inch studs. However, they shall be protected where they pass through 2 inch by 2 inch studs or at other studs or frames where the cable would be less than one and one-half inches ( $1\frac{1}{2}$ " ) from the inside or outside surface. Steel plates on each side of the cable, or a steel tube, with not less than No. 16 Manufacturers' Standard Gage wall thickness, are required to protect the cable. These plates or tubes shall be securely held in place. When the thickness of studs or frames make it impractical or impossible to use metal plates or tubes, particular care shall be exercised in the design and production of the recreational vehicles so as to avoid contacting the cables with nails, screws, or other fasteners. Such care in design shall include appropriate routing of the cables through studs or frames at locations where the likelihood of their being contacted by nails, screws, or other fasteners subsequent to production is remote.

**7.9.8** No bend shall have a radius of less than five times the cable diameter.

**7.9.9** When connected with cable connectors or clamps, cables shall be supported within twelve inches ( $12$ " ) of outlet boxes, distribution panelboards, and splice boxes on appliances. Supports shall be provided every four and one-half feet ( $4\frac{1}{2}$ ' ) at other places.

**7.9.10** Nonmetallic sheathed cables are to be supported within eight inches ( $8$ " ) of a nonmetallic outlet box without cable clamps.

**7.9.11** Nonmetallic cable, if exposed, shall be protected from physical damage, by covering boards, guard strips or conduit. Cable likely to be damaged by stowage shall be so protected in all cases.

**7.9.12** Metallic face plates shall be of ferrous metal not less than 0.030 inch in thickness or of nonferrous metal not less than 0.040 inch in thickness. Nonmetallic face plates shall be of the listed or approved type.

**7.9.13** Where metallic face plates are used they shall be effectively grounded.

**7.9.14** Outdoor or under-chassis wiring (120 volt) exposed to moisture and physical damage shall be protected by rigid metal conduit, or electrical metallic tubing which may be used when closely routed against frames and equipment enclosures. The conductors shall be suitable for wet location.

### **7.10 Conductors and Outlet Boxes.**

**7.10.1** Each wire in an outlet box, including grounding conductors, shall be counted as indicated below. Fixture wires, splicing wires, and conductors that do not leave the box are not counted.

No. 14 AWG — 2 cu. in. per wire

No. 12 AWG — 2.25 cu. in. per wire

No. 10 AWG — 2.50 cu. in. per wire

No. 8 AWG — 3.0 cu. in. per wire

**NOTE:** Where there is not sufficient space for a deeper box, see the National Electrical Code (ANSI C.1-1968), Table 370-6 (a-2).

**7.10.2** Outlet boxes of dimensions less than those required in Table 370-6 (a) (1) and Table 370-6 (a)(2) of the National Electrical Code may be used provided the box has been tested and approved for the purpose.

**7.10.3** At least four inches (4") of free conductor shall be left at each outlet box except where conductors are intended to loop without joints.

**7.11 Painting of Wiring.** During painting or staining of the recreational vehicle, it is acceptable to paint metal raceways (except where grounding continuity would be reduced) or the sheath of the nonmetallic cable. Some arrangement, however, must be made so that no paint is applied to the individual wires, as color coding may be obliterated by the paint.

#### **7.11.1 Polarization.**

**7.11.1.1** The white conductors shall be employed for grounded circuit conductors only and shall be connected to the white terminal

or lead on receptacle outlets and fixtures. It shall be the unswitched wire in switched circuits.

*Exception: A cable containing a white conductor may be used for single-pole, three-way or four-way switch loops where the connections are made so that other than the white conductor is the return conductor from the switch to the outlet. Painting of the terminal end of the wire is not required in such cases.*

**7.11.1.2** If the white conductor of a cable is used for other than grounded conductors or for other than switch loops, as explained in 7.11.1.1 (for a 230-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.

## **7.12 Connection of Terminals and Splices.**

**7.12.1** Connection of conductors to terminal parts shall ensure a thoroughly good connection without damaging the conductors and shall be made by means of pressure connectors (including set screw type), solder lugs, or splices to flexible leads. No. 8 or smaller solid conductors and No. 10 or smaller stranded conductors may be connected by means of clamps or screws with terminal plates having upturned lugs, or by means of approved screwless terminals. Terminals for more than one conductor shall be of a type approved for the purpose.

**7.12.2** Conductors shall be spliced or joined with approved splicing devices or by brazing, welding, or soldering with a fusible metal or alloy. Soldered splices shall first be so spliced or joined as to be mechanically and electrically secure without solder and then soldered. All splices, joints and free ends of conductors shall be covered with an insulation equivalent to that on the conductors.

**7.12.3** If splices of the grounding wire in nonmetallic sheathed cable are made in outlet boxes, the splices shall be insulated.

## **7.13 Wall Switches.**

**7.13.1** Switches shall be rated as follows:

- a. For lighting circuits, switches shall be rated not less than 10 amperes, 125 volts and in no case less than 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 may control a motor 2 horsepower or less with full-load current not over 80 per cent of the switch ampere rating.)

## 7.14 Receptacles.

### 7.14.1 All receptacle outlets:

- a. Shall be of the grounding type; and
- b. Shall be installed in accordance with Sections 210-21 and 210-22 of the National Electrical Code (ANSI C1 -- 1968).

## 7.15 Lighting Fixtures.

### 7.15.1 General.

7.15.1.1 Any combustible wall or ceiling finish exposed between the edge of a fixture canopy, or pan and the outlet box, shall be covered with noncombustible material of either metal equal to the thickness of the fixture or asbestos of one-sixteenth inch ( $\frac{1}{16}$ ").

### 7.15.2 Shower Fixtures.

7.15.2.1 If a lighting fixture is provided over a bathtub or in a shower stall, it shall be of the enclosed and gasketed type and listed or approved for the type of installation.

7.15.2.2 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.

### 7.15.3 Outdoor Outlets, Fixtures, Air-Cooling Equipment, etc.

7.15.3.1 Outdoor fixtures and other equipment shall be listed or approved for outdoor use.

## 7.16 Grounding. (See also Section 7.18 on Bonding of Non-current-Carrying Metal Parts)

7.16.1 **Service Grounding.** The grounding conductor in the supply cord or feeder shall be connected to the grounding bus or other approved grounding means in the distribution panelboard.

7.16.2 **Distribution Panelboard.** The distribution panelboard shall have a grounding bus with sufficient terminals for all grounding conductors or other approved grounding means.

### 7.16.3 Insulated Neutral.

7.16.3.1 The grounded circuit conductor (neutral) shall be insulated from the equipment grounding conductors and from equipment enclosures and other grounded parts. The grounded (neutral) circuit terminals 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.

**7.16.3.2** Connection of electrical ranges and electrical clothes dryers utilizing a grounded (neutral) conductor, if cord connected, shall be made with 4 conductor cord and 3-pole, 4-wire grounding type plugs and receptacles.

## **7.17 Interior Equipment Grounding.**

**7.17.1** In the electrical system, all exposed metal parts, enclosures, frames, lighting fixture canopies, etc., shall be effectively bonded to the grounding terminal or enclosure of the distribution panelboard.

**7.17.2** Bare wires, green-colored wires, or green wires with yellow stripe(s) shall be used for equipment grounding conductors only.

**7.17.3** Where grounding of electrical equipment is specified, it may be accomplished as follows:

a. Connection by metallic raceway (conduit or electrical metallic tubing) or the sheath of metal-clad cable to metallic outlet boxes.

b. A connection between the one or more grounding conductors and a metallic box by means of a grounding screw, which shall be used for no other purpose, or an approved grounding device.

c. The grounding wire in nonmetallic sheathed cable may be secured under a screw threaded into the fixture canopy other than a mounting screw, cover screw, or to a listed grounding means (plate) in a nonmetallic outlet box for fixture mounting (grounding means may also be used for fixture attachment screws).

**7.17.4** A connection between the one or more grounding conductors brought into a nonmetallic outlet box shall be so arranged that a connection can be made to any fitting or device in that box that requires grounding.

**7.17.5** Where more than one equipment grounding conductor of a branch circuit enters a box, all such conductors shall be in good electrical contact with each other, and the arrangement shall be such that the disconnection or removal of a receptacle, fixture, or other device fed from the box will not interfere with or interrupt the grounding continuity.

**7.17.6** Cord-connected appliances, such as washing machines, clothes dryers, refrigerators, and the electrical system of gas ranges, etc., shall be grounded by means of an approved cord with grounding conductor and grounding type plug.

### 7.18 Bonding of Noncurrent-Carrying Metal Parts.

**7.18.1** All exposed noncurrent-carrying metal parts that may become energized shall be effectively bonded to the grounding terminal or enclosure of the distribution panelboard.

**7.18.2** A bonding conductor shall be connected between any distribution panelboard and an accessible terminal on the chassis.

*Exception: Any recreational vehicle which employs a unitized metal chassis-frame construction to which the distribution panelboard is securely fastened with a bolt(s) and nut(s) or by welding or riveting is considered to be bonded.*

**7.18.3** Grounding terminals shall be of the solderless type and listed as pressure terminal connectors recognized for the wire size used. The bonding conductor may be solid or stranded, insulated or bare, and shall be No. 8 AWG copper minimum, or equal.

**7.18.4** The metallic roof and exterior covering are considered bonded if:

a. The metal panels overlap one another and are securely attached to the wood or metal frame parts by metallic fasteners, and

b. The lower panel of the metallic exterior covering is secured by metallic fasteners at each cross member of the chassis, or the lower panel is bonded to the chassis by a metal strap.

**7.18.5** The gas, water and waste pipes are considered grounded if they are bonded to the chassis. (See Paragraph 7.18.2 for chassis bonding.)

**7.18.6** Furnace and metallic circulating air ducts shall be bonded.

**7.19 Appliance Accessibility.** Every appliance shall be accessible for inspection, service, repair, and replacement without removal of permanent construction.

### 8. Factory Tests (Electrical)

**8.1 Electrical Factory Tests.** Each recreational vehicle shall be subjected to the following tests:

**8.1.1 Circuits of 120 volts or 120/240 Volts.** Each recreational vehicle designed with a 120 volt or 120/240 volt electrical system shall withstand the applied potential without electrical breakdown of a one-minute 900-volt dielectric strength test, or a one-second 1,080-volt dielectric strength test, with all switches closed between current carrying conductors, including neutral, and the recreational vehicle ground. The test transformer shall be adjustable. Starting at zero the applied potential shall be increased gradually in at least four steps until either the test value is reached or breakdown occurs. During the test, all switches and other controls shall be in the "on" position. Listed fixtures and permanently installed appliances shall not be required to withstand this test.

**8.1.2. Battery and Low Voltage Circuits.** The battery or low-voltage circuit conductors in each recreational vehicle shall withstand the applied potential without electrical breakdown of a one-minute 500-volt or a one-second 600-volt dielectric strength test. The test transformer shall be adjustable. The potential shall be applied between live and grounded conductors.

### 9. Examination of Equipment for Safety

**9.1** The examination or inspection of equipment for safety, according to the recommendations contained in this Standard, should 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.

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UNITED STATES OF AMERICA  
STANDARDS INSTITUTE

STANDARD FOR  
**MOBILE HOMES**

Body and Frame Design and Construction  
Installation of Plumbing, Heating, and  
Electrical Systems

**American National Standard**

*This standard is one of more than 4000 approved as either a USA Standard or as an American Standard. It became an American National Standard in October 1969 when the Institute changed its name to American National Standards Institute, Inc.*

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## Mobile Homes Manufacturers Association

The Mobile Homes Manufacturers Association (MHMA) is a non-profit, trade organization to serve the mobile home industry and promote industry growth by providing better tools for successful operation. It is voluntarily supported by manufacturers, suppliers, and related service organizations. It has a Standards Division with field engineering personnel to visit member plants regularly, inspecting units and assisting when necessary in the correction of any deviations from the standards applicable to mobile homes. MHMA Manufacturers must comply with the provisions of this Standard as a condition of membership.

## National Fire Protection Association

The National Fire Protection Association (NFPA) is a non-profit technical and educational organization to promote the science and improve the methods of fire protection. Organized in 1896, the Association has a broad-scale standards-making program to aid in its objective to reduce loss of life and destruction of property by fire. The Association publishes the standards developed under its aegis in pamphlet editions (such as this) and in what is known as the National Fire Codes (a ten-volume compilation annually updated, totaling approximately 7,000 pages). For full information about the Association and for a list of its publications, write to the Association's Headquarters.

## Trailer Coach Association

The Trailer Coach Association represents the manufacturers of mobile homes and recreational vehicles, dealers and suppliers in the Western States while drawing its members from all sections of the country. Founded in 1936, the Association sponsors mobile home and recreational vehicle shows in the major western cities and has research programs dedicated to advance the proper use of mobile homes and recreational vehicles. It has a Standards Department which works with the enforcing officials in the various Western States to encourage compliance with the recommendations contained in this standard. The Trailer Coach Association currently has a staff of 18 and a membership of 742.

## United States of America Standards Institute

The United States of America Standards Institute (USASI) is the national coordinating institution for voluntary standardization in the U.S.A. through which organizations concerned with standardization may cooperate in recognizing, establishing and improving standards in this country. Approval of a standard by the Institute is based on a consensus of those essentially concerned with its scope and provisions. The Institute has a Member Body Council, a Consumer Council, and a Company Member Council. The Member Body Council is composed of non-profit technical, professional, scientific, trade, or other membership associates, societies, or organizations which are of national scope and recognition. The Mobile Homes Manufacturers Association, the National Fire Protection Association, and the Trailer Coach Association are Member Bodies of the USASI.

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**United States of America**  
**Standard for Mobile Homes**  
**Body and Frame Design and Construction Requirements**  
**and the**  
**Installation of Plumbing, Heating and Electrical Systems**  
**USA Standard A119.1 — 1969**

**NFPA No. 501B — 1958**

**This Edition of Standard on Mobile Homes**

This Standard has been developed by a USA Standards Committee on Mobile Homes and Travel Trailers sponsored jointly by the Mobile Homes Manufacturers Association, the National Fire Protection Association, and the Trailer Coach Association. Personnel of the Committee are listed on pages A119.1-2 and A119.1-3. It has been approved by all three sponsoring organizations and approved by the United States of America Standards Institute under date of January 27, 1969. Action on behalf of the NFPA took place at the NFPA Annual Meeting, May 20-24, 1968, at Atlanta, Georgia. Tentative Interim Amendment No. 1-1968 has also been processed in accordance with NFPA procedures concerning paragraphs 10.7, 10.10 and 10.11 of Part IV and this Amendment appears on page A119.1-106.

**Origin and Development of Standard on Mobile Homes**

This Standard replaces the American Standard Installations of Plumbing, Heating, and Electrical Systems in Mobile Homes (A119.1-1963) and the NFPA Standard for Fire Prevention and Fire Protection in Mobile Homes and Travel Trailers (NFPA No. 501B-1964). The formation of this Committee under the aegis of the United States of America Standards Institute (formerly American Standards Association) combined the activities of the former ASA A119.1 Committee and the NFPA Committee on Trailers and Trailer Courts and resulted from action taken by the Boards of Directors of the three sponsoring organizations, with the approval of the ASA, in 1964. The principal changes made in this text as compared with the 1963 edition of A119.1 are indicated by vertical marginal rules opposite the affected paragraphs.

## Committee on Mobile Homes and Travel Trailers

Corrected to July 1, 1968

A USA Standards Committee of the United States  
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†Non-voting.

## Standard for Mobile Homes

### Body and Frame Design and Construction Requirements and the Installation of Plumbing, Heating and Electrical Systems

USA Standard A119.1 — 1969  
NFPA No. 501B — 1968

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## Standard for Mobile Homes

### BODY AND FRAME DESIGN AND CONSTRUCTION REQUIREMENTS AND THE INSTALLATION OF PLUMBING, HEATING AND ELECTRICAL SYSTEMS

USA Standard A119.1 — 1969

NFPA No. 501B — 1968

#### Foreword

This USA Standard has been developed by the USA Committee on Mobile Homes and Travel Trailers (A119) of the USA Standards Institute. The USA Committee is sponsored jointly by the Mobile Homes Manufacturers Association, 20 North Wacker Drive, Chicago, Illinois 60606; the National Fire Protection Association, 60 Batterymarch Street, Boston, Massachusetts 02110; and the Trailer Coach Association, 1340 West Third Street, Los Angeles, California 90017. A roster of the personnel of the Committee which developed this Standard appears herein. The Committee membership is inclusive of those having a substantial interest in the subject as consistent with the Bylaws of the USA Standards Institute.

Subcommittees handle the detail technical work with one Subcommittee responsible for each of the "Parts" of the Standard. A number of specialists have served on these Subcommittees who are not members of the USA Committee. The sponsors wish to acknowledge with appreciation their cooperation and assistance in the development of this text.

In conformance with USA Standard Institute policy, the USA Committee responsible for this work is a standing committee which will periodically review this Standard in an effort to keep the information up to date. Anyone interested is invited to make recommendations for revisions to the Chairman and Secretary of the Committee.

This USA Standard for Mobile Homes (A119.1-1969) replaces the American Standard Installations of Plumbing, Heating, and Electrical Systems in Mobile Homes (A119.1-1963) and the NFPA Standard for Fire Prevention and Fire Protection in Mobile Homes and Travel Trailers (No. 501B-1964). Currently work is proceeding on the development of a USA Standard for Recreational Vehicles and standards covering mobile home parks and recreational vehicle parks. The American Standard Installations of Plumbing,

Heating and Electrical Systems in Travel Trailers (A119.2-1963) and the NFPA Standard for Fire Protection in Trailer Courts (NFPA No. 501A-1964) may be used as reference material pending the updating of both texts.

The participation of the National Fire Protection Association as a sponsor of this project is administrative and undertaken in the sole interest of safety to life and property from fire and allied hazards. Some portions of this Standard cover areas outside the scope of NFPA's normal sphere of activity but are of interest and concern to the other sponsors and to users of mobile homes. The NFPA Board of Directors has authorized the Association's participation with the understanding that its responsibility extends only to those areas within its scope.

## Part I

### Body and Frame Design and Construction Requirements

#### 1. Introduction

1.1 Those members of the engineering profession and others associated with the design, manufacturing and quality control of mobile home construction have been aware of the need for standards leading to the providing of healthful and safe housing with complete living facilities arranged and equipped to assure suitable living conditions.

1.2 Much of the material in Part I has been taken from, or is based on, nationally recognized standards for construction including those issued by the Federal Housing Administration, the Building Officials Conference of America, Inc., the Southern Building Code Congress, and the New York State Division of Housing and Community Renewal.

#### 2. Scope

2.1 This standard covers the minimum requirements for materials, products, equipment and workmanship needed to assure that the Mobile Home will provide (a) the structural strength and rigidity, (b) the protection against corrosion, decay, insects and other similar destructive forces, (c) reasonable protection against the hazards of fire and windstorm, (d) resistance to the elements, (e) durability and economy of maintenance as set forth in the provisions of this Standard.

2.2 This standard is not intended as a design specification or an instruction manual for untrained persons.

2.3 Wherever existing standards and this standard differ, the requirements of the latter shall apply.

2.4 This standard has been prepared with the emphasis on performance as opposed to its being a specification standard. The provisions of this standard are not intended to prevent the use of any material, appliance, installation, device, arrangement, or method of construction not specifically prescribed herein, provided any such alternative has been approved or listed. An enforcement agency may approve any such alternative if it finds the proposed design is satisfactory for the purpose intended and if the material, appliance, installation, device, arrangement, and

method of work offered is, for the purpose intended, at least the equivalent of that prescribed in this Standard in quality, strength, effectiveness, durability, safety, and for the protection of life and health. An enforcement authority may require that satisfactory evidence or proof be submitted to substantiate any claims that may be made regarding the use of any such alternative.

### 3. Basic Principles

3.1 The principles of this standard are given as basic goals in the construction of mobile homes, which will also serve as guide lines for the understanding of this standard. These principles will serve to define the intent of this standard when considerations arise which are not covered in the body of the standard.

**Principle No. 1.** To provide safe, healthful and comfortable living facilities with adequate storage space and economy of maintenance.

**Principle No. 2.** To provide adequate natural light and ventilation.

**Principle No. 3.** To provide structural strength and rigidity sufficient for design loads, both in transit and on site.

**Principle No. 4.** To provide adequate running gear and hitch for safe transportation of the mobile home.

**Principle No. 5.** To provide equipment designed and installed for safety of operation, ease of service, and adequate for the intended use.

**Principle No. 6.** To provide installed materials of adequate specification to resist deterioration.

**Principle No. 7.** To provide against the entrance of water and winds at all joints, connections, and openings in exterior surfaces.

**Principle No. 8.** To provide arrangement of habitable spaces for fire and health safety.

### 4. Definitions

4.1 **Accepted Engineering Practice.** The regulations, specifications and standards listed in Table I (Accepted Engineering Practice Standards) shall be deemed to represent accepted engineering practice in respect to materials, equipment, systems or method of construction.

**4.2 Habitable Room.** A room or enclosed floor space arranged for living, eating, food preparation and sleeping purposes (not including bathrooms, water closet compartments, laundries, pantries, foyers, hallways, and other accessory floor spaces).

#### 4.3 Loads.

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

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

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

**4.4 Hurricane and Windstorm Resistive Mobile Home.** A mobile home which meets the added wind design load and anchorage requirements of Section 6.

**4.5 Mobile Home.** A vehicular, portable structure built on a chassis and designed to be used without a permanent foundation\* as a dwelling when connected to indicated utilities.

### 5. General Requirements

**5.1 Minimum Requirements.** The design and construction of a mobile 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 may exceed these standards provided such deviation does not result in any inferior installation or defeat the purpose and intent of this standard.

**5.2 Workmanship.** All construction methods and workmanship shall be in conformance with accepted engineering practices to insure durable, livable, and safe housing.

**5.3 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 occur both in transit and on site. However, tests for flexural rigidity shall be made of each different design in accordance with Section 6 of this Part.

\*The phrase "without a permanent foundation" indicates that the support system is constructed with the intent that the mobile home placed thereon will be moved from time to time at the convenience of the owner.

**5.4 Design Approval Procedure.** Approval of plans, specifications, and completed mobile homes by the authority having jurisdiction under the provisions of this standard shall be accomplished by a certificate of compliance from a firm or organization acceptable to the authority having jurisdiction, by a registered professional engineer or architect, or by a nationally recognized testing laboratory.

**5.5 Hurricane and Windstorm Resistive Design.** Only mobile homes which meet the requirements of Section 6 may be designated "Hurricane and Windstorm Resistive". No similar designation which would imply hurricane or windstorm resistance shall be used when the home does not meet these requirements.

**5.6 New Materials and Methods.** Any new material or method of construction not provided for in this standard and any material or method of questioned suitability, proposed for use in the manufacture of the structure, shall nevertheless conform in performance as outlined in 5.1 of this Part. All test specimens and construction samples shall be representative of the materials, workmanship and details used in actual practice.

**5.7 Acceptability of Materials.** Compliance with applicable provisions of prescribed Standards (Table I), except as otherwise prescribed in this standard, shall constitute compliance with this standard. Deviations from applicable provisions of prescribed Standards (Table I) when they meet the performance requirements of this standard shall constitute compliance with the standard.

**5.8 Structural Requirements.** The mobile homes shall be designed and constructed as a completely integrated structure capable of sustaining the design load requirements of this standard and shall be capable of transmitting these loads to properly designed piers or foundation without causing an unsafe deformation or abnormal internal movement of the structure or its structural parts. (See 6.2 of this Part). For in-transit condition, the integrated structure shall be capable of transmitting the loading specified to the wheel assembly, which in turn shall be designed to safely transmit these loads to the ground. (See 10.1 of this Part).

**5.9 Allowable Design Stress.** The design stresses of all materials shall conform to accepted engineering practice. The use of materials not identified as to strength or stress grade shall be limited to the minimum allowable stresses under accepted engineering practice.

**5.10 Alternate Test Procedures.** In the absence of listed and prescribed Standards, the manufacturer shall develop or cause to be developed necessary tests to demonstrate the structural properties and the significant characteristics of the method employed. Such tests shall be made by a recognized testing organization or may be made and certified to by the manufacturer. Copies of the test results shall be kept on file by the mobile home manufacturer.

## 6. On Site Structural Design Requirements

**6.1 Design Dead Loads.** Design dead loads shall be the actual dead load (see 4.3.1 of this Part) supported by the structural assembly under consideration.

**6.2 Design Live Loads.** The design live loads shall be as specified in 6.3, 6.4, 6.6, 6.8, and 6.9 of this Part and shall be considered to be uniformly distributed. Pier spacings on which the design is based shall be specified by the manufacturer on the manufacturer's certificate.

**6.3 Wind Loads and Snow Loads.** When one of the components of the live load is wind or snow load, unit stresses may be increased in accordance with standard engineering practice, but not to exceed the amounts specified herein.

### 6.3.1 Standard Wind.

Horizontal .....	15 lb/ft <sup>2</sup>
Vertical (horizontal projection) .....	9 lb/ft <sup>2</sup> uplift
Vertical Downward .....	See 6.4 Roof Loads

**6.3.2 Hurricane Wind.** Mobile homes which are designated "Hurricane and Windstorm Resistive" shall be designed for the following wind loads.

Horizontal .....	25 lb/ft <sup>2</sup>
Vertical (horizontal projection) .....	15 lb/ft <sup>2</sup> uplift
Vertical Downward (See 6.4 Roof Loads) .....	30 lb/ft <sup>2</sup>

**6.4 Roof Loads.** Flat, curved and pitched roofs shall be designed to resist the following live loads, applied downward on the horizontal projection:

- NORTH ZONE:** 30 lb/ft<sup>2</sup> (including wind and snow loads) and normal unit stresses may be increased by 15%.
- MIDDLE ZONE:** 20 lb/ft<sup>2</sup> (including wind and snow loads) and normal unit stresses may be increased by 25%.

**HURRICANE ZONE:** 30 lb/ft<sup>2</sup> (including wind and snow loads) and normal unit stresses may be increased by 33-1/3%.

*See Appendix III for Zone Map of U.S.A.*

The Manufacturer's Certificate posted in the mobile home (Paragraph 7.5.1 of this Part) shall state which of these structural zones of the U.S.A. the mobile home has been designed for; and the certificate shall show a reproduction of the zone map in Appendix III at no less than half scale.

**6.5 Fastening of Structural Systems.** Roof framing shall be securely fastened to wall framing, walls to floor structure, and floor structure to frame to secure and maintain continuity between the floor and frame (if provided), so as to resist wind overturning and sliding as imposed by design loads in 6.3.1 of this Part. (Directions for anchorage shall accompany all mobile homes.)

**6.5.1 HURRICANE AND WINDSTORM RESISTIVE MOBILE HOMES** shall have over-the-roof ties with provisions for distributing the load of these ties, and provisions for the attachment of anchors so as to resist wind overturning and sliding as imposed by the design loads in 6.3.2 of this Part.

**6.6 Walls.** The walls shall be of sufficient strength to withstand vertically, the maximum roof load requirements as defined in 6.3.1, 6.3.2, and 6.4 of this Part, without exceeding the deflections as specified in 6.9. The connections between 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 mobile home and to provide for transfer of all lateral and vertical loads to the floor and frame foundation.

**6.7 Interior Partition.** Whenever an interior partition is designed to serve as a secondary structural member, it shall be constructed with values adequate for the purpose intended.

**6.8 Floors.** Floor assemblies shall be designed in accordance with accepted good engineering practice to support a uniform live load of 40 lb/sq. ft., plus the dead load of the materials. In addition (but not simultaneously), floor shall be able to support a 200-pound concentrated load on a 2-inch diameter disc at the most critical location with a maximum deflection not to exceed 1/8 inch relative to floor framing.

**6.9 Design Load Deflections.** When a structural assembly is subjected to total design live and dead loads, the deflections shall not exceed the following:

Floor .....	L/240
Roof and Ceiling .....	L/180 (see Appendix II)
Sidewalls .....	L/180

Where L = the clear span between supports.

**6.10 Ultimate Load Tests.** Every structural assembly shall be capable of sustaining its dead load plus superimposed live loads equal to  $1\frac{3}{4}$  times the required live loads for a period of 12 hours without failure. Failure shall be considered rupture, fracture, or residual deflections which are greater than the limits set in 6.9 of this Part.

**6.11 Basic Structural Integrity.** Basic structural integrity shall be determined by the method described in Appendix I. Effective flexural rigidity of the complete mobile home structure is the basis of this requirement.

(a) For forward loading this is expressed mathematically as follows:

$$(\overline{EI})_f = 36 L_f^3 (P/y)_f; \text{ lb-in}^2 \quad (1)$$

where:

E = Modulus of elasticity

I = Moment of inertia

$(EI)_f$  = Effective flexural rigidity for forward span

$L_f$  = Forward span length in feet between supports

$(P/y)_f$  = Forward spring rate, lb-in

The minimum values for acceptable performance are given in Figure 1, Appendix I.

(b) For rear loading the following shall apply:

$$\frac{1}{2} (\overline{EI})_r = \frac{575}{2} L_r^3 (P/y)_r [1 + L_f/L_r]; \text{ lb-in}^2 \quad (2)$$

where:

$(EI)_r$  = Effective flexural rigidity for rear span

$L_r$  = Rear span length, ft.

$(P/y)_r$  = Rear spring rate, lb-in.

The acceptable value for  $\frac{1}{2} (\overline{EI})_r$  should be within  $\pm 30$  percent of  $(EI)_f$ .

## 7. Construction

**7.1 Weather Resistance.** Exterior covering shall be of moisture and weather resistive materials attached with corrosion resistant fasteners to resist wind and rain. Metal coverings shall be of corrosion resistant materials.

**7.2 Condensation Resistance.** Spaces within outside walls and ceilings shall be ventilated and/or shall be provided with corrosion resistant vapor type barriers on the warm side of the walls and ceilings or other means shall be used to avoid condensation within these structures.

**7.3 Interior Surfaces.** In all habitable spaces, interior exposed ceiling, wall, and partition surfaces shall be faced with materials whose flame-spread classification shall not exceed Class C as defined in Section 6-2114 of the Code for Safety to Life from Fire in Buildings and Structures, NFPA No. 101-1967, (flame spread at more than 75 but not more than 200) when tested by the Standard Method of Test for Surface Burning Characteristics Building Materials (USAS A2.5-1963, ASTM E84-67, UL 723-1960, NFPA No. 255-1966). All wall and partition surfaces shall be capable of resisting horizontal load of not less than five pounds per square foot.

**7.4 Vermin Resistance.** Exterior surfaces shall be effectively sealed so as to prevent the entrance of rodents.

**7.5 Heat Loss.** The total calculated heat loss of the living unit at the outdoor design temperature as certified in 7.5.1 of this Part shall not exceed the following:

a. 50 Btu/hr sq. ft. of the total floor area, or 375 Btu/hr lineal ft. of the perimeter of the space to be heated to 70°F, whichever is the greater.

b. For electrically heated mobile homes 0.184 watts/hr. sq. ft., F (temperature difference), (0.628 Btu/hr. sq. ft., F), and not to exceed 40 Btu/hr. sq. ft. of floor area, whichever is less.

c. The minimum total resistance factors (R) of the wall, ceiling and floor shall never be less than the following:

Type of Fuel Use for Heating	Wall	Ceiling	Floor
Gas or Oil	5.5	8.2	5.5
Electric	6.5	13.0	12.0

The total "R" value is obtained by adding the insulation "R" value together with the "R" value of mobile home construction. Typical mobile home construction "R" values, excluding framing, have been calculated to be: Sidewalls R=2.0; Floor and ceiling R=3.0. These

CERTIFICATE	
The manufacturer of this Mobile Home _____, hereby certifies:	
1) Model No. _____ Mobile Home is designed to meet the Heat Loss Requirements of USA Standard A119.1 (Section 7.5) which provides that heat loss does not exceed: (Check one)	
a) 50 Btu per sq. ft. of floor area	
b) 40 Btu per sq. ft. of floor area if electrically heated	
c) 375 Btu per lineal ft. of outside wall	
with an indoor average temperature of 70°F at no more than 15 mph wind velocity and the following outdoor design temperatures:	
_____°F with storm sash	
_____°F without storm sash	
2) The _____ Furnace installed (Make and Model Number)	
in this Mobile Home has the capacity of maintaining a 70°F average inside temperature, at wind velocities of no more than 15 mph, with an outdoor temperature of:	
_____°F with storm sash	
_____°F without storm sash	
The liability of the manufacturer of the furnace _____ (Name)	
_____ is limited to the printed warranty for the (Address)	
furnace, furnished herewith, to the purchaser.	
_____ (Manufacturer)	
_____ (Address)	

Figure 2

typical R values are to be calculated using all component materials and spaces as outlined in the latest edition of the ASHRAE Handbook of Fundamentals (see footnote).

7.5.1 The mobile home manufacturer shall permanently affix a certificate (see Figure 2) to an interior surface of the home that is readily visible to the home owner. The certificate shall specify the following:

a. The lowest outdoor design temperature at which the mobile home heat loss complies with Paragraph 7.5.\*

(1) With storm sash.

(2) Without storm sash.

b. The lowest outdoor design temperature at which the installed furnace will maintain a 70°F. temperature inside the home with or without storm sash.

\*Outdoor design temperature may be found in the "Handbook of Fundamentals" of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, 345 East 47th St., New York, N.Y. 10017. (Price: \$12.00 Members; \$20.00 Non-Members). In the 1967 volume this information may be found in Chapter 22, "Weather Data and Design Conditions".

7.5.2 Wall, floor, and ceiling cavity "R" and "U" factors shall be calculated as outlined in the latest edition of the ASHRAE Handbook of Fundamentals.\*

7.5.3 Framing Heat Loss. For the purpose of heat loss calculations, the following stud areas shall be assumed:

- Wall — 20% of net wall area (less windows)
- Ceiling — 5% of total ceiling area
- Floor — 10% of net floor area (less duct area)

The following "U" factors shall be used when calculating stud heat loss:

Structure	"U" Factor	"R" Factor
Wall (1 $\frac{5}{8}$ stud)	.32	3.12
Wall (2 $\frac{5}{8}$ stud)	.23	4.35
Wall (3 $\frac{5}{8}$ stud)	.18	5.55
Ceiling	.23	4.35
Floor	.32	3.12

7.5.4 Ventilation Heat Loss. The following shall be used to estimate ventilation heat loss:

Outdoor Design Temperature—F	Ventilation Allowance—Btu/hr
40°	3330
30°	4440
20°	5550
10°	6660
0°	7780
-10°	8880
-20°	10000
-30°	11110
-40°	12200

7.5.5 Duct Heat Loss. The supply duct heat loss shall be calculated separately using the actual duct surface area and the actual thickness of insulation between the duct and outside of the mobile home. If there is an air space of  $\frac{1}{2}$  inch or less, the heat duct shall be assumed in contact with the insulation. If there is an air space of over  $\frac{1}{2}$  inch between the duct and the insulation, no

\*Available from the American Society of Heating, Refrigerating and Air-Conditioning Engineers, 345 East 47th St., New York, N.Y. 10017. (Price: \$12.00 Members; \$20 Non-Members.)

special heat loss need be calculated — if the cavity in which the duct is located is assumed to be at 70°F. The average temperature inside the supply duct shall be assumed to be at least 130°F for the purpose of calculation.

## 8. Design Considerations

**8.1 Light and Ventilation.** Adequate provisions shall be made for light and ventilation in accordance with the following:

**8.1.1 Habitable Rooms.** Habitable rooms shall be provided with windows or doors whose total glass area is not less than 10 percent of the floor area. An area equivalent to not less than 5 percent of the floor area shall be available for unobstructed ventilation. In addition, if the ventilation area in the kitchen is less than 3 square feet, a fan with a minimum rated capacity of 100 CFM shall be provided in the kitchen.

**8.1.2 Bathroom.** The light and ventilation in the bathroom shall comply with Paragraph 8.1.1. In addition, if the ventilation area is less than 1½ square feet, a fan with a minimum rated capacity of 25 CFM shall be provided.

**8.2 Ceiling Height.** The minimum ceiling height in the main structure of the mobile home shall be not less than 7 feet, 0 inch. Any habitable area of greater than 50 square feet, but considered as a secondary structure shall have a minimum ceiling height of 6 feet, 4 inches.

**8.3 Exits.** Mobile homes shall have a minimum of two exterior doors located remote from each other. Doors shall be designed for exterior use, and in no case be less than 24 inches wide. Exterior doors shall permit opening from the inside by the simple operation of a single knob or lever.

## 9. Tests

**9.1 General.** Unless based on accepted engineering design (see 5.3 of Part I) for the use indicated, all new mobile home materials, equipment, systems or methods of construction not provided for in this standard, shall be subjected to the tests specified in 5.10 of Part I.

**9.2 Structural Integrity.** Basic structural integrity as defined in 6.11 of Part I shall be determined by tests as described in Appendix 1. This may be accomplished by the manufacturer or by a recognized testing organization.

**9.3 Heat Loss.** Heat loss shall be determined by accepted engineering methods or tests to assure compliance with the requirements of 7.5 of Part I.

## 10. Structural Design Requirements for In-transit Conditions

**10.1 Chassis Assembly.** The chassis assembly in conjunction with the mobile home structure shall be designed and constructed so as to be capable of sustaining the dead load plus 3 pounds per square foot floor load and the superimposed dynamic load resulting from over the road movement. (See 6.11 of Part I). The design shall be such as to insure rigidity and structural integrity of the complete mobile home structure and to insure against unsafe deformation or exceeding the allowable stresses of the materials that make up the assembly. All metal surfaces shall be protected against corrosion with an approved paint or other approved protective means.

**10.1.1 Hitch Assembly.** The hitch assembly which includes the "A" frame and coupling mechanism shall be rigidly constructed and securely fastened to the main structure to assure safe and adequate transfer of the maximum load between the mobile home and the hitch assembly.

**10.1.2 Coupling Mechanism.** The coupling mechanism which is normally of the socket type shall be securely fastened to the "A" frame in such a manner as to assure safe and adequate transfer of maximum loads including impact loads between the mobile home and hitch assembly and the towing vehicle. Couplings must be equipped with a manually operated mechanism so adapted as to prevent disengagement of the unit while in operation. In addition to this positive locking mechanism the coupling shall be so designed that it can be disconnected regardless of the angle of the mobile home to the towing vehicle. With the mobile home parked on level ground, the center of the socket of the coupler shall not be less than 20 inches nor more than 26 inches from the ground level.

**10.2 Running Gear Assembly.** The running gear assembly which includes springs, spring hangers, axles, bearings, wheels, brakes, rims and tires with their related hardware shall be designed in accordance with accepted engineering practice to adequately sustain the designed loads, as indicated in Paragraph 10.1, and provide for the mobility of the mobile home. The subject assembly shall transmit the mobile home load to the ground without causing unsafe deformation or internal movement of any of the

mobile home structural parts. The location of the running gear assembly in relation to the over-all length of the mobile home and its total weight including all its contents shall be such as to provide sufficient hitch weight to assure good and safe towing and braking qualities. Hitch weight should not be less than 12 per cent of the total weight of the mobile home nor more than 25 per cent. This hitch loading can normally be obtained by locating the running gear approximately  $2/3$  of the total chassis length to the rear of the front end.

**10.2.1 Spring and Spring Hangers.** Spring assemblies and hangers, shackles, bushings, and mounting bolts shall be capable of withstanding all the design loads as outlined in Paragraph 10.1 without exceeding maximum allowable stresses as set forth in the SAE Handbook† published by the Society of Automotive Engineers. Full recognition must be given both to operating stress and to fatigue life in determining the suitability of any spring suspension system. The capacity of the spring system shall be such as to assure that under maximum load conditions sufficient clearance will be maintained between tire and wheel well to provide for unimpeded wheel and tire movement.

**10.2.2 Axles.** Axles shall be manufactured in accordance with accepted standards to a degree of accuracy that will assure proper fit of bearings and brake mountings. The number of axles used will depend upon the total load to be carried by the undercarriage and the maximum load carrying capacity of the axle as specified by the axle manufacturer.

**10.2.3 Hubs and Bearings.** Hubs and bearings shall be provided in accordance with design load requirements as described in Paragraph 10.1. Bearings shall be manufactured to specific standards so as to insure interchangeability with replacement parts. Provisions for proper lubrication with properly applied seals shall be provided in accordance with good engineering practice.

**10.2.4 Wheels and Rims.** Wheels and rims shall be furnished and installed in accordance with the load requirements (Paragraph 10.1), the recommended practices contained in the latest edition of the Yearbook\* of The Tire & Rim Association, and the recommendations of the wheel and rim manufacturer.

†Available from the Society of Automotive Engineers, 485 Lexington Ave., New York, N.Y. 10017 (Price \$25.00 List).

\*Available from the Tire and Rim Association, Inc., Command Building, 34 N. Hawkins Ave., Akron, Ohio 44313 (Price: \$3.75).

**10.2.5 Tires.** Tires installed on mobile homes shall be capable of safely carrying all design loads, due consideration being given to anticipated usage.

**10.2.6 Brakes.** Brakes used shall be manufactured to accepted and listed standards and installed in accordance with the brake manufacturers recommendations. They shall be of the proper size, type, number and design, with method of actuation to adequately meet the stopping distance performance standards herein prescribed.

**10.2.6.1 Acceptance Standards.** Brakes on tractor and mobile homes shall be such that the maximum stopping distance from an initial velocity of 20 MPH shall not exceed 40 feet. (U.S. Department of Transportation Regulations)

**10.2.7 Low Voltage Wiring.** Electrical wiring between mobile home and towing vehicle shall comply with all applicable requirements of the U.S. Department of Transportation Motor Carrier Safety Regulations.

**TABLE I**  
**Accepted Engineering Practice Standards**

**Aluminum**

Aluminum Construction Manual, Specifications for  
Aluminum Structures ..... AA-1967

**Steel**

Specification for the Design, Fabrication and Erection  
of Structural Steel for Buildings ..... AISC-1963  
Specification for the Design of Light Gage Cold-  
Formed Steel Structural Members ..... AISI-1962  
Standard Specifications and Load Tables Open Web  
Steel Joist ..... SJI-1966  
Code for Arc and Gas Welding in Building Construc-  
tion ..... AWS D1.0-66

**Wood and Wood Products**

Hardboard ..... USDC CS 251-63  
Lumber, Structural Glued Laminated — Inspection  
Manual for ..... AITC-200-1963  
Softwood Plywood — Construction and Industrial .... PS 1-66  
Plywood Design Specification (Form No. 66-510) .... APA, 1966  
Plywood Stressed Skin Panels, Design and Fabrication  
of (Form No. T64-370) ..... APA, 1965  
Plywood Beams, Design and Fabrication of (Form  
No. T64-140) ..... APA, 1964  
Plywood Curved Panels, Design and Fabrication of  
(Form No. F67-1510) ..... PFS, 1967  
Plywood Construction Guide (Form No. 66-450) .... APA, 1966  
Stress Grade Lumber and Its Fastenings — National  
Design Specifications for ..... (N) FPA-1962\*  
Structural Design Data — Wood ..... (N) FPA-1957  
Timber Construction Standards ..... AITC-100-1965  
Design Specifications for Light Metal Plate Connected  
Wood Trusses ..... TPI-66

**Unclassified**

ASHRAE Guide and Data Book — Handbook of Fundamentals — 1967

AA — The Aluminum Association, 420 Lexington Ave., New York, N.Y.  
10017

AISI — American Iron and Steel Institute, 150 East 42nd St., New York,  
N.Y. 10017

AISC — American Institute of Steel Construction, 101 Park Ave., New  
York, N.Y. 10017

\*Amended July 1967

- AITC — American Institute of Timber Construction, 1700 K Street, N.W., Washington, D.C. 20006
- APA — American Plywood Association, 1119 A Street, Tacoma, Wash. 98401
- ASHRAE — American Society of Heating, Refrigeration and Air-conditioning Engineers, 345 East 47th Street, New York, N.Y. 10017
- AWS — American Welding Society, 345 East 47th St., New York, N.Y. 10017
- CS — Commercial Standards — available from Sup't. of Documents, U.S. Government Printing Office, Washington, D.C. 20402
- (N)FPA — National Forest Products Association (formerly National Lumber Manufacturers Assn.), 1619 Massachusetts Ave., N.W., Washington, D.C. 20036
- PFS — Plywood Fabricator Service, Inc., 119 A Street, Tacoma, Wash. 98401
- PS — Product Standard — available from Sup't. of Documents, U.S. Government Printing Office, Washington, D.C. 20402
- SJI — Steel Joist Institute, 1346 Connecticut Ave., N.W., Washington, D.C. 20036
- TPI — Truss Plate Institute, P.O. Box 253, Perrine, Florida 33157
- USDC — United States Department of Commerce, Washington, D.C. 20234

## Appendix I

### Equipment and Procedures for Determining Effective Flexural Rigidity (EI)

#### EQUIPMENT

The following is a description of the equipment required to perform a load-deflection test on a mobile home:

Item	Quantity Required	Description
1	2	Hydraulic jack: 5 ton.
2	2	Rear support: Heavy wall steel pipe with bearing plates welded to ends, 8 in. diameter pipe or equivalent may be used.
3	—	Steel shims: As required to level coach when on rear supports.
4	2	Forward supports: 5 ton adjustable screw jacks.
5	1	Tape measure: 50 foot.
6	2	Dial indicator: (3 in. diameter indicators having an overall range of 1 in. and reading down to 0.001 in. is suggested).
7	2	Apparatus stand with adjustable fittings for dial indicator.
8	500 lbs.	Test weight: Almost any material is suitable, such as steel shot in cloth mail bags, or lead shot is ideal for long term use.

#### PROCEDURE

The recommended procedure for running a load-deflection test at a manufacturers plant is given as follows. The objective of the test is to determine the spring rate, (P/y), of a mobile home. Once the spring rate is known the effective flexural rigidity, (EI), can be easily calculated.

##### Step

##### Procedure

- (1) Move mobile home to test area. For best results this should be a concrete pad that will provide a firm, non-yielding surface for the forward and rear supports. The area should be selected such that a stable temperature condition can be obtained.
- (2) Jack the running gear clear of the pad and position the rear supports. For two axle systems with an equalizer link, place the support under the equalizer (see Figure 3). For three axle systems position the supports under the forward equalizer link. Spread axle system should be supported at the steel frame midway between the axles. The mobile home should be kept as level as possible.

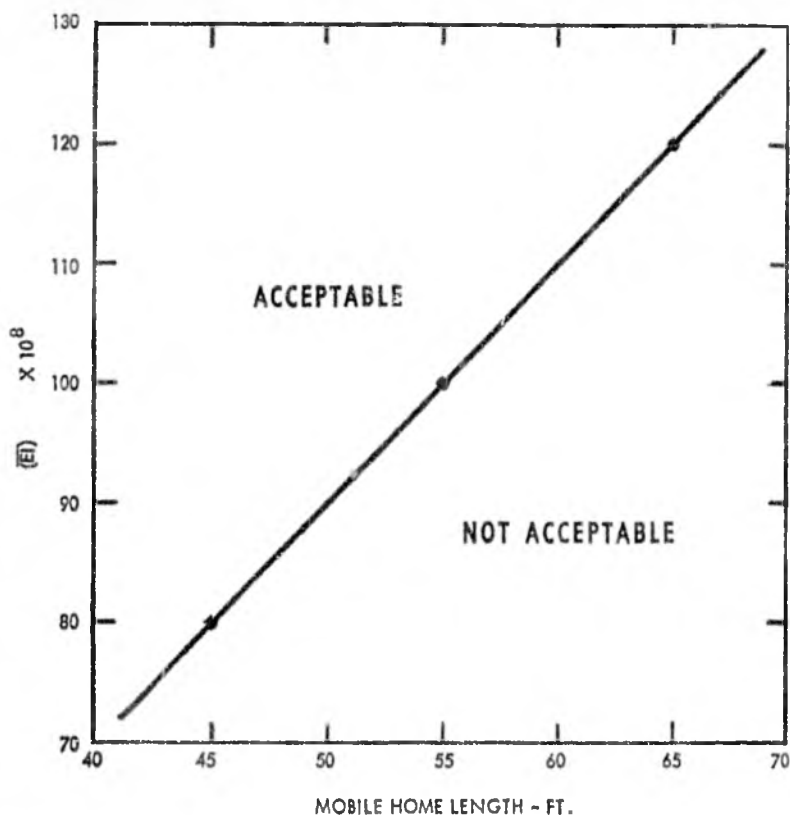


Figure 1

- (3) With the mobile home leveled, position the two forward screw jack supports (see Figure 3). These are brought up hand tight against the steel frame. Once in place, the screw jack fitted to the A-frame shall be retracted.
- (4) Measure the center-to-center distance between forward and rear supports. This dimension, in feet, is  $L_r$  in Equation 1-A (see also 6.11 of Part I).
- (5) With  $L_r$  known, find the midspan position and scribe a mark on the steel frame on both sides of the mobile home. Also, mark the midspan position inside the mobile home on the floor.

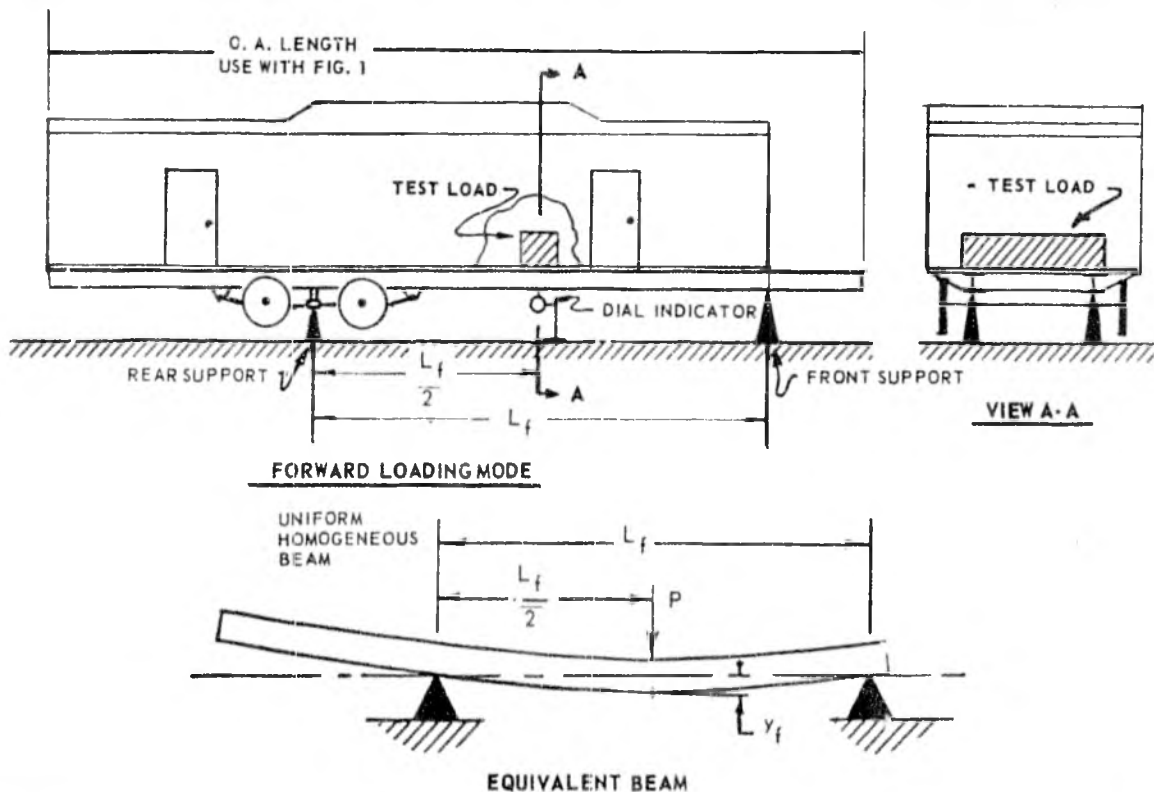


Figure 3

- (6) Position the dial indicators at the midspan locations (see Figure 3). Deflections are required at the steel frame *only*. Preload the dial indicators to any random reading so as to insure good contact between the indicator and the frame. Make sure the apparatus stands supporting the dial indicators are on a flat surface and are weighted down to prevent movement.
- (7) Note and record the initial dial indicator readings. Then, transfer 250 pounds of test weights into the mobile home and place on the floor at midspan such as shown in Figure 3. Note and record dial indicator readings. Apply another 250 pounds of weight and again take deflection readings.
- (8) With above data available plot the load-deflection curves for the mobile home; these should be very close to straight lines. The slope of the load-deflection curve is the spring rate,  $(P/y)_t$ , for the mobile home in the forward loading mode. Two spring rates will be found, one for each side of the mobile home. The average value should be used to calculate  $(\overline{EI})_t$ .
- (9) Apply the numerical values for the average forward spring rate,  $(P/y)_t$ , and span length,  $L_t$ , to Equation 1-A to obtain a numerical value for the forward effective flexural rigidity,  $(\overline{EI})_t$ .

Equation 1-A is as follows:

$$(\overline{EI})_t = 36 L_t^3 (P/y)_t; \text{ lb-in}^2 \quad (1-A)$$

Where:

E = Modulus of elasticity

I = Moment of inertia

$L_t$  = Forward span length, ft.

$(P/y)_t$  = Forward spring rate, lb-in.

- (10) A similar procedure can be carried out for the rear loading mode (see Figure 4). Equation 2-A (adjusted) applies. The limited amount of information available suggests that the numerical value for effective flexural rigidity in the rear mode,  $\frac{1}{2} (\overline{EI})_r$ , should be within  $\pm 30$  percent of  $(\overline{EI})_t$ . Equation 2-A is as follows:

$$\frac{1}{2} (\overline{EI})_r = \frac{575}{2} L_r^3 (P/y)_r [1 + L_t/L_r]; \text{ lb-in}^2 \quad (2-A)$$

where:

$L_r$  = Rear span length, ft.

$(P/y)_r$  = Rear spring rate, lb-in.

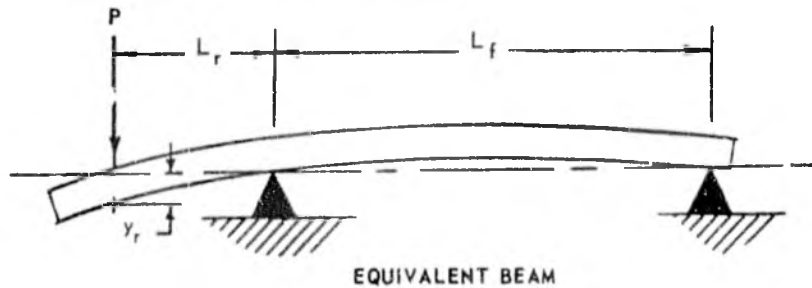
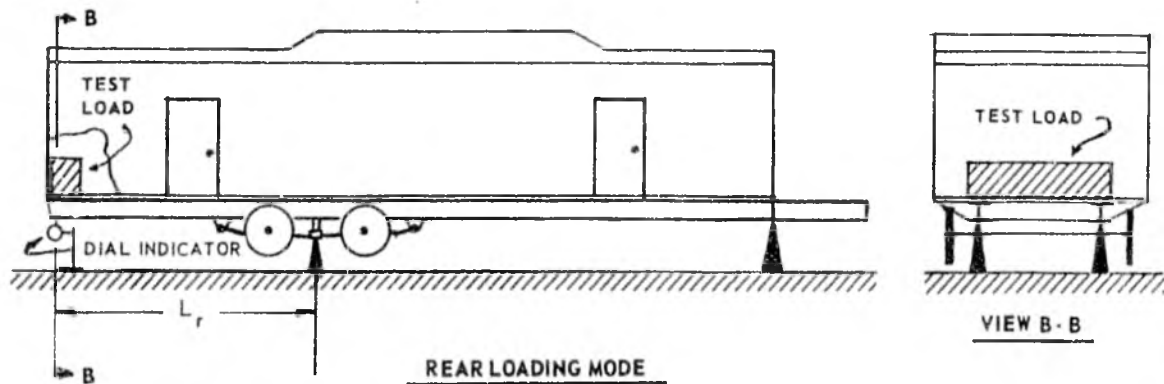


Figure 4

## Appendix II

### Test Procedure for Roof Rafters or Roof Trusses

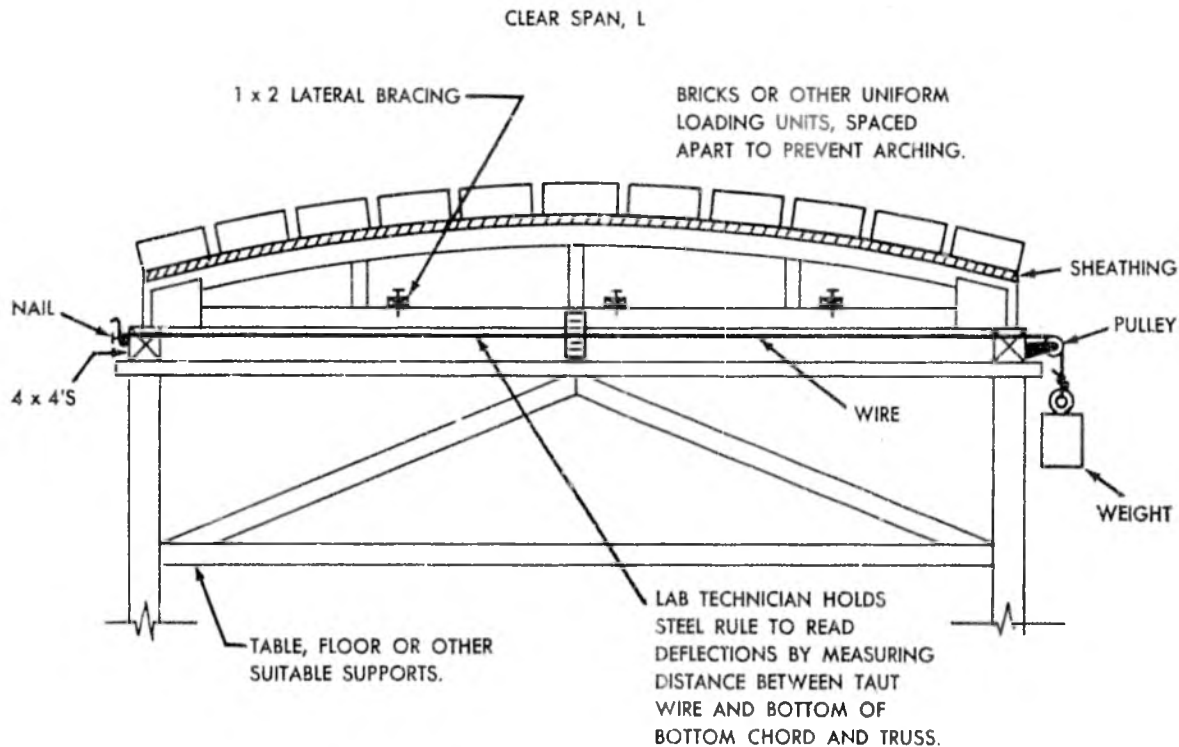
#### GENERAL:

Rafters and trusses may be tested in pairs, sheathed and mounted across supports, or singly in a suitable test facility. When tested in pairs, trusses shall be spaced at the design spacing. Trusses will be mounted on 4 inch by 4 inch supports accurately positioned to give the required clear span distance ( $L$ ) as specified in the design of the truss. The top chord may be sheathed with the specified design sheathing or with 2 by 4 foot sheets  $\frac{1}{4}$  inch plywood. Butting plywood sheets must be separated at least  $\frac{1}{8}$  inch. Design sheathing shall be attached with specified design fasteners. Plywood sheathing shall be nailed with 4d nails not closer than 8 inch on center along each top chord. The bottom chord shall be cross tied with 1 x 2 inch stripping not closer than 24 inches on center running perpendicular between trusses.

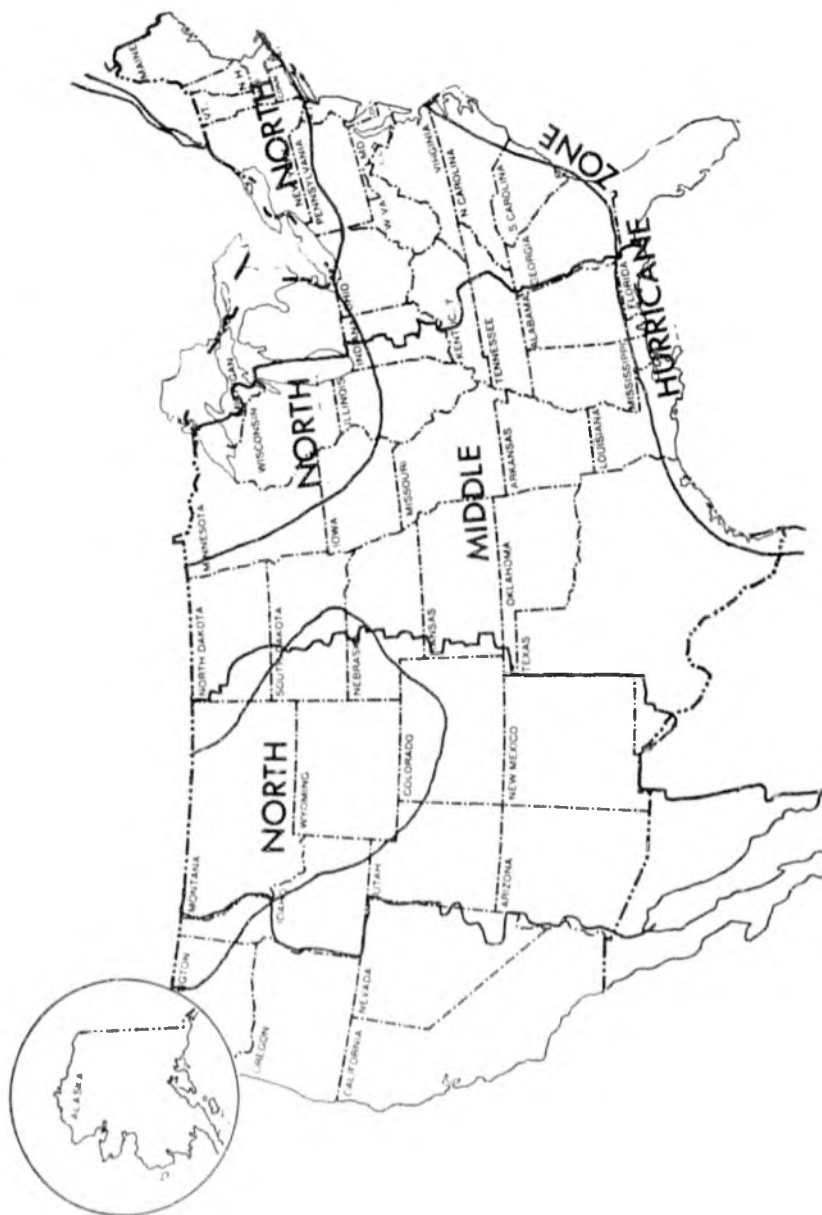
Rafter and truss deflections will be measured relative to a taut wire running over the supports and weighted at the end to insure constant tension. Deflections will be measured at the 2 quarter points and at midspan. Loading shall be applied to the top chord through a suitable hydraulic system, masonry units or weights to simulate a uniformly distributed load. Load units shall be separated so that arch action does not occur.

#### TEST PROCEDURE:

1. Noting the drawing, measure and record initial elevation of rafter or truss in test position at no load.
2. Apply load units to the sheathing to equal the full dead load of roof and ceiling. Measure and record the deflections.
3. Maintaining the dead load, add live load in approximate 10 lb./ft<sup>2</sup> increments. Measure the deflections after each 10 lb./ft<sup>2</sup> increment. Apply incremental loads at a uniform rate such that approximately  $\frac{1}{2}$  hour is required to establish the total design load condition. Measure and record the deflections. The maximum deflection due to design live load (deflection measured in step 3 minus step 2) shall not exceed  $L/180$ , where  $L$  is the clear span measured in same units.
4. Continue to load rafter or truss to dead load plus 1.75 times the design live load. Maintain this loading for 12 hours and inspect truss for failure.
5. Remove superimposed live load and truss shall recover to at least the  $L/180$  position within another 12 hours.



Appendix III



## Part II

### Plumbing Systems

#### 1. Introduction

1.1 Those members of the engineering profession and others associated with the design, manufacturing, installation, and inspection of mobile home plumbing systems have been aware of the need for uniform technical standards leading to the safe and sanitary use of this special type of equipment. They have also recognized that because of unique conditions of transport and use, existing plumbing standards for permanent buildings are not completely applicable to mobile homes. It is with these factors in mind that Part II of this standard has been developed.

1.2 Much of the material in Part II has been taken from, or is based on, the National Plumbing Code, Uniform Plumbing Code, and other nationally recognized standards for plumbing materials, fixtures, fittings, and equipment.

#### 2. Scope

2.1 Part II of this standard covers the plumbing materials, fixtures, fittings, and equipment installed within or on mobile homes.

2.2 This standard is not intended as a design specification or an instruction manual for untrained persons.

2.3 Wherever the American Standard National Plumbing Code, A40.8-1955, Uniform Plumbing Code, and other nationally recognized standards for plumbing materials, fixtures, fittings and equipment and Part II of this standard differ, the requirements of the latter shall apply.

2.4 The provisions of this Standard are not intended to prevent the use of any material, appliance, installation, device, arrangement, or method of construction not specifically prescribed herein, provided any such alternative has been approved or listed. An enforcement agency may approve any such alternative if it finds the proposed design is satisfactory for the purpose intended, and if the material, appliance, installation, device, arrangement, and method or work offered is, for the purpose intended, at least the equivalent performance of that prescribed in this standard considering quality, strength, effectiveness, durability, safety, and protection of life and health. An enforcement authority shall re-

quire that satisfactory evidence or proof be submitted to substantiate any claims that may be made regarding the use of any such alternative.

### 3. Basic Principles

The principles of this standard are enunciated as basic goals in environmental sanitation, worthy of accomplishment through properly designed, acceptably installed, and adequately maintained plumbing systems. The results desired and necessary to protect the health of the public are the same everywhere. Furthermore, as unforeseen situations arise that are not covered in the body of the standard, the principles may serve to define the intent.

**Principle No. 1.** Plumbing fixtures, devices, and appurtenances shall be supplied with water in sufficient volume and at pressures adequate to enable them to function satisfactorily and without undue noise under all normal conditions of use.

**Principle No. 2.** Plumbing shall be designed and adjusted to use the minimum quantity of water consistent with proper performance and cleaning.

**Principle No. 3.** Devices for heating and storing water shall be so designed and installed as to prevent dangers from contamination and explosion through overheating.

**Principle No. 4.** Plumbing fixtures shall be made of smooth non-absorbent material, shall be free from concealed fouling surfaces, and shall be located in ventilated enclosures.

**Principle No. 5.** The piping of the plumbing system shall be of durable material, free from defective workmanship, and so designed and constructed as to give satisfactory service for its reasonable life expectancy.

**Principle No. 6.** Each fixture directly connected to the drainage system, except for mechanically sealed water closets or recirculating chemical toilets, shall be installed with a water seal trap.

**Principle No. 7.** 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.

**Principle No. 8.** The plumbing system shall be subjected to tests that will effectively disclose all leaks and defects in the work, which must then be repaired.

**Principle No. 9.** No water closet shall be located in a room or compartment that is not properly lighted and ventilated.

**Principle No. 10.** All plumbing fixtures shall be so installed with regard to spacing as to be reasonably accessible for their intended use.

#### 4. Definitions

**Administrative Authority.** The administrative authority is the individual official, board, department, or agency established and authorized by a state, county, city, or other political subdivision created by law to administer and enforce the provisions of this Part as adopted or amended.

**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 of the receptacle.

**Approved.** "Approved" means acceptable to the authority having jurisdiction.

**Authority having jurisdiction.** The "authority having jurisdiction" is the organization, office, or individual responsible for "approving" equipment, an installation, or a procedure.

**Backflow.** The flow of water or other liquids, mixtures, or substances into the distributing pipes of a potable supply of water from any source or sources other than its intended sources. Back-siphonage is one type of backflow.

**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.

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

**Center.** The midpoint between the right and left side of the mobile home.

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

**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.

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

**Developed Length.** The developed length of a pipe is the length measured along the centerline of the pipe and fittings.

**Diameter.** The diameter is the nominal diameter designated commercially.

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

**Drain Hose.** (See Sewer Connector).

**Drain Outlet.** The lowest end of the main drain to which the terminal end of the sewer connector is attached.

**Drainage System.** All the piping within or attached to the structure that conveys sewage or other liquid wastes to the drain outlet but does not include the sewer 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 flood-level is the level in the receptacle over which water would overflow to the outside of the receptacle.

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

**Flush Tank.** A water tank that contains sufficient water to adequately flush a water closet.

**Flush Valve.** A device located at the bottom of a tank for flushing water closets.

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

**Grade.** (See Pitch)

**Horizontal Branch Drain.** A drain branch pipe extending laterally from a soil or waste stack or building drain with or without vertical sections or branches, which receives the discharge from one or more fixture drains and conducts it to the soil or waste stack or to the building drain.

**Horizontal Pipe.** Any pipe or fitting which makes an angle of no more than 45 degrees with the horizontal.

**Individual Vent.** A pipe installed to vent a fixture drain. It connects with the vent system above the fixture served or terminates outside the building into the open air.

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

**Labeled.** Equipment bearing an inspection label of a nationally recognized testing agency (see **Listed**).

**Length.** Length of a mobile home is the distance measured from the tip of the hitch to the part farthest to the rear.

**Liquid Waste.** The discharge from any fixture, appliance, area or appurtenance, which does not contain fecal matter or urine.

**Listed.** Refers to plumbing materials, devices, fixtures, fittings, equipment, appliances, and accessories that are shown in a list published by a recognized agency, maintaining an adequate periodic inspection of current production of listed models, and whose listing states either that the material, device, fixture, fitting, equipment, appliance, or accessory complies with nationally recognized health and safety requirements or has been tested and found safe for use in a specified manner.

**Main.** The principal pipe artery to which branches may be connected.

**Main Drain.** The principal artery of the drainage system to which drainage may be connected.

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

**Mobile Home.** A vehicular, portable structure built on a chassis and designed to be used without a permanent foundation\* as a dwelling when connected to indicated utilities.

**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.** The fall (slope) of a pipe in reference to a horizontal plane expressed in inches per foot length.

**Plumbing Fixtures.** Plumbing fixtures are approved-type installed receptacles, devices, or appliances which (1) are supplied with water or (2) receive liquid or liquid-borne wastes for discharge into the drainage system.

**NOTE:** For the purpose of this standard, water closet refers to tank-bowl combination, mechanical seal, grinder, recirculating chemical, and flushometer type toilets.

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

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

**Sewage.** Any liquid waste containing animal or vegetable matter in suspension or solution, and may include liquids containing chemicals in solution.

**Sewer Connector.** Consists of all pipes, fittings, and appurtenances from the drain outlet of the mobile home to the inlet of the corresponding sewer riser pipe of the sewerage system serving the mobile home.

**Siphonage** is the loss of water seal from fixture traps resulting from partial vacuum in the drainage system and may be of 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, or,

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.

\*The phrase "without a permanent foundation" indicates that the support system is constructed with the intent that the mobile home placed thereon will be moved from time to time at the convenience of the owner.

**Standard.** The word "standard" or "this standard" when used alone shall mean these requirements and subsequent amendments which the administrative authority may adopt.

**Trap.** A fitting or device which, when properly vented, provides a liquid seal to prevent the emission of sewer gas without materially affecting the flow of sewage or waste water through it.

**Trap Arm.** See **Fixture Drain**.

**Trap Seal Depth.** The vertical distance between the crown weir and the top of the dip of the trap.

**Vacuum Breaker.** See **Backflow Preventer**.

**Vent Stack.** A vertical vent pipe installed to provide circulation of air to and from the drainage system and which extends through one or more stories.

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

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

**Waste Pipe.** A pipe receiving discharge from fixtures and conveying it to the main drain or soil pipe.

**Waste Holding Tank.** An enclosed tank for the temporary retention of water-borne waste.

**Water Connector.** Consists of all pipes, fittings, and appurtenances from the water riser pipe to the water inlet coupling of the distribution system within the mobile home.

**Water Distribution System.** All of the water piping within the mobile home.

**Water Storage Tank.** A tank installed in a mobile home for the purpose of storing potable water.

**Wet Vent.** A vent which receives the discharge of wastes other than from water closets.

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

## 5. General Requirements

**5.1 Minimum Requirements.** Plumbing systems installed in a mobile home shall conform, at least, with the provisions of this standard. Requirements for any size, weight, or quality of material modified by the terms "minimum," "not less than," "at least," and similar expressions are "*minimum standards.*"

**5.1.1 Connections 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 mobile home drainage system in a manner provided by this standard.

**5.1.2 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.

**5.1.3 Components.** Plumbing materials, devices, fixtures, fittings, equipment, appliances, and accessories intended for use in or attached to a mobile home shall be listed by a recognized agency, or be specifically approved by the administrative authority enforcing this Standard when listing by a recognized agency is not available or cannot be legally recognized.

### 5.1.4. Prohibited Fittings and Practices

**5.1.4.1** No drainage or vent piping shall be drilled and tapped for the purpose of making connections.

**5.1.4.2** Except as provided, no vent pipe shall be used as a waste or drain pipe.

**5.1.4.3** No fitting, connection, device, or method of installation that obstructs or retards the flow of water, waste, sewage, or air in the drainage or venting systems in an amount greater than the normal frictional resistance to flow shall be used unless it is indicated as acceptable in this standard or is approved as having a desirable and acceptable function and is of ultimate benefit to the proper and continued functioning of the plumbing system.

**5.1.4.4** 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.

**5.1.4.5** 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.

5.1.4.6 Galvanized pipe shall not be bent or welded.

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

## 5.2 Protective Requirements

5.2.1 **Cutting Structural Members.** No structural member shall be unnecessarily or carelessly weakened by cutting or notching.

5.2.2 **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 deteriorating.

5.2.3 **Road Damage.** No pipe, supports, drain, outlet, or sewer connector shall extend or protrude in a manner where it will be subjected to damage during transit.

5.2.4 **Freezing.** All piping and fixtures subject to freezing temperatures shall be insulated or protected to prevent freezing, under normal occupancy.

5.2.5 **Vermin Proofing.** All exterior openings around piping shall be effectively closed to prevent the entrance of rodents.

## 6. Materials—Quality and Weight

6.1 **Minimum Standards.** Materials, fixtures, or devices used or entering into the construction of plumbing systems in any mobile home shall be free from defects and shall conform to approved or listed applicable standards.

6.2 **Applicable Standards.** Standards for plumbing system components are shown in Table II.

**NOTE:** All standards and specifications for materials are subject to change. Designations carrying indication of the year of issue may thus become obsolete. Table II gives the full designations of standards current at the time this standard was printed.

**TABLE II**  
**Standards for Plumbing System Components\***

Materials	USASI	ASTM	FS	Other Standards
<i>Ferrous Pipe and Fittings</i>				
Cast-Iron Screwed Fittings	B16.4 -1963			
Malleable Iron Screwed Fittings	B16.3 -1963			
Cast-Iron (Screwed) Drainage Fittings				UPC-PS 5-66
Welded Wrought Iron Pipe	B36.2 -1966	A72 -1966		
Wrought-Steel and Wrought-Iron Pipe	B36.10 -1959			
Black and Zinc-Coated (Galvanized) Steel Pipe	B36.20 -1966	A120 -1966		
Welded and Seamless Steel Pipe	B36.1 -1966	A53 -1967		
Pipe Threads	B2.1 -1960			
<i>Nonferrous Pipe and Fittings</i>				
Seamless Copper Pipe, Standard Sizes	H26.1 -1963	B42 -1966		
Seamless Copper and Copper Alloy Pipe	H23.4 -1967	B251 -1967		
Seamless Copper Water Tube	H23.1 -1967	B88 -1966		
Copper Drainage Tube (DWV)	H23.6 -1967	B306 -1966		
Wrought Copper & Bronze Solder-Joint Fittings	B16.22 -1963			
Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings				UPC-PS 21-65
Cast Brass Solder-Joint Pressure Fittings	B16.18 -1967			
Cast - Bronze Solder - Joint Drainage Fittings	B16.23 -1960			
Brass Fittings for Flared Copper Tubes	B16.26 -1967			
Seamless Red Brass Pipe	H27.1 -1963	B43 -1966		
Cast Bronze Screwed Fittings, 125 and 250 Lb.	B16.15 -1964			

\*Dates shown are latest editions at time of printing including the dates of any addenda issued. Other standards on solvent cements, thermoplastic pipes and fittings are also available from ASTM.

Materials	USASI	ASTM	FS	Other Standards
<i>Plastic Pipe and Fittings</i>				
ABS Plastic Drain, Waste, and Vent Pipe and Fittings		D1527 -67	L-P- 00322	CS270 -65 NSF-14 1965
PVC Plastic Drain, Waste and Vent Pipe and Fittings		D1785 -67	L-P- 00320	CS272 -65 NSF-14 1965
Plastic Sewer, Drain Pipe, Fittings, Styrene Rubber (SRP)			WW-P -00380a	NSF-14 1965
ABS Plastic Pipe (SDR-PR and Class T)		D2282 -66		CS254 -63 NSF-14 1965
Polyethylene (PE) Plastic Pipe (SDR-PR)		D2239 -67		CS255 -63 NSF-14 1965
Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR and Class T)		D2241 -65		CS256 -63 NSF-14 1965
<i>Miscellaneous</i>				
Pipe Nipples, Threaded			WW-N- 351a'60	
Backflow Preventers in Plumbing Systems	A40.6 -1943			
Air Gaps in Plumbing Systems	A40.4 -1942			
Valve, Bronze, Gate 125-150 Lb.			WW-V- 54b.'62	
Valve, Cast-Iron Gate, 125 and 250 Lb.			WW-V- -58(1)'46	
Plumbing — Fixture-Setting Compound			HH-C- -536-a'54	
Cast Brass and Tubing P-Traps				UPC-PS 2-66
Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems	Z21.22 -1965			
Solvent Cement for ABS Plastic Pipe and Fittings		D2235 -63T		
Diversion Tees and Twin Waste Elbow				UPC-PS 9-66
Flexible Copper Water Connectors				UPC-PS 14-66

Materials	USASI	ASTM	FS	Other Standards
Dishwasher Drain Airgaps				UPC-PS 23-66-T
Backflow Preventers and Relief Valves				TSC 8-66-T
Flexible Metal Mobile Home Gas Connectors				TSC 9-63
Drain Connectors for Independent Mobile Homes				TSC 10-64
Thermoplastic Joining Material				NSF 14
<i>Plumbing Fixtures</i>				
Plumbing Fixtures for Land Use			WW-P 541b(4)'62	
Vitreous China Plumbing Fixtures				CS-20 -63
Enameled Cast-Iron Plumbing Fixtures				CS-77 -62
Porcelain - Enameled (Glass-Lined) Hot Water Tanks				CS-115 -60
Formed Metal Porcelain-Enameled Sanitaryware				CS-144 -47
Gel-Coated Glass-Fiber Reinforced Polyester Bathtubs	Z124.1 -1967			
Gel-Coated Glass-Fiber Reinforced Polyester Resin Shower Receptor, Shower Stalls	Z124.2 -1967			
Stainless Steel Plumbing Fixtures — Residential Use				CS-243 -62
Mechanical Seal Water Closet				TSC-1 -1959
Waste Holding Tanks				TSC-2 -1960a
Water Storage Tanks				TSC-4 -1960
Drains for Prefabricated and Precast Showers				UPC-PS 4-66
Shower Drainage Fittings				UPC-PS 5-66
Cultured Marble Lavatory				UPC-PS 18-65
Prefabricated Shower Receptors, Prefabricated Stall Showers				TSC 11-64
Self-contained, Electrically Operated Recirculating, Chemically Controlled Toilet				TSC 12-65-T

## Notes to Table II

Abbreviations used in Table II refer to standards as identified below and elsewhere in this standard.

AGA: Standards and Tentative Standards published by the *American Gas Association*, 1032 East 62nd Street, Cleveland, Ohio 44103.

ASA: *American Standards Association* — now *United States of America Standards Institute* (USASI), to 10 East 40th Street, New York, N.Y. 10016.

ASME: Standards and Tentative Standards published by the *American Society of Mechanical Engineers*, 345 East 47th Street, New York, N. Y. 10017.

ASTM: Standards and Tentative Standards published by the *American Society for Testing and Materials*, 1916 Race Street, Philadelphia, Pa. 19103.

AWWA: Standards and Tentative Standards published by the *American Water Works Association*, 2 Park Ave., New York, N. Y. 10016.

CS: Commercial Standards representing recorded voluntary recommendations of the trade, issued by the *United States Department of Commerce* and obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

FS: Federal Specifications published by the *Federal Specifications Board* and obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

IAPMO: Standards and Tentative Standards designated above as UPC-PS (Uniform Plumbing Code — Product Standard) and TSC (Trailer Standard) available from the *International Association of Plumbing and Mechanical Officials*, 5032 Alhambra Ave., Los Angeles, Calif. 90032 (formerly *Western Plumbing Officials Association* (WPOA)).

MSS: Standards published by the *Manufacturers Standardization Society of the Valve and Fittings Industry*, 420 Lexington Avenue, New York, N. Y. 10017.

NSF: Standards and Tentative Standards published by the *National Sanitation Foundation*, Ann Arbor, Michigan 48106.

SPR: Simplified Practice Recommendations representing recorded recommendations of the trade and issued by the *United States Department of Commerce*, Washington, D. C. 20234.

TSC: See IAPMO.

UL: Standards and Tentative Standards published by the *Underwriters' Laboratories, Inc.*, 207 East Ohio Street, Chicago, Illinois 60611.

UPC-PS: See IAPMO.

USAS: *A United States of America Standard* (usually followed by a number and date) as available from or through the United States of America Standards Institute (USASI).

USASI: United States of America Standards Institute, 10 East 40th Street, New York, N. Y. 10016.

**6.3 Specific Usage.** Each of the following sections indicates specifically the type of material presently permitted for use in the various parts of the plumbing system.

## 7. Joints and Connections

**7.1 Tightness.** Joints and connections in the plumbing system shall be gastight and watertight for the pressures required under testing procedures.

**7.1.1 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.

**7.1.2 Threaded Joints.** Threads for screw pipe and fittings shall conform to the approved or listed standard. All burrs shall be removed. Pipe ends shall be reamed out to size of bore, and all chips shall be removed. Pipe joint cement or thread lubricant shall be of approved type and applied to male threads only.

**7.1.3 Solder Joints.** Solder joints for tubing shall be made with approved or listed sweat solder type fittings. Surfaces to be soldered shall be cleaned bright. The joints shall be properly fluxed with noncorrosive paste type flux and made with approved or listed 50-50 solder or an approved solder having a higher melting temperature.

**7.1.4 Plastic Pipe and Fittings.** Plastic pipe and fittings shall be joined by installation methods recommended by the manufacturer or by a recognized, approved, or listed standard. They shall not affect the potability of the water.

**7.1.5 Union Joints.** Metal unions shall have metal-to-metal ground seats.

**7.1.6 Flared Joints.** Flared joints for soft-copper water tubing shall be made with listed fittings. The tubing shall be expanded with a proper flaring tool.

## 8. Traps and Cleanouts

### 8.1 Traps

**8.1.1 Traps Required.** Each plumbing fixture shall be separately trapped by an approved water seal "P" trap. Water closets,

except mechanical sealed water closets and circulating chemical toilets shall have integral traps.

**8.1.2 Dual Fixtures.** A two-compartment sink or two single sinks or two lavatories set immediately adjacent to each other in the same room with waste outlets not more than 30 inches apart may be connected to one trap and may be considered as one fixture for the purpose of drainage and vent requirements.

**8.1.3 Prohibited Traps.** No form of trap which depends for its seal upon concealed interior partitions shall be used. Full "S" traps, bell traps, drum traps, and crown-vented traps are prohibited, and no fixture shall be double-trapped.

**8.1.4 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 gage, or 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 metal of the trap, and each tubing shall show the gage of the tubing.

**8.1.5 Trap Seal.** Each trap shall have a water seal of not less than 2 inches and not more than 4 inches and shall be set true to its seal.

**8.1.6 Size.** Traps shall be not less than 1½ inches in diameter, except that a 1¼-inch diameter trap may be used when connected to a single fixture having no more than a 2-inch drain opening. No trap shall be larger than the waste pipe to which it is connected.

**8.1.7 Location.** Each trap shall be located as close to its vent and to its fixture outlet as structural conditions will permit.

**8.1.8 Distance from Trap to Vent.** The distance between a trap and its vent or vented waste line shall be in accordance with Table 3 (see 13.3.5 of this Part).

**8.1.9 Length of Tailpiece.** The vertical distance from a trap to the fixture outlet shall not exceed 24 inches.

#### **8.1.10 Installation**

**8.1.10.1 Grade of Fixture Drain.** The fixture drain piping between a trap and the fixture tee or the vented waste line shall be graded ¼ inch per foot towards the vent and in no event shall have a slope greater than its diameter. Except for water closet

drains, the vent opening at fixture tees shall not be below the invert of the trap outlet.

**8.1.10.2 Fixture Drain Offset.** The fixture drain piping between the trap and vent may change direction or be offset horizontally with the equivalent of no more than 180 degrees.

**8.1.10.3 Concealed Traps.** Traps with slip joint connections shall be readily accessible for repair and inspection.

**8.1.10.4 Protection.** Traps shall be adequately protected from damage during transit and from freezing, where necessary, during normal occupancy.

## 8.2 Cleanout Openings

### 8.2.1 Location of Cleanout Fittings

**8.2.1.1 Cleanouts** shall be installed if the drainage system cannot be cleaned through fixtures, drains, or vents. Cleanouts shall also be provided when fittings of more than 45 degrees are used to affect an offset except where long turn ells are used which provide sufficient "sweep" for cleaning.

**8.2.1.2** A full size cleanout shall be installed at the upper end of any section of drain piping which does not have the required minimum slope of  $\frac{1}{4}$  inch per foot grade.

**8.2.1.3** A cleaning tool shall not be required to pass through more than 360 degrees of fittings to reach any part of the drainage system.

**8.2.2. Access to Cleanouts.** Cleanouts shall be accessible through an unobstructed minimum clearance of 12 inches 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 mobile home, with pipe and fittings installed, as required, for drainage piping.

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

**8.2.4 Design.** Cleanout plugs shall have raised heads except that plugs at floor level shall have counter-sunk slots.

## 9. Plumbing Fixtures

### 9.1 General Requirements

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

**9.1.2 Strainers.** The waste outlet of all plumbing fixtures, other than water closets, shall be covered with substantial metal strainers that will provide an adequate unobstructed waterway.

**9.1.3 Fixture Connections.** Fixture tailpieces and continuous wastes in exposed or accessible locations shall be not less than No. 20 Brown and Sharpe gage seamless drawn-brass tubing or other approved 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 inches for sinks of two or more compartments, dishwashers, clothes washing machines, laundry tubs, bath tubs, and not less than 1¼ inches for lavatories and single compartment sinks having a 2 inch maximum drain opening.

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

**9.1.5 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 force-discharge fixture or appliance. Dishwasher drains shall not be connected to a sink tailpiece, continuous waste, or trap on the discharge side of a food-waste disposal unit.

### 9.2 Fixtures

#### 9.2.1. Water Closet

**9.2.1.1** Each water closet 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.

**9.2.1.2** Water closet flushing devices shall be designed to replace the water seal in the bowl after each operation. Flush valves,

flushometer valves, and ball cocks shall operate automatically to shut off at the end of each flush or when the tank is filled to operating capacity.

9.2.1.3 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 water closet, through the tank.

9.2.1.4 Water closets that have fouling surfaces that are not thoroughly washed at each discharge shall be prohibited. Any water closet that might permit the contents of the bowl to be siphoned back into the water system shall be prohibited.

## 9.2.2 Shower Stalls

9.2.2.1 Each shower stall receptor shall be provided with an approved-type watertight receptor, with sides and back extending 1 inch above the finished dam or threshold. In no case shall the depth of a shower receptor be less than 2 inches or more than 9 inches measured from the top of the finished threshold to the top of the drain. The wall area in shower compartments shall be constructed of smooth, noncorrosive, and nonabsorbent waterproof materials to a height not less than 6 feet above the floor level. Such walls shall form a watertight joint with each other and with the receptor or shower floor. The floor shall slope uniformly to the drain at not less than one-fourth nor more than one-half inch per foot.

9.2.2.2 The joint around the drain connection and around the water closet outlets in combination compartments shall be made watertight by a flange, clamping ring, or other approved or listed means.

9.2.2.3 Hinged shower doors shall open outward.

9.2.2.4 Prefabricated shower stalls shall be approved or listed and shall comply with all the requirements relating to plumbing fixtures and shower stalls.

9.2.3. Fixed Shower and Tub Enclosures. Fixed shower doors and tub and shower enclosures shall be constructed of materials such as wired-glass, laminated safety glass, fiberglass, reinforced plastics, or other listed materials.

## 9.2.4 Dishwashing Machines

9.2.4.1 No dishwashing machine shall be directly connected to any waste piping, but shall discharge its waste through a fixed

air gap installed above the machine. The drain connection from the air gap may connect to an individual trap, to a directional fitting installed in the sink tailpiece, or to the opening provided on the inlet side of a food waste disposal unit.

9.2.4.2 Drain from a dishwashing machine shall not be connected to a continuous waste line or trap on the discharge side of a food waste disposal unit.

### 9.2.5 Clothes Washing Machines

9.2.5.1 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.

9.2.5.2 Standpipes shall be 1½ inches, minimum, nominal iron pipe size, or 1½ inches outside diameter nominal brass tubing not less than No. 20 Brown and Sharpe gage. 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 inches or more than 30 inches above its trap and shall terminate in an accessible location not less than 6 inches above the highest water level of the clothes washing machine.

9.2.5.3 No clothes washing machine drain shall be connected to the tailpiece, continuous waste, or trap of any sink or dishwashing machine.

### 9.3 Installation

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

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

9.3.3 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 adequate size bolts or screws of brass or other noncorrosive metal.

9.3.4 Floor Connection. Water closets shall be rigidly bolted to the closet flange, and when screw holds are provided the bowl shall also be solidly fastened to the floor. Bolts and screws shall be adequate in size and shall be made of solid brass or other

approved or listed noncorrosive metal. An approved or listed gasket or setting compound shall be used to form a watertight seal between the fixture and the drain connection. The exposed joint between the fixture and the floor shall be made watertight, and the floor under the water closet, and to at least 6 inches around the fixture, shall be made impervious to moisture.

## 10. Hangers and Supports

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

**10.2 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.

### 10.3 Hangers and Anchors

**10.3.1 Hangers and anchors** shall be of sufficient strength to support their proportional share of the pipe alignments and prevent rattling.

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

## 11. Water Distribution System

### 11.1 Water Supply

**11.1.1 Potable Water.** Water piping shall be sized to provide an adequate quantity of running water to each plumbing fixture at a flow rate sufficient to flush and keep the fixture in a clean and sanitary condition without any danger of backflow or siphonage.

**11.1.2 Hot Water Supply.** Each mobile home equipped with a kitchen sink, and bathtub and/or shower shall be provided with a hot water supply system including a water heater.

### 11.2 Water Outlets and Supply Connections

**11.2.1 Water Connection.** Each mobile home with a water distribution system shall be equipped with a  $\frac{3}{4}$ -inch inlet coupling located within the rear third of the length of the mobile home. 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 attached with a substantial chain. A master cold water shutoff gate valve shall be installed on the main feeder line in an accessible area.

### 11.2.2 Prohibited Connections

11.2.2.1 The installation of water supply piping or fixture or appliance connections shall be made in manner to preclude the possibility of used, unclean, polluted, or contaminated water, mixtures, or substances entering any part of the water supply system from any tank, receptacle, equipment, or plumbing fixture by reason of siphonage, suction, or any other cause, either during normal use and operation or when any such tank, receptacle, equipment, or plumbing fixture is flooded or subject to pressure in excess of the operating pressure in the water piping system.

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

11.2.3 Rim outlets. The outlets of faucets, spouts, and similar devices shall be spaced at least 1 inch above the flood level of the fixture.

11.2.4 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.

11.2.5 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 inches from the flood level of the fixture to the critical level mark unless otherwise permitted in their approval.

11.2.6 Flush Tanks. Water closet flush tanks shall be equipped with an approved anti-siphon ball cock which shall be installed and maintained with its outlet or critical level mark not less than 1 inch above the full opening of the overflow pipe.

11.2.7 Critical Level. The critical level, C-L or  $\frac{C}{L}$  marking on a backflow prevention device or vacuum breaker is a point established by the testing laboratory (usually stamped on the device by the manufacturer) which determines the minimum elevation above the flood level rim of the fixture or receptacle served on which the device may be installed. When a backflow prevention

device does not bear a critical level marking, the bottom of the vacuum breaker, combination valve, or of any such approved or listed device shall constitute the critical level.

**11.2.8 Backflow Preventer.** When pressure- or gravity-type water supply tanks or reservoirs (except water heaters or flush tanks) for storing potable water are connected to the water distribution system of mobile homes, they shall have an approved or listed spring-loaded check valve or other approved or listed type backflow prevention device installed in the water-supply piping adjacent to the inlet coupling. An approved or listed pressure relief valve shall be required on the outlet side of the check valve.

### 11.3 Safety Devices

#### 11.3.1 Relief Valves

**11.3.1.1** All water heaters shall be installed with approved and listed fully-automatic valve or valves designed to provide temperature and pressure relief.

**11.3.1.2** Any temperature relief valve or the 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 inches of the tank. It shall be set to start relieving at a pressure not exceeding the rated working pressure of the tank and at or below a water temperature of 210 degrees F.

**11.3.1.3** All relief valves shall have connected a drainpipe not smaller than the relief valve drain connection pipe size. Where the relief valve is located within the mobile home, the drain line shall extend outside, with the end directed downward in a location where the outlet end will be protected from dirt, mud and freezing. No part of the drain line shall be trapped.

#### 11.3.2 Water Supply Tanks and Heaters

**11.3.2.1** Pressure and gravity cold water storage tanks shall be constructed of sound, nontoxic, durable materials, corrosion resistant, and shall impart no taste or odor to the potable water in the system. Each pressure tank shall be capable of withstanding 200 psi minimum test water pressure.

**11.3.2.2** Each storage water heater shall be provided with a three-quarter ( $\frac{3}{4}$ )-inch pipe tapping for a combined pressure-temperature relief valve within the top 6 inches of the tank. The tapping shall be in a location which will permit easy access for installing, testing and maintenance of the valve.

## 11.4 Materials

**11.4.1 Piping Material.** Water pipe shall be of standard weight brass, galvanized wrought iron, galvanized steel, Type L copper tubing, approved or listed plastic, or other approved or listed material (see 11.4.2).

**11.4.2 Plastic Piping.** Mobile homes that have no provision for hot water piping or hot water faucets, or no space allotted for a water heater, may have cold water piping (only), and fittings may be constructed from approved or listed plastic.

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

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

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

**11.4.3.3 Fittings for cold water, plastic water piping** shall be of approved or listed brass or plastic.

**11.4.4 Prohibited Material.** Used piping materials shall not be permitted. Pipe dope, solder flux, oils, solvents, chemicals, or other substances that are toxic, corrosive, or otherwise detrimental to the water system shall not be used.

## 11.5 Installation of Piping

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

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

**11.5.3 Solder Fittings.** Copper tubing shall be joined to sweat solder fittings by means of hot solder and a noncorrosive flux. The surfaces to be soldered shall be thoroughly cleaned. The use of self-cleaning fluxes shall not be permitted.

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

**11.5.5 Plastic Pipe and Fittings.** Plastic pipe and fittings shall be joined by installation methods recommended by the manufacturer or by a listed standard.

## 11.6 Size of Water Supply Piping

**11.6.1 Minimum Size.** The size of water supply piping and branch lines shall not be less than sizes shown in Table 2.

TABLE 2

Minimum Size Tubing and Pipe for Water Distribution Systems

Number of Fixtures	Tubing		Pipe Iron Pipe Size (Inches)
	Inner Dia. (Inches)	Outer Dia. (Inches)	
1	$\frac{1}{4}$ *	$\frac{3}{8}$	$\frac{1}{2}$
2	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{1}{2}$
3	$\frac{1}{2}$	$\frac{3}{8}$	$\frac{1}{2}$
4	$\frac{1}{2}$	$\frac{3}{8}$	$\frac{1}{2}$
5 or more	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{3}{4}$

\*6 feet maximum length for  $\frac{1}{4}$  inch id tubing.

Exceptions to Table:  $\frac{3}{8}$  inch id nominal or  $\frac{1}{2}$  inch od minimum size for clothes washing or dishwashing machines, unless larger size is recommended by the fixture manufacturer.

$\frac{1}{2}$  inch id nominal or  $\frac{3}{8}$  inch od minimum size for flushometer or metering type valves unless otherwise specified in their listing.

No galvanized screw piping shall be less than  $\frac{1}{2}$  inch iron pipe size.

**11.6.2 Sizing Procedure.** Both hot and cold water piping systems shall be computed by the following method:

**11.6.2.1 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 totalled so that no fixture is counted twice. Following down the left-hand column of Table 2 a corresponding number of fixtures will be found. The required pipe or tubing size is indicated in the other columns on the same line.

11.6.2.2 A water heater or food waste disposal unit shall not be counted as a water-using fixture when computing pipe sizes.

11.7 **Line Valves.** Valves, when installed in the water supply distribution system (except those immediately controlling one fixture supply) and when 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.

## 12. Drainage Systems

### 12.1 Materials

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

12.1.2 **Fittings.** Drainage fittings shall be recessed drainage pattern with smooth interior waterways of the same diameter as the piping and shall be of a material conforming to the type of piping used. Drainage fittings shall be designed to provide for a  $\frac{1}{4}$  inch per foot grade in horizontal piping.

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

12.1.2.2 Fittings for copper tubing shall be cast brass or drawn copper sweat solder.

12.1.2.3 Fittings for plastic piping shall be made to listed standards.

12.1.2.4 Brass adaptor fittings shall be used to join copper tubing to threaded pipe.

### 12.2 Drain Outlets

12.2.1 **Location of Drain.** Each mobile home shall have only one drain outlet which shall terminate in the rear third section on the left (road) side. This outlet shall be tagged or marked "Drain Outlet" or "Sewer Outlet."

12.2.2 **Exception.** A drain outlet may terminate horizontally when it is equipped with an acceptable fitting(s).

12.2.3 **Cap or Plug.** A cap or plug on the drain outlet shall be permanently attached to the structure by a chain or cable.

**12.2.4 Clearance from Drain Outlet.** The drainage outlet and couplers shall be provided with a minimum clearance of 3 inches in any direction from all parts of the structure or appurtenances and with not less than 18 inches unrestricted clearance directly in front of the drainage outlet.

### 12.2.5 Hose Couplers and Caps

**12.2.5.1** Hose couplers for drain outlets shall be a quick disconnect type not requiring any special tools or knowledge to make the connection or remove the drain hose.

**12.2.5.2** Hose couplers and drain hoses shall not be smaller than the piping to which they are connected and shall be equipped with a watertight cap or plug matching the drainage outlet or coupler. The cap or plug shall be permanently attached to the structure by means of a substantial chain.

**12.2.5.3** Drain outlet or attached drain hoses for drain piping connected to a mobile home shall be 3 inches minimum inside diameter.

**12.3 Fixture Connections.** Drainage piping shall be provided with approved or listed inlet fittings for fixture connections, correctly located according to the size and type of fixture to be connected.

**12.3.1 Water Closet Connection.** The drain connection for each water closet shall be 3 inches minimum inside diameter and shall be fitted with an iron, brass, or listed plastic floor flange adaptor ring securely screwed, soldered or otherwise permanently attached to the drain piping, in an approved manner and securely fastened to the floor.

### 12.4 Size of Drainage Piping

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

**12.4.1.1** A 1½-inch minimum diameter piping shall be required for one and not more than three individually vented fixtures.

**12.4.1.2** A 2-inch minimum diameter piping shall be required for four or more fixtures individually vented.

**12.4.1.3** A 3-inch minimum diameter piping shall be required for water closets.

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

**12.5.1 Horizontal Piping.** All parts of a wet-vented drainage system, including the connected fixture drains, shall be horizontal except for wet-vented vertical risers which shall terminate with a 1½-inch minimum diameter continuous vent. Where required by structural design, wet-vented drain piping may be offset vertically when other vented fixture drains or relief vents are connected to the drain piping below the vertical offsets.

**12.5.2 Size.** A wet-vented drain pipe shall be 2 inches minimum diameter and at least one pipe size larger than the largest connected trap or fixture drain. Not more than three fixtures may connect to a 2-inch diameter wet-vented drain system.

**12.5.3 Length of Fixture Drain.** Fixture traps shall be located within the distance given in Table 3 (see 13.3.5 of this Part). Not more than one trap shall connect to a trap branch.

## 12.6 Offsets and Branch Fittings

**12.6.1 Changes in Direction.** Changes in direction of drainage piping shall be made by the appropriate use of approved or listed fittings, and shall be of the following angles: 11¼, 22½, 45 or 60 degrees; or other approved or listed fittings or combination of fittings with equivalent radius or sweep.

**12.6.2 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. No fitting having more than one branch at the same level shall be used, unless the fitting is constructed so that the discharge from any one branch cannot readily enter any other branch. However, a double sanitary "T" may be used when the drain line is increased not less than two pipe sizes.

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

**12.7 Slope of Horizontal Drainage Piping.** Horizontal drainage piping shall be run in practical alignment and have a uniform slope of not less than  $\frac{1}{4}$  inch per foot toward the mobile home drain outlet. Where it is impractical, due to the structural features or arrangement of any mobile home, to obtain a slope of  $\frac{1}{4}$  inch per foot, the pipe or piping may have a slope of not less than  $\frac{1}{8}$  inch per foot, when a full size cleanout is installed at the upper end.

### 13. Vents and Venting

**13.1 General.** Each plumbing fixture trap shall be protected against siphonage and back pressure, and air circulation shall be ensured throughout all parts of the drainage system by means of vent pipes installed in accordance with the requirements of this section and as otherwise required by this standard.

#### 13.2 Materials

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

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

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

**13.2.2.2 Fittings for copper tubing** shall be cast brass or drawn copper sweat solder pattern.

**13.2.2.3 Fittings for plastic piping** shall be made to recognized, approved, or listed standards.

**13.2.2.4 Brass adaptor fittings** shall be used to join copper tube to threaded pipe.

**13.2.2.5 Listed rectangular cross section pipe** may be used for vent piping *only* providing it has an open cross section at least equal to the circular vent pipe required. Listed transition fittings shall be used.

#### 13.3 Size of Vent Piping

**13.3.1 Main Vent.** The drain piping for each water closet shall be vented by a  $1\frac{1}{2}$ -inch minimum diameter vent or rectangular

vent of venting cross section equivalent to or greater than the venting cross section of a 1½-inch diameter vent, connected to the main drain by one of the following methods:

- (a) A 1½-inch diameter (min.) individual vent pipe or equivalent directly connected to the water closet drain and extended undiminished in size through the roof.
- (b) A 1½-inch diameter (min.) continuous vent or equivalent indirectly connected to the water closet drain piping through a 2-inch wet-vented drain that carries the waste of not more than one fixture, or not more than two fixtures when one is a combination compartment drain.
- (c) Two or more vented drains when at least one is wet-vented and each drain is separately connected to the main drain.

**13.3.2 Individual Vents.** A vent pipe equivalent in area to 1¼-inch tubing required for all individually vented fixtures with a 1½-inch or smaller trap. The main vent, water closet vent and relief vent, and the continuous vent of wet-vented systems shall have an area equivalent to 1½-inch tubing.

*Exception: In the case of copper tube, 1¼ inch nominal size may be used for individual vents.*

**13.3.3 Common Vent.** When two fixture traps located within the distance allowed from their vent have their trap arms connected separately at the same level into an approved double fitting, an individual vent pipe may serve as a common vent without any increase in size.

**13.3.4 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 and shall have a minimum area equivalent to a 1½ inch IPS.

**13.3.5 Distance of fixture trap from vent** shall not exceed the values given in Table 3 (next page).

#### 13.4 Grade and Connections

**13.4.1 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 inches 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 (down-

**TABLE 3**  
**Distance of Fixture Trap from Vent**

Size of Fixture Drain (Inches)	Distance Trap to Vent
1¼	4 feet 6 inches
1½	4 feet 6 inches
2	5 feet 0 inches
3	6 feet 0 inches

stream) of the trap. Where required by structural conditions, vent piping may offset below the rim of the fixture at the maximum angle or height possible.

**13.4.2 Grade.** Vents shall grade or drain back to the drainage system by gravity.

### 13.5 Vent Terminal

**13.5.1 Roof Extension.** Each vent pipe shall extend through its flashing and terminate vertically, undiminished in size, not less than 2 inches above the roof. Vent openings shall not be less than 3 feet, 0 inch away from any motor-driven air intake that opens into habitable areas.

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

## 14. Test and Inspection

**14.1 Water System.** All water piping in the water distribution system shall be subjected to a pressure test before any portion is covered or concealed. The test shall be made by subjecting the system to air or water at 100 psi for 15 minutes without leakage or loss of pressure. An adequate and accurate pressure gage shall be used on all tests.

**14.2 Drainage and Vent System and Plumbing Fixtures.** The waste and vent system shall be tested by one of the following alternate methods for evidence or indication of leakage.

**14.2.1 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. The system shall be watertight at all points.

**14.2.2 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 inch (manometer) water column air pressure test. If the system loses pressure, leaks may be located with smoke pumped into the system, or with soap suds spread on the exterior of the piping (Bubble test).

**14.2.3. Flood Level Test.** The mobile 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 should be plugged.) After all trapped air has been released, the test shall be sustained for not less than 15 minutes. The waste piping above the level of the water closet shall be tested and show no indication of leakage when the high fixtures are filled with water and emptied simultaneously to obtain the maximum possible flow in the drain piping.

**14.2.4 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.

**14.3 Shower Stalls.** Nonmetallic shower stall linings 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.

## Part III

### Heating Systems

#### 1. Introduction

1.1 Those members of the engineering profession and others associated with the design, manufacturing, installation, and inspection of mobile home heating systems have been aware of the need for uniform technical standards leading to the safe use of this special type of equipment. They have also recognized that, because of unique conditions of transport and use, existing heating equipment standards for motor vehicles or for buildings are not completely applicable to mobile homes. It is with these factors in mind that Part III of this standard has been developed.

1.2 Much of the material in Part III has been taken from, or is based on, nationally recognized standards for heat producing appliances and fuel supply systems including those of the National Fire Protection Association.

#### 2. Scope

2.1 This standard covers the heating systems and equipment installed within or on mobile homes.

2.2 This standard is not intended as a design specification or an instruction manual for untrained persons.

2.3 Wherever nationally recognized standards for heat producing appliances and fuel supply systems and Part III of this standard differ, the requirements of the latter shall apply.

2.4 The provisions of this standard are not intended to prevent the use of any material, appliance, installation, device, arrangement, or method of construction not specifically prescribed herein, provided any such alternative has been approved. An enforcement agency may approve any such alternative if it finds the proposed design is satisfactory for the purpose intended, and if the material, appliance, installation, device, arrangement, and method or work offered is, for the purpose intended, at least the equivalent in performance of that prescribed in this standard considering quality, strength, effectiveness, durability, safety, and protection of life and health. An enforcement authority shall require that satisfactory evidence or proof be submitted to substantiate any claims that may be made regarding the use of any such alternative.

### 3. Definitions

**Accessible.** When applied to a fixture, connection, appliance or equipment shall mean having access thereto, but which may require the removal of an access panel, door or similar obstruction.

**Air Duct.** Conduits or passageways for conveying air to or from heating, cooling, air conditioning or ventilation equipment, but not including the plenum.

**Appliance Branch Piping.** Any run of piping or tubing, and fittings, not a part of an appliance that is used to convey fuel from the main piping manifold to a heat-producing appliance.

**Approved.** The word "approved" as used in this standard means acceptable to the authority having jurisdiction.

**Automatic Pump (Oil Lifter).** A pump, not an integral part of the oil-burning appliance, that automatically pumps oil from the supply tank and delivers the oil by gravity under a constant head to an oil-burning appliance.

**BTU. British Thermal Units.** The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

**BTUH.** British thermal units per hour.

**Burner.** A device for the final conveyance of fuel or a mixture of fuel and air to the combustion zone.

**Clearance.** The distance between the appliance, chimney, vent, chimney or vent connector or plenum and the nearest surface.

**Combustible Material.** The term applies to materials adjacent to, or in contact with, heat producing appliances, chimney connectors and vent connectors, steam and hot water pipes, and warm air ducts. Such material is made of, or surfaced with, wood, compressed paper, plant fibers, or other material that will ignite and burn. These materials shall be considered as combustible even though flameproofed, fire-retardant treated, or plastered.

**Connector-Gas Appliance.** A connector used to convey fuel gas, three feet or less in length (six feet or less for ranges) between a gas outlet and gas appliance in the same room with the outlet.

**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