NFPA

13D

ANSI / NFPA 13D
An American
National
Standard
November 20, 1980

SPRINKLER SYSTEMS—ONE- AND TWO-FAMILY DWELLINGS 1980

NATIONAL FIRE PROTECTION ASSOCIATION, INC.
Batterymarch Park, Quincy, MA 02269

3M-1-81-FP
Printed in U.S.A.

NOTICE

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

For information on obtaining Formal Interpretations of the document, proposing Tentative Interim Amendments, proposing amendments for Committee consideration, and appeals on matters relating to the content of the document, write to the Secretary, Standards Council, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

Statement on NFPA Procedures

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

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

Standard for the

Installation of Sprinkler Systems in One- and Two-Family Dwellings and Mobile Homes

NFPA 13D-1980

1980 Edition of NFPA 13D

This 1980 edition of NFPA 13D, *Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Mobile Homes*, was prepared by the Technical Committee on Automatic Sprinklers and was adopted by the National Fire Protection Association, Inc. on November 20, 1980 at its Fall Meeting in San Diego, CA. It was released for publication by the Standards Council on December 10, 1980. It supersedes the 1975 edition.

Origin and Development of NFPA 13D

Recognizing the need to reduce the annual life loss from fire in residential occupancies (about 50 percent of total loss of life by fire), the Committee on Automatic Sprinklers appointed a subcommittee in May 1973 to prepare a Standard on the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Mobile Homes. The Subcommittee was composed of members of the Committee on Automatic Sprinklers and other technically competent experts. The standard was submitted and adopted at the Annual Meeting in Chicago, IL on May 12-16, 1975.

The 1980 edition is a complete rewrite of the 1975 edition including SI units where appropriate. The 1980 edition incorporates the results of the residential sprinkler test program administered by the National Fire Protection Association and funded by a research grant from the United States Fire Administration. Factory Mutual Research Corporation and the Los Angeles City Fire Department conducted the dwelling tests. Factory Mutual Research Corporation, McNeary Insurance Consulting Services and the Charlotte, North Carolina Fire Department conducted the mobile home tests.

Committee on Water Extinguishing Systems and Related Equipment

Correlating Committee

Paul D. Smith, *Chairman*
Gage-Babcock & Associates, Inc.

Robert M. Hodnett, *Secretary*
National Fire Protection Association
(Nonvoting)

Wayne E. Ault, Rolf Jensen & Assoc., Inc.

Thomas J. Brown, Jr., Factory Mutual Research Corp.

John D. Cook, Catalytic Inc.

Robert H. Merz, Moorestown, NJ

James W. Nolan, James W. Nolan Co.

Chester W. Schirmer, Schirmer Engineering Corp.

J. Samuel Slicer, W. Chatham, MA

Nonvoting

Stephen Gilbert, Scandia Industries
Rep. NFPA Fire Hose Comm.

Technical Committee on Automatic Sprinklers

Chester W. Schirmer, *Chairman*
Schirmer Engineering Corp.

Richard F. Edington, *Secretary*
American Risk Management

Frank E. Cann, Jr., Standard Fire Protection Equipment Co.

Ronald M. Cote, Factory Mutual Research Corp.

John L. DeRoo, Union Carbide Corp.
Rep. NFPA Industrial Fire Protection Section

Lee J. Dosedlo, Underwriters Laboratories Inc.

Denison H. Featherstonhaugh, Ontario, Canada
Rep. Canadia Automatic Sprinkler Assn.

D. B. Grant, Insurers Advisory Organization

David M. Hammerman, Office of the Fire Marshal, MD
Rep. Fire Marshals Assn. of North America

W. L. Henry, Dow Chemical Co.
Rep. Manufacturing Chemists, Assn.

Richard E. Hughey, Insurance Services Office

Rolf H. Jensen, Rolf Jensen & Assoc., Inc.

Marshall A. Klein, Elderburg, MD
Rep. Fire Marshals Assn. of North America

Richard P. Kuchnicki, National Assn. of Home Builders
(Vote limited to NFPA 13D)

W. N. Lawton, Grinnell Fire Protection Systems Co., Inc.
Rep. National Auto Sprinkler & Fire Control Assn.

Murvan M. Maxwell, Maxwell & LeBreton Architects
Rep. American Institute of Architects

Donald I. McGillivray, Underwriters' Labs of Canada

Edward J. O'Donoghue, Industrial Risk Insurers

John G. O'Neill, U.S. NBS/Center for Fire Research

Robert L. Retelle, Insurance Services Office

E. J. Schiffhauer, Eastman Kodak Co.

Harry Shaw, U.S. Fire Administration, FEMA
(Vote limited to NFPA 13D)

John J. Walsh, United Assn. of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada

Harry R. Winchell, Liberty Mutual Insurance Co.

Rep. Alliance of American Insurers

Jack A. Wood, Viking Corp.

Rep. National Auto Sprinkler & Fire Control Assn.

D. M. Yarlas, ICI American Inc.

Rep. NFPA Industrial Fire Protection Section

Alternates

Thomas J. Brown Jr., Factory Mutual Research Corp.
(Alternate to Ronald M Cote)

Barry L. Clark, Insurance Services Office
(Alternate to R. E. Hughey)

Richard Custer, U.S. NBS/Center for Fire Research
(Alternate to J. G. O'Neill)

Robert E. Duke, Fire Control Inc.
(Alternate to F. E. Cann, Jr.)

Thomas W. Hanna, Road Sprinkler Fitters, Local 669
(Alternate to J. J. Walsh)

Frank C. Hill, Culligan Corp.
(Alternate to National Auto Sprinkler & Fire Control Assn.)

Stephen R. Hoover, Kemper Insurance Cos.
(Alternate to H. Winchell)

Thomas A. Lenton, Libbey-Owens-Ford Co.
(Alternate to J. L. DeRoo)

Joseph T. Merry, Eastman Kodak Co.
(Alternate to E. J. Schiffhauer)

Stanley W. Muller, Sizeler & Muller Architects
(Alternate to M. M. Maxwell)

Morley E. Naylor, Insurance Services Office
(Alternate to R. L. Retelle)

Gerald W. O'Rourke, Schirmer Engineering Corp.
(Alternate to C. W. Schirmer)

Edward Reilly, National Auto Sprinkler & Fire Control Assn.
(Alternate to National Auto Sprinkler & Fire Control Assn.)

J. Kenneth Richardson, Rolf Jensen & Assoc., Inc.
(Alternate to R. Jensen)

W. L. Stuart, Dow Chemical Co.
(Alternate to W. L. Henry)

Miles Suchomel, Underwriters Laboratories Inc.
(Alternate to L. J. Dosedlo)

William Testa, Grinnell Fire Protection Systems Co., Inc.
(Alternate to National Auto Sprinkler & Fire Control Assn.)

D. B. Tucker, Industrial Risk Insurers
(Alternate to Edward J. O'Donoghue)

Nonvoting

Barry M. Lee, Wormald Brothers, Ltd.

This list represents the membership at the time the committee was balloted on the text of this edition. Since that time, changes in membership may have occurred.

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

Contents

Standard for the Installation of Sprinkler Systems In One- and Two-Family Dwellings and Mobile Homes

NFPA 13D-1980

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

Preface

It is intended that this standard provide a method for those individuals wishing to install a sprinkler system for additional life safety and property protection. It is not the purpose of this standard to require the installation of an automatic sprinkler system. This standard assumes that one or more smoke detectors will be installed in accordance with NFPA 74, *Standard for the Installation, Maintenance and Use of Household Fire Warning Equipment.*

Chapter 1 General Information

1-1* Scope. This standard deals with the design and installation of automatic sprinkler systems for one- and two-family dwellings and mobile homes.

1-2* Purpose. The purpose of this standard is to provide a sprinkler system that will aid in the detection and control of residential fires and thus provide improved protection against injury, life loss, and property damage. A sprinkler system installed in accordance with this standard is expected to prevent flashover (total involvement) in the room of fire origin, when sprinklered, and to improve the chance for occupants to escape or be evacuated.

1-3* Definitions.

Approved. Means "acceptable to the authority having jurisdiction."

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

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

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

Check Valve. A valve which allows flow in one direction only.

Control Valve.* A valve employed to control (shut) a supply of water to a sprinkler system.

Density. The quantity of water discharged by an automatic sprinkler over a specific area expressed as gal per min per sq ft [L/(min)m²].

Design Area. An area expressed in sq ft (m²) having a number of sprinklers, all flowing at least at a minimum required application rate.

Dry System. A system employing automatic sprinklers attached to a piping system containing air under atmospheric or higher pressures. Loss of pressure from the opening of a sprinkler or detection of a fire condition causes the release of water into the piping system and out the opened sprinkler.

Dwelling. Any building which contains one or two "dwelling units" intended to be used, rented, leased, let or hired out to be occupied, or which are occupied for habitation purposes.

Dwelling Unit. One or more rooms arranged for the use of one or more individuals living together as in a single housekeeping unit, normally having cooking, living, sanitary and sleeping facilities.

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

Listed. Equipment or materials included in a list published by an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The "authority having jurisdiction" should utilize the system employed by the listing organization to identify a listed product.

Mobile Home. A factory-assembled structure equipped with service connections and made so as to be readily movable as a unit on its running gear and designed to be used as a dwelling unit with or without a foundation.

Preengineered System. A packaged sprinkler system including all components connected to the water supply designed to be installed according to pretested limitations.

Pump. A mechanical device that transfers and/or raises the pressure of a fluid (water).

Residential Sprinkler. An automatic sprinkler which has been specifically listed for use in residential occupancies.

Shall. Indicates a mandatory requirement.

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

Sprinkler-Automatic. A fire suppression device which operates automatically when its heat-actuated element is heated to or above its thermal rating allowing water to discharge over a specific area.

Sprinkler System. An integrated system of piping connected to a water supply, with listed sprinklers which will automatically initiate water discharge over a fire area. When required, the sprinkler system also includes a control valve and a device for actuating an alarm when the system operates.

Standard. A document containing only mandatory provisions using the word "shall" to indicate requirements. Explanatory material may be included only in the form of "fine print" notes, in footnotes, or in an Appendix.

Supply Pressure. Pressure within the supply (i.e., city or private supply water source).

System Pressure. A pressure within the system (i.e., above the control valve).

Water Flow Alarm. A sounding device activated by a water flow detector or alarm check valve and arranged to sound an alarm which will be audible in all living areas over background noise levels with all intervening doors closed.

Water Flow Detector. An electric signaling indicator or alarm check valve actuated by water flow in one direction only.

Wet System. A system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by a fire.

1-4* Maintenance. The owner is responsible for the condition of a sprinkler system and shall keep the system in normal operating condition.

1-5 Design and Installation.

1-5.1 Devices and Materials.

1-5.1.1* Only listed new sprinklers shall be employed in the installation of sprinkler systems.

1-5.1.2 Only approved materials and devices shall be used in sprinkler systems.

Exception: Listing may be waived for tanks, pumps, hangers, water flow detection devices and water control valves.

1-5.1.3 Preengineered systems shall be installed within the limitations which have been established by the testing laboratories where listed.

1-5.1.4* All systems shall be tested for leakage at normal system operating water pressure.

Exception: When a fire department pumper connection is provided, hydrostatic pressure tests shall be provided in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems.

1-6 Units. Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI). Two units (liter and bar), outside of but recognized by SI, are commonly used in international fire protection. These units are listed in Table 1-6 with conversion factors.

Table 1-6

Name of Unit	*Unit Symbol*	*Conversion Factor*
liter	L	1 gal = 3.785 L
liter per minute per sq meter	$(L/min)/m^2$	1 gpm/ft^2 = 40.746 $(L/min)/m^2$
millimeter per minute	1 mm/min	1 gpm/ft^2 = 40.746 mm/min
cubic decimeter	dm^3	1 gal = 3.785 dm^3
pascal	Pa	1 psi = 6894.757 Pa
bar	bar	1 psi = 0.0689 bar
bar	bar	1 bar = 105 Pa

For additional conversions and information see ASTM E380, *Standard for Metric Practice.*

1-6.1 If a value for measurement as given in this standard is followed by an equivalent value in other units, the first stated is to be regarded as the requirement. A given equivalent value may be approximate.

1-6.2 The conversion procedure for the SI units has been to multiply the quantity by the conversion factor and then round the result to the appropriate number of significant digits.

Chapter 2 Water Supply

2-1 General Provisions. Every automatic sprinkler system shall have at least one automatic water supply. When stored water is used as the sole source of supply, the minimum quantity shall equal the water demand rate times 10 min. (*See 4-1.3.*)

2-2* Water Supply Sources. The following water supply sources are acceptable:

(a) A connection to a reliable water works system.

(b) An elevated tank.

(c) A pressure tank installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, and NFPA 22, *Standard for Water Tanks for Private Fire Protection.*

(d) A stored water source with an automatically operated pump.

2-3* Combined Piping System. A piping system serving both sprinkler and domestic needs shall be acceptable when:

(a)* A common water supply connection serves more than one dwelling unit; 5 gal/min (19 L/min) shall be included for domestic use. The domestic use shall be added to the sprinkler system demand in determining the size of common piping and the size of the total water supply requirements.

(b) Smoke detectors are provided in accordance with NFPA 74, *Standard for the Installation, Maintenance and Use of Household Fire Warning Equipment.*

(c) All piping in the system conforms to the piping specifications of this standard.

(d) Permitted by the local plumbing or health authority.

2-4 Mobile Home Water Supply. A water supply for a sprinklered dwelling manufactured off-site shall not be less than that specified on the manufacturer's nameplate [*see 4-4.3 (k) Exception*].

Chapter 3 System Components

3-1 Valves and Drains.

3-1.1 Each system shall have a control valve.

3-1.2 Each sprinkler system shall have a ½ in. or larger drain and test connection with valve on the system side of the control valve.

3-1.3 Additional drains shall be installed for each trapped portion of a dry system which is subject to freezing temperatures.

3-2 Pressure Gages.

3-2.1 A pressure gage shall be installed to indicate air pressure on dry systems and on water supply pressure tanks.

3-3 Piping.

3-3.1 Pipe or tube used in sprinkler systems shall be of the materials in Table 3-3.1 or in accordance with 3-3.2 through 3-3.5. The chemical properties, physical properties and dimensions of the materials listed in Table 3-3.1 shall be at least equivalent to the standards cited in the table and designed to withstand a working pressure of not less than 175 psi (12.1 bars).

Table 3-3.1

Materials and Dimensions	Standard
Ferrous Piping (Welded and Seamless), Welded and Seamless Steel Pipe for Ordinary Uses, Specification for Black and Hot-Dipped Zinc Coated (Galvanized)	ASTM A120
Specification for Welded and Seamless Steel Pipe	ASTM A53
Wrought-Steel Pipe	ANSI B36.10
Specifications for Electric-Resistance Welded Steel Pipe	ASTM A135
Copper Tube (Drawn, Seamless) Specification for Seamless Copper Tube	ASTM B75
Specification for Seamless Copper Water Tube	ASTM B88
Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube	ASTM B251
Brazing Filler Metal (Classification BCuP-3 or BCuP-4)	AWS A5.8
Specification for Solder Metal, 95-5 (Tin-Antimony-Grade 95TA)	ASTM B32
Specification for Solder Metal, 50-50	ASTM B32

3-3.2 Other types of pipe or tube may be used, but only those investigated and listed for this service by a testing and inspection agency laboratory.

3-3.3 Whenever the word pipe is used in this standard, it shall be understood to also mean tube.

3-3.4 Schedule 10 steel pipe may be joined with mechanical groove couplings approved for service with grooves rolled on the pipe by an approved groove rolling machine.

3-3.5 Fittings used in sprinkler systems shall be of the materials listed in Table 3-3.5 or in accordance with 3-3.7. The chemical properties, physical properties and dimensions of the materials listed in Table 3-3.5 shall be at least equivalent to the standards cited in the table. Fittings used in sprinkler systems shall be designed to withstand the working pressures involved, but not less than 175 psi (12.1 bars) cold water pressure.

Table 3-3.5

Materials and Dimensions	Standard
Cast Iron	
Cast Iron Screwed Fittings, 125 and 250 lb.	ANSI B16.4
Cast Iron Pipe Flanges and Flanged Fittings	ANSI B16.1
Malleable Iron	
Malleable Iron Screwed Fittings, 150 and 300 lb.	ANSI B16.3
Steel	
Factory-Made Wrought Steel Buttweld Fittings	ANSI B16.9
Buttwelding Ends for Pipe, Valves, Flanges and Fittings	ANSI B16.25
Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures	ASTM A234
Steel Pipe Flanges and Flanged Fittings	ANSI B16.5
Forged Steel Fittings, Socket Welded and Threaded	ANSI B16.11
Copper	
Wrought Copper and Bronze Solder-Joint Pressure Fittings	ANSI B16.22
Cast Bronze Solder Joint Pressure Fittings	ANSI B16.18

3-3.6 Joints for the connection of copper tube shall be brazed.

Exception: Soldered joints may be used for wet-pipe copper tube systems.

3-3.7 Other types of fittings may be used, but only those investigated and listed for this service by a testing and inspection agency laboratory.

3-4 Piping Support.

3-4.1 Piping shall be supported from structural members. This standard contemplates hanging methods comparable to those used in local plumbing codes.

3-4.2 Piping laid on open joists or rafters shall be secured to prevent lateral movement.

3-5 Sprinklers.

3-5.1 Listed residential sprinklers shall be used. The basis of such a listing shall be tests to establish the ability of the sprinklers to control residential fires under standardized fire test conditions. The standardized room fires shall be based on a residential array of furnishings and finishes.

3-5.2 The sprinklers shall have fusing temperatures not less than 35°F (19°C) above maximum expected ambient temperature.

3-5.3 Operated, damaged, or painted sprinklers shall be replaced with sprinklers having the same performance characteristics as original equipment.

3-6* Alarms. Local water flow alarms shall be provided on all sprinkler systems.

Exception: Dwellings or mobile homes having smoke detectors in accordance with NFPA 74, Standard for the Installation, Maintenance, and use of Household Fire Warning Equipment.

Chapter 4 System Design

4-1 Design Criteria

4-1.1 Design Discharge. The system shall provide a discharge of not less than 18 gal/min (68 L/min) to any single operating sprinkler and not less than 13 gal/min (49 L/min) per sprinkler to all operating sprinklers in the design area.

4-1.2* Number of Design Sprinklers. The number of design sprinklers shall include all sprinklers within a compartment to a maximum of 2 sprinklers.

Exception: For dry-pipe systems the design area shall include all sprinklers within a compartment to a maximum of 4 sprinklers.

4-1.2.1 The definition of compartment for use in 4-1.2 to determine the number of design sprinklers is a space which is completely enclosed by walls and a ceiling. The compartment enclosure may have openings to an adjoining space if the openings have a minimun lintel depth of 8 in. (203 mm) from the ceiling.

4-1.3 Water Demand. The water demand for the system shall be determined by multiplying the design discharge of 4-1.1 by the number of design sprinklers of 4-1.2.

4-1.4 Sprinkler Coverage.

4-1.4.1 Residential sprinklers shall be spaced so that the maximum area protected by a single sprinkler does not exceed 144 sq ft (13.4 m^2).

4-1.4.2 The maximum distance between sprinklers shall not exceed 12 ft (3.7 m) on or between pipe lines and the maximum distance to a wall or partition shall not exceed 6 ft (1.8 m). The minimum distance between sprinklers within a compartment shall be 8 ft (2.4 m).

4-1.5 The minimum operating pressure of any sprinkler shall be in accordance with the listing information of the sprinkler and provide the minimum flow rates specified in 4-1.1.

4-1.6 Application rates, design areas, areas of coverage, and minimum design pressures other than those specified in 4-1.1, 4-1.2, 4-1.4, and 4-1.5 may be used with special sprinklers which have been listed for such specific residential installation conditions.

4-2 Position of Sprinklers.

4-2.1 Sprinklers shall be positioned so that deflectors are within 4 in. (102 mm) of a ceiling.

Exception: Special residential sprinklers shall be installed in accordance with listing limitations.

4-2.2* Sprinklers shall be positioned so that the discharge is not obstructed by beams or light fixtures.

4-2.2.1 When tests are performed which show that sprinklers are positioned so that the discharge is not obstructed, sprinklers shall be installed in accordance with the test results.

4-3 System Types.

4-3.1 Wet-Pipe Systems. A wet-pipe system shall be used when all piping is installed in areas not subject to freezing.

4-3.2 Dry-Pipe Systems. Where system piping is located in unheated areas subject to freezing, a dry-pipe system shall be used.

4-4 Pipe Sizing.

4-4.1 Piping shall be sized in accordance with 4-4.3 and 4-4.4.

Exception: When piping is sized hydraulically, calculations shall be made in accordance with the methods described in NFPA 13, Standard for the Installation of Sprinkler Systems.

4-4.2 Minimum pipe size shall be ½ in. for copper; ¾ in. for steel.

4-4.3* To size piping for systems connected to a city water supply, the following approximate method is acceptable.

(a) Establish system flow rate in accordance with Section 4-1.

(b) Determine water pressure in the street.

(c) Arbitrarily select pipe sizes.

(d) Deduct meter losses if any. [*See Table 4-4.3(d).*]

(e) Deduct loss for elevation. (Building height above street in ft x 0.434 = psi) . (Building height above street in meters x 0.098 = bars.)

(f) Deduct losses from city main to control valve by multiplying the factor from Table 4-4.3(a) or (b) by the total length(s) of pipe in ft (m).

(g) Deduct losses for piping within building by multiplying factor from Table 4-4.3(a) or (b) by the total length in ft (m) of each size of pipe between the control valve and the farthest sprinkler.

(h) Deduct valve and fitting losses. Count the valves and fittings from the control valve to the farthest sprinkler. Determine the equivalent length for each valve and fitting as shown in Table 4-4.3(c) and add these values to obtain the total equivalent length for each pipe size. Multiply the equivalent length for each size by the factor from Table 4-4.3(a) or (b) and total these values.

(i) In multilevel buildings, steps (a) through (g) shall be repeated to size piping for each floor.

(j) If the remaining pressure is less than the operating pressure established by the testing laboratory for the sprinkler being used, a redesign is necessary. If this pressure is higher than required, smaller piping may be used when justified by calculations.

(k) The remaining piping shall be sized the same as the piping to the farthest sprinkler unless smaller sizes are justified by calculations.

Exception: For sprinklered dwellings manufactured off-site, the minimum pressure needed to satisfy the system design criteria on the system side of the meter shall be specified on a data plate by the manufacturer. (See Section 2-3.)

Table 4-4.3 (a)
Design Factors (psi/ft)
Schedule 40 Steel Pipe
C = 120

Pipe Size	Flow Rate – GPM											
in.	10	12	14	16	18	20	25	30	35	40	45	50
¾	0.12	–	–	–	–	0.42	0.64	–	–	–	–	–
1	0.04	0.05	0.07	0.09	0.11	0.13	0.20	0.28	0.37	0.47	0.58	0.71
1¼	0.01	0.01	0.02	0.02	0.03	0.03	0.05	0.07	0.10	0.12	0.15	0.19
1½	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.05	0.06	0.07	0.09
2	–	–	–	–	–	0.01	0.01	0.01	0.01	0.02	0.02	0.03

For SI Units
1 gal = 3.785 L
1 psi = 0.0689 bar
1 ft = 0.3048 m

Table 4-4.3 (b)
Design Factors (psi/ft)
Copper Tubing — Types K, L & M
C = 150

Tubing Size in.	Type	Flow Rate — GPM 10	12	14	16	18	20	25	30	35	40	45	50
½	M	0.47	0.66	0.86	—	—	—	—	—	—	—	—	—
	L	0.58	0.81	1.08	—	—	—	—	—	—	—	—	—
	K	0.68	0.96	1.27	—	—	—	—	—	—	—	—	—
¾	M	0.08	0.12	0.16	0.20	0.25	0.30	0.46	0.64	0.85	—	—	—
	L	0.10	0.14	0.18	0.23	0.29	0.35	0.53	0.75	1.00	—	—	
	K	0.13	0.18	0.24	0.30	0.38	0.46	0.69	0.97	1.28	—	—	—
1	M	0.02	0.03	0.04	0.06	0.07	0.08	0.13	0.18	0.24	0.30	0.38	0.46
	L	0.03	0.04	0.05	0.06	0.08	0.10	0.15	0.20	0.27	0.35	0.43	0.53
	K	0.03	0.04	0.06	0.07	0.09	0.11	0.17	0.24	0.31	0.40	0.50	0.61
1¼	M	0.01	0.01	0.02	0.02	0.03	0.03	0.05	0.07	0.09	0.11	0.14	0.17
	L	0.01	0.01	0.02	0.02	0.03	0.03	0.05	0.07	0.10	0.12	0.16	0.19
	K	0.01	0.01	0.02	0.02	0.03	0.04	0.06	0.08	0.11	0.13	0.17	0.20
1½	M	—	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08
	L	—	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.07	0.08
	K	—	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.05	0.06	0.07	0.09
2	M	—	—	—	—	—	—	0.01	0.01	0.01	0.01	0.02	0.02
	L	—	—	—	—	—	—	0.01	0.01	0.01	0.01	0.02	0.02
	K	—	—	—	—	—	—	0.01	0.01	0.01	0.01	0.02	0.02

For *SI* Units
1 gal. = 3.785 L
1 psi = 0.0689 bar
1 ft = 0.3048 m

Table 4.4.3 (c)
Equivalent Length of Pipe in Feet for Fittings and Valves

Fitting/Valve Diameter In.	Elbows 45 Degrees	90 Degrees	Long Radius	Tees Flow Thru Branch	Flow Thru Run	Gate	Valves Angle	Globe	Globe "Y" Pattern	Cock	Check
½	0.5	1	0.8	2	0.6	0.2	5	10	6	2	2
¾	1	2	1	4	1	1	10	21	11	3	3
1	1	3	2	5	2	1	12	28	15	4	4
1¼	2	3	2	6	2	2	15	35	18	5	5
1½	2	4	3	8	3	2	18	43	22	6	6
2	3	5	3	10	3	2	24	57	28	7	8

Based on Crane Technical Paper No. 410.

For SI Units
1 ft = 0.3048 m

Table 4-4.3 (d)
Pressure Drop in Water Meters
Pressure Loss (psi)

Meter Size in.	Flow Rate – GPM 10	20	25
⅝	3.8	15.0	25.0
¾	1.6	6.5	10.0
1	*	2.4	3.8
1½	*	*	1.2
2	*	*	*

*Less than 1.0 psi

Reference: National Standard Plumbing Code, Appendix B, Chart 1, National Association of Plumbing – Heating – Cooling Contractors and the American Society of Plumbing Engineers, 1978 Ed.

4-4.4 To size piping for systems with an elevated tank, pump or pump-tank combination, determine the pressure at the water supply outlet and proceed through steps (c), (e), (g), (h), (i), (j) and (k) of 4-4.3.

4-5 Piping Configurations. Piping configurations may be looped, gridded, straight run, or combinations thereof.

4-6 Location of Sprinklers. Sprinklers shall be installed in all areas.

Exception No. 1: Sprinklers may be omitted from bathrooms not exceeding 55 sq ft (5.1 m²) with noncombustible plumbing fixtures.

Exception No. 2: Sprinklers may be omitted from small closets where the least dimension does not exceed 3 ft (0.9 m) and the area does not exceed 24 sq ft (2.2 m²) and the walls and ceiling are surfaced with noncombustible materials.

Exception No. 3: Sprinklers may be omitted from open attached porches.

Exception No. 4: Sprinklers may be omitted from carports, garages, and similar structures.

Exception No. 5: Sprinklers may be omitted from attics which are not used or intended for living purposes or storage.

Exception No. 6: Sprinklers may be omitted from entrance foyers which are not the only means of egress.

Appendix A

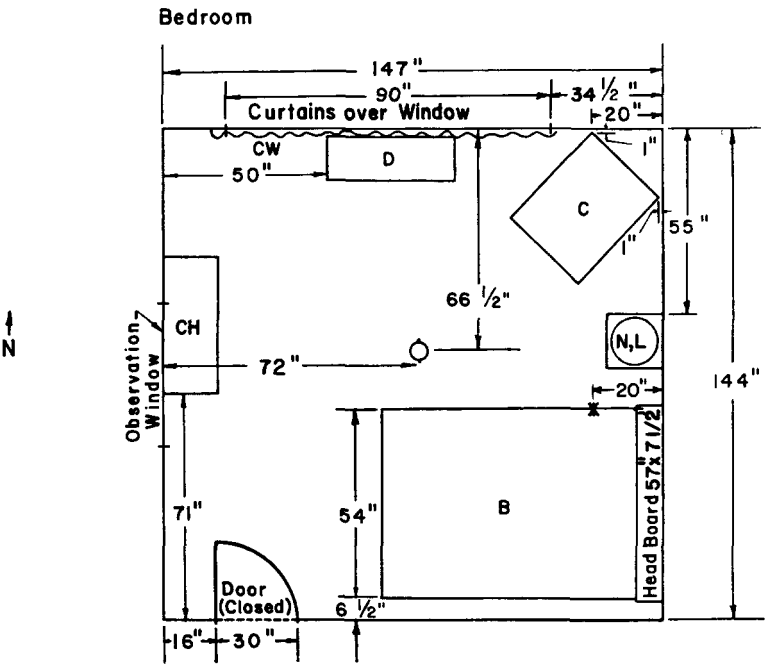
This Appendix is not a part of the requirements of this NFPA document but is included for information purposes only.

A-1-1 The criteria in this standard are based on full-scale fire tests of rooms containing typical furnishings found in residential living rooms, kitchens, and bedrooms. The furnishings were arranged as typically found in dwelling units in a manner similar to that shown in Figures A-1-1(a), A-1-1(b) and A-1-1(c). Sixty full scale fire tests were conducted in a two story dwelling in Los Angeles, California and 16 tests were conducted in a 14-ft (4.3-m) wide mobile home in Charlotte, North Carolina. Sprinkler systems designed and installed according to this standard are expected to prevent flashover within the compartment of origin if sprinklers are installed in the compartment. A sprinkler system designed and installed according to this standard cannot, however, be completely expected to control a fire involving unusually higher average fuel loads than typical for dwelling units [10 lbs/ft^2 (49 kg/m^2)] and where the interior finish has an unusually high flame spread rating (greater than 225).

A-1-2 Levels of Protection. Various levels of fire safety are available to dwelling occupants to provide life safety and property protection.

This standard recommends, but does not require, sprinklering of all areas in a dwelling; it permits sprinklers to be omitted in certain areas. These areas are the ones shown by NFPA statistics (*see Table A-1-2*) to be the ones where the incidence of life loss from fires in dwellings is low. Such an approach produces a reasonable degree of fire safety. Greater protection to both life and property will be achieved by sprinklering all areas.

Guidance for installation of smoke detectors and fire detection systems may be found in NFPA 74, *Standard for the Installation, Maintenance and Use of Household Fire Warning Equipment.*



- Ignition
- Sprinkler
- CW Curtains
- D Dresser
- CH Chest
- C Chair
- B Bed
- HB Head Board
- N Night Stand
- L Lamp

Figure A-1-1(a)

Mobile Home Bedroom

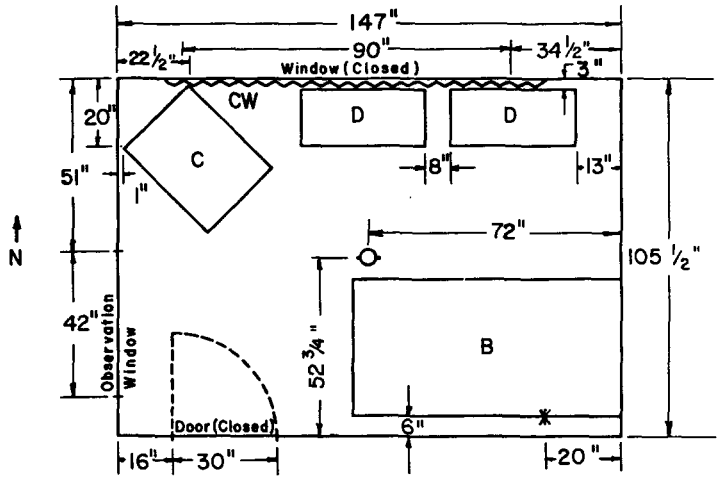


Figure A-1-1(b)

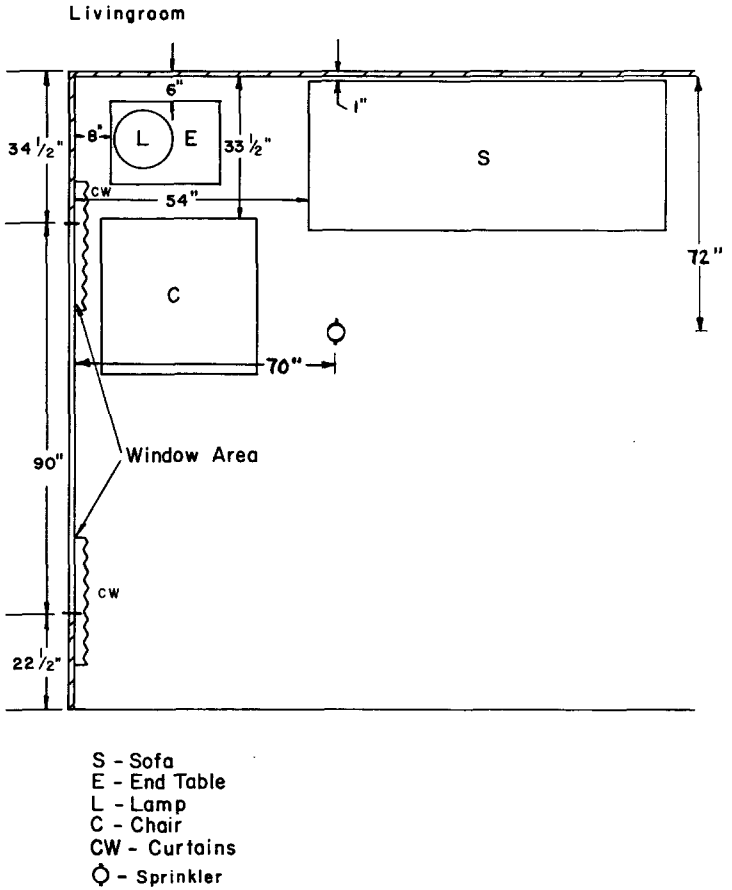

Livingroom
6"
1"
34 1/2"
8"
L
E
33 1/2"
S
CW
54"
72"
C
70"
90"
Window Area
CW
22 1/2"
S - Sofa
E - End Table
L - Lamp
C - Chair
CW - Curtains
- Sprinkler

Figure A-1-1(c)

Table A-1-2
Causal Factors in
One- and Two-Family Dwelling
Fires Which Caused One or More Deaths

	Area of Origin	
Living Room	39%	
Bedroom	28%	
Kitchen	16%	
Storage Area	4%	Based on 3951 incidents where area of origin was reported
Heating Equipment Room	2%	
Structural Area	2%	
Other Areas	9%	
	Form of Material	
Furniture	27%	
Bedding	18%	
Combustible Liquid or Gas	14%	
Interior Finish	9%	Based upon 3254 incidents where form of material ignited was reported
Structural Member	7%	
Clothing, on a Person	5%	
Waste, Rubbish	5%	
Electrical Insulation	2%	
Other	13%	
	Form of Heat of Ignition	
Smoking Materials	39%	
Heat from Fuel — Fire or Powered Object	26%	
Heat from Miscellaneous Open Flame (Including Match)	14%	Based upon 3221 incidents where form of heat of ignition was reported
Heat from Electrical Equipment Arcing or Overload	13%	
Hot Objects Including Properly Operating Electrical Equipment	6%	
Other	2%	
		Total number of incidents reported
		7,694

Source: FIDO Data Base 1971 to 1978, NFPA Fire Analysis Department.

A-1-3 System control valves should be of the indicating type, such as plug valves, ball valves, butterfly valves, or OS & Y gate valves.

A-1-4 The responsibility for properly maintaining a sprinkler system is the obligation of the owner or manager who should understand the sprinkler system operation. A minimum monthly maintenance program should include the following:

(a) Visually inspect all sprinklers to ensure against obstruction of spray.

(b) Inspect all valves to assure that they are open.

(c) Test all water flow devices.

(d) The alarm system, if installed, should be tested.

NOTE: When it appears likely that the test will result in a response of the fire department, notification to the fire department should be made prior to the test.

(e) Pumps, where employed, should be operated. See NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps.*

(f) The pressure of air used with dry systems should be checked.

(g) Water level in tanks should be checked.

(h) Care should be taken to see that sprinklers are not painted either at the time of installation or during subsequent redecoration. When painting sprinkler piping or painting in areas next to sprinklers, the sprinklers may be protected by covering with a bag which should be removed immediately after painting has been finished.

(i) For further information see NFPA 13A, *Recommended Practice for the Care and Maintenance of Sprinkler Systems.*

A-1-5.1.1 At least 3 spare sprinklers of each type, temperature rating and orifice size used in the system should be kept on the premises. When fused sprinklers are replaced by the owner, fire department or others, care should be taken to assure that the replacement sprinkler has the same operating characteristics.

A-1-5.1.4 Testing of a system can be accomplished by filling the system with water and checking visually for leaks at each joint or coupling.

Dry systems should also be tested by placing the system under air pressure. Any leak which results in a drop in system pressure greater than 2 lb/sq in. (0.14 bars) in 24 hrs should be corrected. Check for leaks using soapy water brushed on each joint or coupling. Leaks will be shown by the presence of bubbles. This test should be made prior to concealing of piping.

A-2-2 Connection for fire protection to city mains is often subject to local regulation concerning metering and backflow prevention requirements. Preferred and acceptable water supply arrangements are shown in Figure A-2-2. When a meter must be used between the city water main and the sprinkler system supply, an acceptable arrangement is shown in Figure A-2-2. Under these circumstances, the

flow characteristics of the meter must be included in the hydraulic calculation of the system. [*See Table 4-4.3(d).*] When a tank is used for both domestic and fire protection purposes, a low water alarm actuated when the water level falls below 110 percent of the minimum quantity specified in Section 2-1 should be provided.

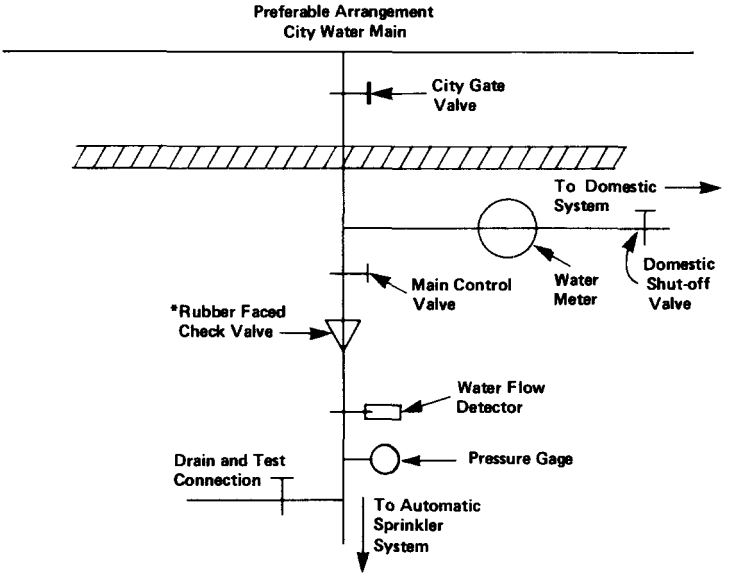
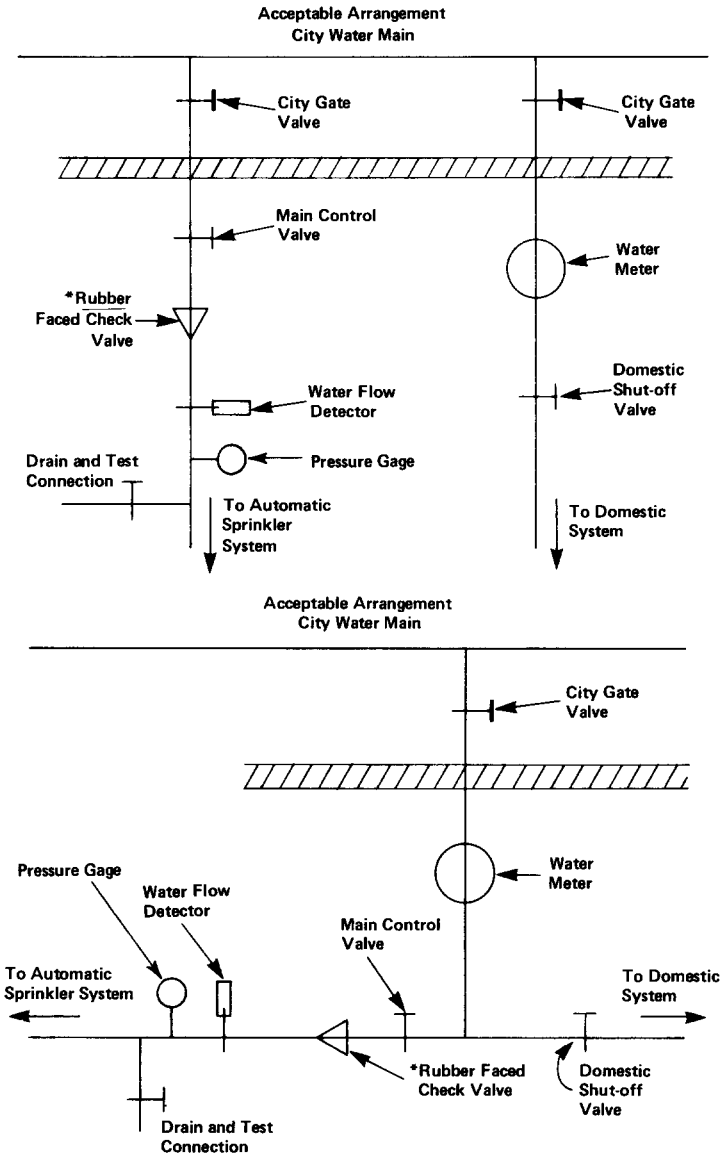


Figure A-2-2



*Rubber faced check valves optional.

Figure A-2-2

A-2-3(a) In dwellings where long term use of lawn sprinklers is common, provision should be made for such usage.

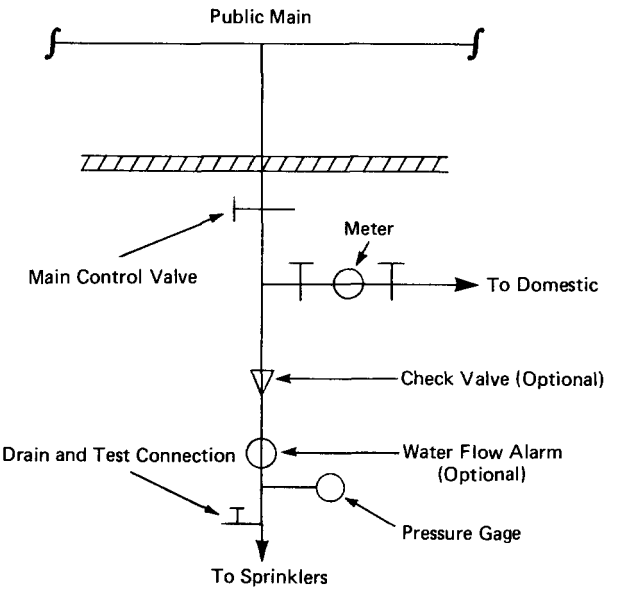


Figure A-2-3(a)

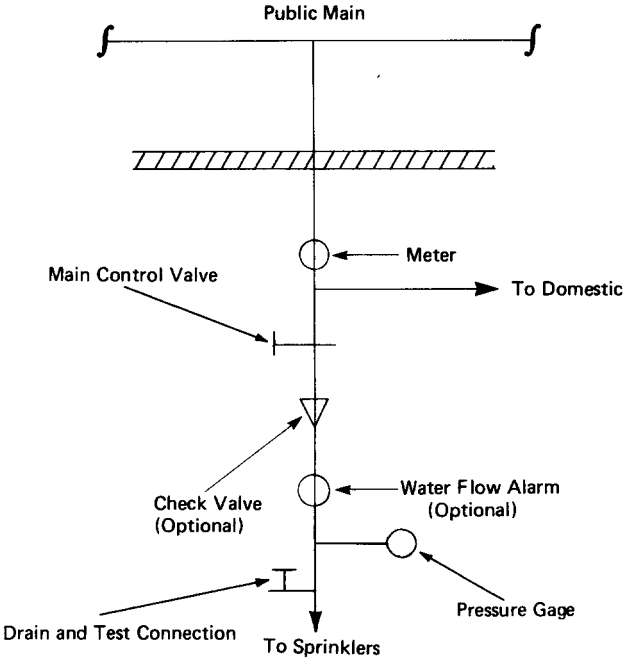


Figure A-2-3(b)

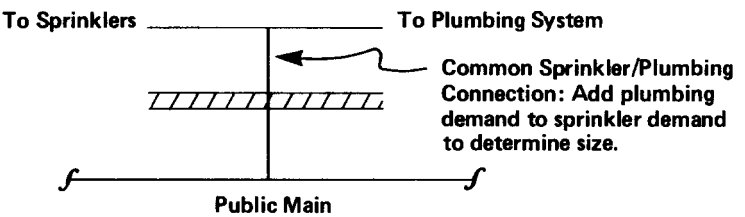


Figure A-2-3(c)

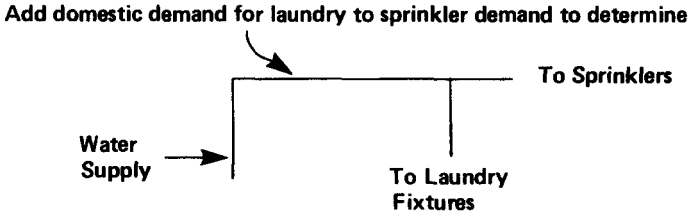


Figure A-2-3(d)

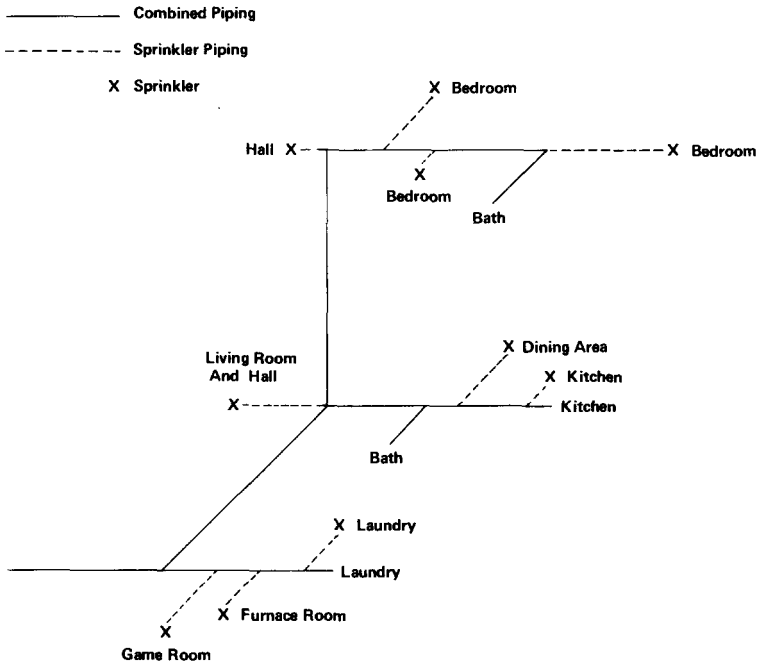


Figure A-2-3(e)

A-3-6 Alarms should be of sufficient intensity to be clearly audible in all bedrooms over background noise levels with all intervening doors closed. The tests of audibility level should be conducted with