NFPA No.

13

INSTALLATION OF SPRINKLER SYSTEMS 1975

NATIONAL FIRE PROTECTION ASSOCIATION
470 Atlantic Avenue, Boston, MA 02210

20M-7-75-FP-AP
Printed in U.S.A.

Official NFPA Definitions

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NOTE: The means for identifying listed equipment may vary for each testing laboratory, inspection agency or other 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.

SHALL: is intended to indicate requirements.

SHOULD: is intended to indicate recommendations or that which is advised but not required.

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.

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Standard for the Installation of

Sprinkler Systems

NFPA No. 13 — 1975

This edition, adopted by the National Fire Protection Association on May 14, 1975, on recommendation of the Committee on Automatic Sprinklers, supersedes all previous editions.

This edition of the standard is a revision of 1974 edition.

Origin and Development of No. 13

This standard was first printed under the direction of the Committee on Automatic Sprinklers in 1896 and since that date has been continuously revised to keep it up to date.

Full information as to the NFPA actions on various changes will be found in the NFPA Proceedings. The dates of successive editions are as follows: 1896, 1899, 1902, 1905, 1907, 1908, 1910, 1912, 1913, 1915, 1916, 1917, 1919, 1920, 1921, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929. In 1930 a separate standard was published on so-called Class B systems. This was integrated in the 1931 edition. Further revisions were adopted in 1934, 1935 and 1936. A complete revision was presented in the form of a progress report in 1939 and finally adopted in 1940. Further amendments were made in 1947, 1950, 1953, 1956, 1958, 1960, 1961, 1963, 1964, 1965, 1966, 1968, 1969, 1971, 1972, 1973, 1974, and 1975.

Interpretation Procedure of the Committee on Automatic Sprinklers

Those desiring an interpretation shall supply the Chairman with five identical copies of a statement in which shall appear specific reference to a single problem, paragraph, or section. Such a statement shall be on the business stationery of the inquirer and shall be duly signed.

When applications involve actual field situations they shall so state and all parties involved shall be named.

The Interpretations Committee will reserve the prerogative to refuse consideration of any application that refers specifically to proprietary items of equipment or devices. Generally inquiries should be confined to interpretation of the literal text or the intent thereof.

Requests for interpretations should be addressed to the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

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

Table of Contents

NOTE
Reference herein to the 1975 National Electrical Code, NFPA No. 70, is to that code adopted by the National Fire Protection Association on May 22, 1974 at its Annual Meeting. This code is also known as the 1975 National Electrical Code.

Standard for the Installation of

Sprinkler Systems

NFPA No. 13 — 1975

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

Chapter 1 General Information

1-1 Scope.

1-1.1 This standard is the minimum for the installation of sprinkler systems for fire protection in buildings and for the character and adequacy of water supplies to sprinkler systems.

NOTE: Consult other NFPA Standards for additional requirements relating to water supplies.

1-2 Purpose. The purpose of this standard is to provide a reasonable degree of protection for life and property from fire through installation requirements for sprinkler systems based upon sound engineering principles, test data and field experience. The standard endeavors to continue the excellent record that has been established by standard sprinkler systems and meet the needs of changing technology.

1-3 Definition of a Sprinkler System. A sprinkler system, for fire protection purposes, is an integrated system of underground and overhead piping designed in accordance with fire protection engineering standards. The installation includes a water supply, such as a gravity tank, fire pump, reservoir or pressure tank and/or connection by underground piping to a city main. The portion of the sprinkler system above ground is a network of specially sized or hydraulically designed piping installed in a building, structure or area, generally overhead, and to which sprinklers are

connected in a systematic pattern. The system includes a controlling valve and a device for actuating an alarm when the system is in operation. The system is usually activated by heat from a fire and discharges water over the fire area.

NOTE: The design and installation of water supply facilities such as gravity tanks, fire pumps, reservoirs or pressure tanks, and underground piping are covered by the following NFPA Standards: Water Tanks For Private Fire Protection, No. 22, 1974; Installation of Centrifugal Fire Pumps, No. 20, 1974; and Outside Protection, No. 24, 1973.

1-4 Other Publications. A selected list of other publications related to the installation of sprinkler systems is published at the end of this standard.

1-5 Maintenance.

1-5.1* A sprinkler system installed under this standard shall be properly maintained for efficient service. The owner is responsible for the condition of his sprinkler system and shall use due diligence in keeping the system in good operating condition.

1-5.2 The installing contractor shall provide the owner with:

(a) Instruction charts describing operation and proper maintenance of sprinkler devices.

(b) Publication entitled: Care and Maintenance of Sprinkler Systems, NFPA No. 13A, 1971.

1-6 Classification of Sprinkler Systems.

1-6.1 This standard covers automatic sprinkler systems of the types listed below, also systems of outside sprinklers for protection against exposure fires covered specifically in Chapter 6. Manually operated deluge systems, used for certain special hazard conditions, are not specifically covered in this standard but certain provisions of this standard will be found applicable.

Wet-Pipe Systems (See Section 5-1.)

Dry-Pipe Systems (See Section 5-2.)

Pre-Action Systems (See Section 5-3.)

Deluge Systems (See Section 5-3.)

Combined Dry-Pipe and Pre-Action Systems (See Section 5-4.)

Sprinkler Systems — Special Types. Special purpose system employing departures from the requirements of this standard, such as special water supplies and reduced pipe sizing shall be installed in accordance with their listing.

1-7 Classification of Occupancies.

1-7.1 Occupancy classifications for this standard relate to sprinkler installations and their water supplies only. They are not intended to be a general classification of occupancy hazards.

1-7.2 Light Hazard Occupancies.

1-7.2.1 Light Hazard — Occupancies or portions of other occupancies where the quantity and/or combustibility of contents is low and fires with relatively low rates of heat release are expected.

Light Hazard Occupancies include occupancies such as:

Churches
Clubs
Educational
Hospitals
Institutional
Libraries, except large stack rooms
Museums
Nursing or Convalescent Homes
Office, including Data Processing
Residential
Restaurant seating areas
Theaters and Auditoriums excluding stages and prosceniums

1-7.3 Ordinary Hazard Occupancies.

1-7.3.1 Ordinary Hazard (Group 1) — Occupancies or portions of other occupancies where combustibility is low, quantity of combustibles is moderate, stock piles of combustibles do not exceed eight feet and fires with moderate rates of heat release are expected.

Ordinary Hazard Occupancies (Group 1) include occupancies such as:

Automobile Parking Garages
Bakeries
Beverage Manufacturing
Canneries
Dairy Products Mfg. and Processing
Electronic Plants
Glass and Glass Products Manufacturing
Laundries

1-7.3.2 Ordinary Hazard (Group 2) — Occupancies or portions of other occupancies where quantity and combustibility of contents is moderate, stock piles do not exceed 12 feet and fires with moderate rate of heat release are expected.

Ordinary Hazard Occupancies (Group 2) include occupancies such as:

Cereal Mills
Chemical Plants — Ordinary
Cold Storage Warehouses
Confectionery Products
Distilleries
Leather Goods Mfg.
Libraries-Large Stack Room Areas
Mercantiles
Machine Shops
Metal Working
Printing and Publishing
Textile Mfg.
Tobacco Products Mfg.
Wood Product Assembly (See Appendix C.)

1-7.3.3* Ordinary Hazard (Group 3) — Occupancies or portions of other occupancies where quantity and/or combustibility of contents is high, and fires of high rate of heat release are expected.

Ordinary Hazard Occupancies (Group 3) include occupancies such as:

Exhibition Halls
Feed Mills
Paper and Pulp Mills
Paper Process Plants
Piers and Wharves
Repair Garages
Tire Manufacturing
Warehouses (having moderate to higher combustibility of content, such as paper, household furniture, paint, general storage, whiskey, etc.)[1]
Wood Machining (See Appendix C)

1-7.4* Extra Hazard Occupancies.

1-7.4.1 Extra hazard occupancies or portions of other occupancies where quantity and combustibility of contents is very high, flammable liquids, dust, lint or other materials are present

[1]For high-piled storage as defined in 4-1.3.8, see Appendix for separately published NFPA standards relating to water supply requirements, particularly Indoor General Storage, No. 231, 1974 and Rack Storage of Materials, No. 231C, 1974.

introducing the probability of rapidly developing fires with high rates of heat release.

Extra Hazard Occupancies include occupancies such as:

Aircraft Hangars[1]
Chemical Works (Extra Hazard)
Cotton Pickers and Opening Operations
Explosives and Pyrotechnics
Woodworking with Flammable Finishing (See Appendix C)

1-7.5 Under favorable conditions and subject to the approval of the authority having jurisdiction, a reduction of requirements to the next less restrictive occupancy classification may be applied to the following occupancies:

Cold Storage Warehouses
Cotton Picker & Opening Operations
Feed Mills
Leather Goods Manufacturing
Machine Shops
Mercantiles
Metal Working
Paper & Pulp Mills

1-8 Design and Installation.

1-8.1* Devices and Materials.

1-8.1.1 Only new sprinklers shall be employed in the installation of sprinkler systems.

1-8.1.2* When a sprinkler system is installed only approved materials and devices shall be used.

1-9* Working Plans.

1-9.1 Working plans shall be submitted for approval to the authority having jurisdiction before any equipment is installed or remodeled. Deviation from approved plans will require permission of the authority having jurisdiction.

1-9.2* Working plans shall be drawn to an indicated scale, on sheets of uniform size, with plan of each floor, made so that they can be easily duplicated, and show the following data:

(a) Name of owner and occupant
(b) Location, including street address
(c) Point of compass
(d) Ceiling construction

[1]For Aircraft Hangars refer also to NFPA 409, Standard on Aircraft Hangars, 1973.

(e) Full height cross section

(f) Location of fire walls

(g) Location of partitions

(h) Occupancy of each area or room

(i) Location and size of blind spaces and closets, see 4-4.3 to 4-4.17 inclusive, except Paragraphs 4-4.5 and 4-4.6.

(j) Any questionable small enclosures in which no sprinklers are to be installed.

(k) Size of city main in street, pressure and whether dead-end or circulating and if dead-end, direction and distance to nearest circulating main, city main test results (See B-2–1.)

(l) Other sources of water supply, with pressure or elevation

(m) Make, type and orifice size of sprinkler

(n) Temperature rating and location of high temperature sprinklers

(o) Number of sprinklers on each riser and on each system by floors and total area protected by each system on each floor

(p) Number of sprinklers on each riser and total per floor

(q) Make, type, model and size of alarm or dry-pipe valve

(r) Make, type, model and size of pre-action or deluge valve

(s) Kind and location of alarm bells

(t) Total number of sprinklers on each dry-pipe system or pre-action deluge system

(u) Approximate capacity in gallons of each dry-pipe system

(v) Cutting lengths of pipe (or center to center dimensions)

NOTE: Where typical branch lines prevail, it will be necessary to size only one line.

(w) Crosses, riser nipples and size

(x) Type of hangers, inserts and sleeves

(y) All control valves, checks, drain pipes and test pipes

(z) Small hand hose and hose equipment

(aa) When plans include underground pipe, the weight or class and size and material of pipe; the type of valves, meters, and valve pits; and the depth that the top of the pipe is to be laid below grade.

(bb) Provision for flushing (See Paragraph 3-7.3.)

(cc) When the equipment to be installed is an addition to an old group of sprinklers without additional feed from the yard system, enough of the old system shall be indicated on the plans to show the total number of sprinklers to be supplied and to make all conditions clear.

(dd) Name and address of contractor.

1-10 Approval of Sprinkler Systems. Before asking final approval of automatic sprinkler equipment by the authority having jurisdiction the installing company shall furnish a written statement to the effect that the work covered by its contract has been

completed and tested in accordance with the approved specifications and plans. (See Section 1-12.)

1-11 Acceptance Tests.

1-11.1 Performance. All tests required by this standard for new work shall be performed by the installer. When the authority having jurisdiction desires to be present during the conduct of tests, the installer shall give the authority having jurisdiction advance notification of time tests will be performed. When the representative of authority having jurisdiction is not available and permission is granted by that authority, tests may be witnessed by the owner or his representative and the Contractor's Material and Test Certificate (see Section 1-12) shall be completed and forwarded to the authority having jurisdiction.

1-11.2 Flushing of Underground Connections. Underground mains and lead-in connections to system risers shall be flushed before connection is made to sprinkler piping in order to remove foreign materials which may have entered the underground during the course of the installation. Underground mains supplying wet pipe, dry pipe or pre-action sprinkler systems shall be flushed at a rate of flow of not less than 750 gallons per minute for 6-inch pipe, 1,000 gallons per minute for 8-inch pipe, 1,500 gallons per minute for 10-inch pipe and 2,000 gallons per minute for 12-inch pipe. The minimum rate of flow for flushing underground connections to open sprinkler, deluge, and hydraulically designed systems shall not be less than the water demand rate of the system which is determined by system design. For all systems, the flushing operations shall be continued until water is clear. When planning the flushing operations, consideration shall be given to disposal of the water issuing from the test outlets. If the water supply will not produce the stipulated flow rate, the maximum flow rate available shall be used.

1-11.3 Hydrostatic Tests.

1-11.3.1* Test Pressure. All new systems including yard piping shall be tested hydrostatically at not less than 200 pounds per square inch pressure for two hours, or at 50 pounds per square inch in excess of the maximum static pressure when the maximum static pressure is in excess of 150 pounds.

1-11.3.2 The hydrostatic test pressure shall be measured at the low point of the individual system or zone being tested.

1-11.3.3 Permissible Leakage. The inside sprinkler piping shall be installed in such a manner that there will be no visible leakage when the system is subjected to the hydrostatic pressure

test. Refer to Standard for Outside Protection (NFPA No. 24–1973) for permissible leakage in underground piping. The amount of leakage may be measured by pumping from a calibrated container.

1-11.3.4 Fire Department Connection. Piping between the check valve in the fire department inlet pipe and the outside connection shall be tested the same as the balance of the system.

1-11.3.5 Corrosive Chemicals. Brine or other corrosive chemicals shall not be used for testing systems.

1-11.3.6 Test Blanks. Whenever a test blank is used it shall be of the self-indicating type. Test blanks shall have red painted lugs protruding beyond the flange in such a way as to clearly indicate their presence. The installer shall have all test blanks numbered so as to keep track of their use and assure their removal after the work is completed.

1-11.4 Tests of Dry Pipe Systems.

1-11.4.1 Hydrostatic Test. New dry-pipe systems shall be tested hydrostatically as specified in Section 1-11.3, except that at seasons of the year which will not permit testing with water, an interim test shall be conducted with air pressure of at least 40 lbs. per sq. in. allowed to stand 24 hrs. The standard hydrostatic test shall be conducted when weather permits. The clapper of a differential-type dry-pipe valve shall be held off its seat during any test at a pressure in excess of 50 lbs. per sq. in., to prevent damaging the valve.

1-11.4.2 Air Test. In dry-pipe systems an air pressure of 40 lbs per sq. in. shall be pumped up, allowed to stand 24 hours, and all leaks which allow a loss of pressure over 1½ pounds for the 24 hours shall be stopped.

1-11.4.3 Operating Test of Dry-Pipe Valve. A working test of the dry-pipe valve alone and with quick opening device, if installed, shall be made before acceptance.

1-11.5 Tests of Drainage Facilities. Tests of drainage facilities shall be made while the control valve is wide open. The main drain valve shall be opened and remain open until the system pressure stabilizes. (See 2-9.1).

1-12 Contractor's Material and Test Certificate.

Part "A" General

PROCEDURE

Upon completion of work, inspection and tests shall be made by the contractor's representative and witnessed by an owner's representative. All defects shall be corrected and system left in service before contractor's men finally leave the job.

A certificate shall be filled out and signed by both representatives. Copies shall be prepared for approving authorities, owners, and contractor. It is understood the owner's representative's signature in no way prejudices any claim against contractor for faulty material, poor workmanship, or failure to comply with approving authority's requirements or local ordinances.

Property name..... Date.....

Property address.....

PLANS

Accepted by approving authority(s) names.....

Address .....

Installation conforms to accepted plans: Yes ☐ No ☐

Equipment used is approved Yes ☐ No ☐

If no, state deviations.....

INSTRUCTIONS

Has person in charge of fire equipment been instructed as to location of control valves and care of this new equipment? Yes ☐ No ☐

If no, explain.....

Has a copy of instruction and maintenance chart been left at plant? Yes ☐ No ☐

If no, explain.....

TEST DESCRIPTION

Flushing: Flow the required rate until water is clear as indicated by no collection of foreign material in burlap bags at outlets such as hydrants and blow-offs.

Flush at flows not less than 750 GPM for 6-inch pipe and smaller, 1000 GPM for 8-inch pipe, 1,500 GPM for 10-inch pipe, and 2,000 GPM for 12-inch pipe. When supply cannot produce stipulated flow rates, obtain maximum available.

Hydrostatic: Hydrostatic tests shall be made at not less than 200 psi for two hours or 50 psi above static pressure in excess of 150 psi. Differential dry-pipe valve clappers shall be left open during test to prevent damage. All aboveground piping leakage shall be stopped.

Leakage: New pipe laid with rubber gasketed joints shall, if the workmanship is satisfactory, have little or no leakage at the joints. The amount of leakage at the joints shall not exceed 2 quarts per hour per 100 joints irrespectively of pipe diameter. The leakage shall be distributed over all joints. If such leakage occurs at a few joints the installation shall be considered unsatisfactory and necessary repairs made.

New pipe laid with caulked lead or lead-substitute joints, shall if the workmanship is satisfactory, have little or no leakage at the joints. Any joint having leakage or more than a "slight drip" or "weeping" shall be repaired. Leakage shall not exceed 1 oz. (liquid measure) per hour per inch of pipe diameter per joint. The leakage shall be distributed over all joints. If such leakage occurs almost entirely at a few joints, the installation shall be considered unsatisfactory and necessary repairs made.

Pneumatic: Establish 40 PSI air pressure and measure drop which shall not exceed 1½ PSI in 24 hours. Test pressure tanks at normal water level and air pressure and measure air pressure drop which shall not exceed 1½ psi in 24 hours.

Part "B" Underground Piping

LOCATION

Feeds bldgs.....

UNDERGROUND PIPES AND JOINTS

Pipe types and class.....Type joint.....

Conforms to.....Standard Yes ☐ No ☐

If no, explain.....

Joints needing anchorage clamped, strapped, or backed in accordance with.....Standard Yes ☐ No ☐

If no, explain.....

TESTS REQUIRED

Flushing Tests

New underground piping flushed according to.....Standard Yes ☐

by (Company).....

How flushing flow was obtained:

Public water ☐ Tank or reservoir ☐ Fire pump ☐

Through what type opening: Hydrant butt ☐ Open pipe ☐

Lead-ins flushed according to.....Standard Yes ☐

By (Company).....

How flushing flow was obtained:

Public water ☐ Tank or reservoir ☐ Fire pump ☐

Through what type opening: Y conn. to flange & spigot ☐ Open pipe ☐

Hydrostatic Test

All new underground piping hydrostatically tested at.....psi. For.....hours

Leakage Test

Total amount of leakage measured.....gals.....hours

Allowable leakage.....gals.....hours

HYDRANTS

Number installed.....Type and Make.....

All operate satisfactorily Yes ☐ No ☐

CONTROL VALVES

Water control valves left wide open: Yes ☐ No ☐

If no, state reason.....

Hose threads of fire department connections and hydrants interchangeable with those of fire department answering alarm? Yes ☐ No ☐

REMARKS

Date left in service.....

.....

PARTS A AND F SIGNATURES

Name of sprinkler contractor.....

For sprinkler contractor (signed).....Date.....

For property owner (signed).....Title.....

Tests Witnessed By....., Title....., Date.....

Part "C" Sprinkler and Water Spray Aboveground Piping

(Fill out separate Part "C" for each riser)

LOCATION

Serves buildings:.....

TESTS REQUIRED

Hydrostatic: all piping.

Pneumatic: dry piping.

Equipment operation: all

Drain:.....

SPRINKLERS OR SPRAY NOZZLES

Make	Model	Size	Quantity	Temperature Rating

PIPE AND FITTINGS

Material and kind conforms to.....Standard

If none, explain.....

ALARM VALVE OR FLOW INDICATOR

ALARM DEVICE			MAXIMUM TIME TO OPERATE THROUGH TEST PIPE	
Type	Make	Model	Min	Sec

DRY PIPE VALVES

Operating Test Results: Make.....Model.....Serial No.....

Time to Trip Through Test Pipe						
Without Q.O.D		With Q.O.D				
Min	Sec	Min	Sec	Water Pressure PSI	Air Pressure PSI	Trip Point Air Pressure PSI	Time Water Reached Test Outlet Min Sec
.....		.....		.....	.....	.....	.....

Alarm operated properly? Yes ☐ No ☐

If no, explain.....

DELUGE AND PREACTION VALVES

Operation: Pneumatic ☐ Electric ☐ Hydraulic ☐

Piping supervised: Yes ☐ No ☐

Detecting media supervised: Yes ☐ No ☐

Does valve operate from the manual trip and/or remote control stations? Yes ☐ No ☐

Is there an accessible facility in each circuit for testing? Yes ☐ No ☐

If no, explain.....

Make..... Model.....

Does each circuit operate supervision loss alarm? Yes ☐ No ☐

Does each circuit operate valve release? Yes ☐ No ☐

Maximum time to operate release: Min.....Sec.....

TESTS

All piping hydrostatically tested at..... .....PSI for..... .....hours

Dry piping pneumatically tested: Yes ☐ No ☐

Equipment operates properly: Yes ☐ No ☐

If no, state reason.....

Drain test:

Reading of gage located near water supply test pipe:

Static pressure.....PSI

Residual pressure with valve in test pipe open wide:

.....PSI

TEST BLANKS

Number used.....Locations .....Number removed.....

WELDED OR BRAZED PIPING Yes ☐ No ☐

If Yes, do you certify as the sprinkler contractor that the welders or brazers are qualified for welding or brazing in accordance with the requirements of

ASME Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators–1968 Edition. Yes ☐ No ☐

REMARKS

Date left in service with all control valves open.....

PART "C" SIGNATURES

Name of sprinkler contractor.....

For sprinkler contractor (signed).....

For property owner (signed)..... Title.....

Tests Witnessed By....., Title....., Date.....

Chapter 2 Water Supplies

2-1* General Provisions. Every automatic sprinkler system shall have at least one automatic water supply.

2-2* Guide to Water Supply Requirements for Sprinkler Systems.

2-2.1 Guide Tables.

2-2.1.1 One of the following guide tables shall be used in determining the minimum water supply requirements for light and ordinary hazard groups 1, 2 and 3.

NOTE 1: Table 2-2.1(A) is used to determine the minimum volume of water and pressure normally required for a pipe schedule sprinkler system. THE TABLE IS TO BE USED ONLY WITH EXPERIENCED JUDGMENT.

NOTE 2: Table 2-2.1(B) is used to determine density, area of sprinkler operation and water supply requirements for hydraulically designed sprinkler systems. Systems shall be calculated to satisfy a single point on the appropriate design curve and interior piping shall be based on this design point. It is not necessary to meet all points on the selected curve. Total water supply available to the system at the base of the riser at the residual pressure required by the design shall be not less than shown in Table 2-2.1(B) but this total water supply need not be calculated through the overhead piping. (See Chapter 7.)

2-2.1.2 Classification of Occupancy. Occupancy classification in Tables 2-2.1(A) and 2-2.1(B) shall be determined from Section 1-7.

2-3 Connections to Water Works Systems.

2-3.1 Acceptability.

2-3.1.1* A connection to a reliable water works system shall be an acceptable water supply source. The volume and pressure of a public water supply shall be determined from water flow test data.

2-3.1.2 Meters. Meters are not recommended for use on sprinkler systems; however, where required by other authorities, they shall be of approved type.

Table 2-2.1(A)
Guide to Water Supply Requirements for Pipe Schedule Sprinkler Systems

Occupancy Classification	Residual Pressure Required (See Note 1)	Acceptable Flow at Base of Riser (See Note 2)	Duration in Minutes (See Note 4)
Light Hazard	15 psi	500–750 gpm (See Note 3)	30–60
Ordinary Hazard (Group 1)	15 psi or higher	700–1000 gpm	60–90
Ordinary Hazard (Group 2)	15 psi or higher	850–1500 gpm	60–90
Ordinary Hazard (Group 3)	Pressure and flow requirements for sprinklers and hose streams to be determined by authority having jurisdiction.		60–120
Warehouses	Pressure and flow requirements for sprinklers and hose streams to be determined by authority having jurisdiction. See Chapter 7 and NFPA 231 and NFPA 231C.		
High-Rise Buildings	Pressure and flow requirements for sprinklers and hose streams to be determined by authority having jurisdiction. See Chapter 8.		
Extra Hazard	Pressure and flow requirements for sprinklers and hose streams to be determined by authority having jurisdiction.		

Notes:

1. The pressure required at the base of the sprinkler riser(s) is defined as the residual pressure required at the elevation of the highest sprinkler plus the pressure required to reach this elevation.

2. The lower figure is the minimum flow including hose streams ordinarily acceptable for pipe schedule sprinkler systems. The higher flow should normally suffice for all cases under each group.

3. The requirement may be reduced to 250 gpm if building area is limited by size or compartmentation or if building (including roof) is noncombustible construction.

4. The lower duration figure is ordinarily acceptable where remote station water flow alarm service or equivalent is provided. The higher duration figure should normally suffice for all cases under each group.

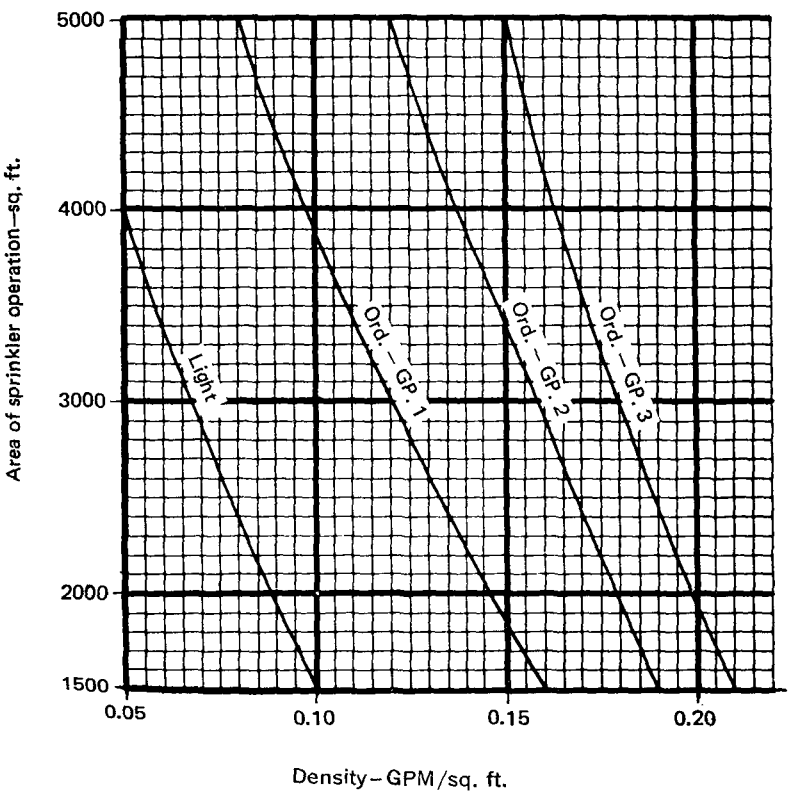
Table 2-2.1(B)*

A Guide for Determining Density, Area of Sprinkler Operation and Water Supply Requirements for Hydraulically Designed Sprinkler Systems.

Minimum Water Supplies

Hazard Classification	Sprinklers GPM	Combined Inside & Outside Hose — GPM	Duration in Minutes
Light	150	100	30
Ord. — Gp. 1	400	250	*60–90
Ord. — Gp. 2	600	250	*60–90
Ord. — Gp. 3	750	500	*60–120

*NOTES: The lower duration figure is ordinarily acceptable where remote station water flow alarm service or equivalent is provided. (*Notes to graph below are continued on page* 21.)



NOTES. (*Cont.*):

For dry systems increase area of sprinkler operation by 30 percent.

For construction having unsprinklered combustible concealed spaces, the minimum area of sprinkler operation shall be 3,000 square feet.

For hazard classifications other than those indicated see appropriate NFPA Standards for design criteria.

Calculations shall be based upon the area of sprinkler operation selected from Table 2-2.1(B) or upon the area of the largest room. Such a room shall be enclosed with construction having a fire resistance rating equal to the water supply duration indicated in Table 2-2.1(B) with minimum protection of openings as follows:

a. Light Hazard — automatic or self-closing doors.

b. Ordinary and Extra Hazard — automatic or self-closing doors with appropriate fire-resistance ratings for the enclosure.

For areas of sprinkler operation less than 1500 square feet, the density for 1500 square feet shall be used.

2-3.2* Capacity. The connection and arrangement of underground supply piping shall be capable of supplying the volume as required in Tables 2-2.1(A) or 2-2.1(B). Pipe size shall be at least as large as the riser but not less than 4 inches in diameter where unlined cast iron pipe is used.

2-4 Gravity Tanks.

2-4.1 Acceptability. An elevated tank sized in accordance with Table 2-2.1(A) or 2-2.1(B) shall be an acceptable water supply source. (See Water Tanks for Private Fire Protection No. 22–1974.)

2-4.2 Capacity and Elevation. The capacity and elevation of the tank and the arrangement of the underground supply piping shall provide the volume and pressure required by Table 2-2.1(A) or 2-2.1(B) designs.

2-5* Pumps.

2-5.1* Acceptability. A single automatically controlled fire pump sized in accordance with Table 2-2.1(A) or 2-2.1(B) supplied under positive head shall be an acceptable water supply source. (See Installation of Centrifugal Fire Pumps, No. 20–1974.)

2-5.2 Supervision. When a single fire pump constitutes the sole sprinkler supply, it shall be provided with supervisory service from an approved central station, proprietary, remote station system or equivalent.

2-6 Pressure Tanks.

2-6.1 Acceptability.

2-6.1.1 A pressure tank sized in accordance with Table 2-2.1(A) or 2-2.1(B) is an acceptable water supply source. (See Standard Water Tanks for Private Fire Protection, NFPA No. 22–1974.)

2-6.1.2 Pressure tanks shall be provided with an approved means for automatically maintaining the required air pressure. When a pressure tank is the sole water supply there shall also be provided an approved trouble alarm to indicate low air pressure and low water level with the alarm supplied from an electrical branch circuit independent of the air compressor.

2-6.1.3 Pressure tanks shall not be used to supply other than sprinklers and hand hose attached to sprinkler piping.

2-6.2 Capacity.

2-6.2.1 The size of the pressure tank required shall be in accordance with Table 2-2.1(A) or 2-2.1(B) and shall include the extra capacity needed to fill dry pipe systems when installed. Minimum requirements when pressure tanks are not the sole water supply source shall be as indicated in 2-6.2.2, 2-6.2.3, and 2-6.2.4.

2-6.2.2 LIGHT HAZARD OCCUPANCY. Amount of available water, not less than 2,000 gallons.

2-6.2.3 ORDINARY HAZARD OCCUPANCY. Amount of available water, not less than 3,000 gallons for Groups 1 and 2. For Group 3, refer to authority having jurisdiction.

2-6.2.4 EXTRA HAZARD AND WOODWORKER OCCUPANCIES. Refer to authority having jurisdiction.

2-6.2.5 For High Rise Buildings see Chapter 8.

2-6.3* **Water Level and Air Pressure.** Unless otherwise approved by the authority having jurisdiction, the pressure tank shall be kept two-thirds full of water, and an air pressure of at least 75 lbs. by the gage shall be maintained. When the bottom of the tank is located below the highest sprinklers served, the air pressure by the gage shall be at least 75 lbs. plus three times the pressure caused by the column of water in the sprinkler system above the tank bottom.

2-7 Fire Department Connections.

2-7.1 When Required. A connection through which a fire department can pump water into the sprinkler system makes a desirable auxiliary supply. For this purpose, a fire department

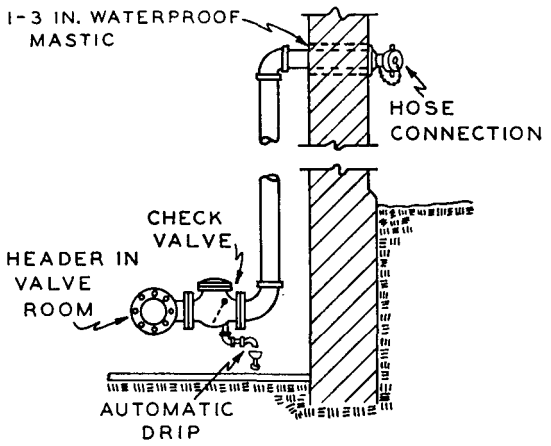


Fig. 2-7.1 Fire Department Connection.

connection shall be provided in all cases except when permission of the authority having jurisdiction is obtained for their omission.

2-7.2* Size. Pipe size shall be not less than 4 inches for fire engine connections and not less than 6 inches for fire boat connections, except that 3-inch pipe may be used to connect a single hose connection to a 3-inch or smaller riser.

2-7.3* Arrangement. See Paragraph 3-13.2.5.

2-7.3.1 The fire department connection shall be made on the system side of a check valve in the water supply piping.

2-7.3.2 On wet pipe systems with a single riser the connection shall be made on the system side of approved indicating, check and alarm valves to the riser, unless the sprinklers are supplied by fire department pumper connection in the yard. (See 3-13.2.6.)

2-7.3.3 On dry pipe systems with a single riser the connection shall be made between the approved indicating valve and the dry pipe valve, unless the sprinklers are supplied by fire department pumper connection in the yard.

2-7.3.4 On systems with two or more risers the connection shall be made on the system side of all shutoff valves controlling other water supplies, but on the supply side of the riser shutoff valves so that with any one riser off, the connection will feed the

remaining sprinklers, unless the sprinklers are supplied by fire department pumper connection in the yard.

2-7.3.5 Fire department connections shall not be connected on the suction side of booster pumps.

2-7.3.6 Fire department connections to sprinkler systems shall be designated by a sign having raised letters at least one inch in size cast on plate or fitting reading for service designated: Viz. — "AUTOSPKR.", "OPEN SPKR." or "AUTOSPKR. and STANDPIPE."

2-7.4 Valves.

2-7.4.1 An approved check valve shall be installed in each fire department connection, located as near as practicable to the point where it joins the system.

2-7.4.2 There shall be no shutoff valve in the fire department connection.

2-7.5 Drainage. The piping between the check valve and the outside hose coupling shall be equipped with an approved automatic drip.

2-7.6 Hose Connections.

2-7.6.1 Hose coupling threads shall conform to those used by the local fire department. National (American) Standard Fire Hose Coupling Screw Threads shall be used whenever they will fit the local fire department hose.

2-7.6.2 Hose connections shall be equipped with listed plugs or caps.

2-8 Arrangement of Water Supply Connections.

2-8.1 Connection Between Underground and System Piping. The connection between the system piping and underground piping shall be made with a suitable transition piece and shall be properly strapped or fastened by approved devices. A cast-iron flanged piece is a suitable transition piece.

2-8.2* Connection Passing Through or Under Foundation Walls. When system piping pierces a foundation wall below grade or is located under the foundation wall, clearance shall be provided to prevent breakage of the piping due to building settlement.

2-9 Water Supply Test Pipes and Gages.

2-9.1* Test Pipes. Test pipes, which may also be used as drain pipes, shall be provided at locations that will permit flowing tests to be made to determine whether water supplies and connections are in order. Such test pipes shall be not less than the sizes specified in Section 3-10.2 and equipped with a shutoff valve. They shall be so installed that the valve may be opened wide for a sufficient time to assure a proper test without causing water damage. (See Sections 3-10.2 and 3-10.4.)

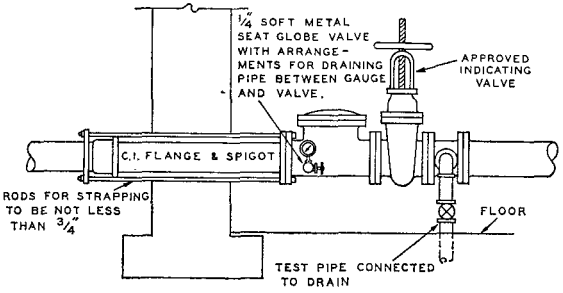


Fig. 2-9.1 Water Supply Connection with Test Pipe.

Located on the system side of the gate valve, one test pipe may serve for more than one city connection. It will also indicate the condition of the gate valve. Located on the supply side of the check valve, it will serve to test out check valve by closing the waterworks gate or other outside valve.

2-9.2 Gages.

2-9.2.1 A pressure gage shall be installed on the riser or feed main, at or near each test pipe, with a connection not smaller than ¼ inch. This gage connection shall be equipped with a shutoff valve and with provision for draining.

2-9.2.2 The required pressure gages shall be of approved type and shall have a maximum limit not less than twice the normal working pressure at the point where installed. They shall be installed to permit removal, and shall be located where they will not be subject to freezing.

Chapter 3 System Components

3-1 Piping.

3-1.1 Piping Specifications.

3-1.1.1 Pipe or tube used in sprinkler systems shall be of the materials in Table 3-1.1.1 or in accordance with 3-1.1.2 through 3-1.1.7. The chemical properties, physical properties and dimensions of the materials listed in Table 3-1.1.1 shall be at least equivalent to the standards cited in the table designed to withstand a working pressure of not less than 175 psi.

Table 3-1.1.1

Material and Dimensions	Standard
Ferrous Piping (Welded and Seamless)	
Welded and Seamless Steel Pipe For Ordinary Uses, Spec. For Black and Hot-Dipped Zinc Coated (Galvanized)	ASTM A 120–72a
Spec. for Welded and Seamless Steel Pipe	ASTM A 53–72a
Wrought Steel Pipe	ANSI B36.10–70
Copper Tube (Drawn, Seamless)	
Spec. For Seamless Copper Tube	ASTM B 75–72 or
Spec. For Seamless Copper Water Tube	ASTM B 88–72
Spec. For General Requirements for Wrought Seamless Copper and Copper-Alloy Tube	ASTM B 251–71
Brazing Filler Metal (Classification BCuP-3 or BCuP-4)	AWS A 5.8–69
Solder Metal, 95–5 (Tin-Antimony-Grade 95TA)	ASTM B32–70

3-1.1.2 When Welded and Seamless Steel Pipe as specified in ASTM A53-72a is used in Welded Systems a minimum pipe wall thickness of 0.188 inches is permitted for pressures up to 300 psi in sizes 4 inches and larger.

3-1.1.3 For pipe size 3½ inches and smaller, in Welded Sprinkler systems, a minimum wall thickness equivalent to Schedules 10S pipe as specified in *ANSI Standard B36-19-1965 (R1971)* is permitted for pressures up to 300 psi.

3-1.1.4 For methods of joining pipes referenced in 3-1.1.3, see 3-9.4 and 3-12.4.

3-1.1.5 Standard Wall Schedule 40 pipe is permitted for pressures up to 300 psi. Schedule 30 pipe is acceptable in sizes 8 inches and larger.

3-1.1.6 Copper Tube as specified in the standards listed in Table 3-1.1.1, used in fire protection systems shall have a wall thickness of Type K, L or M.

3-1.1.7 Other types of pipe or tube may be used, but only those investigated and listed for this service by a nationally recognized testing and inspection agency laboratory.

3-1.1.8 Whenever the word pipe is used in this standard it shall be understood to also mean tube.

3-2* Definitions. (See Fig. A-3.2.)

Risers means the vertical supply pipes in a sprinkler system;

Feed Mains means mains supplying risers or cross mains;

Cross Mains means pipes directly supplying the lines in which the sprinklers are placed;

Branch Lines means lines of pipe, from the point of attachment to the cross main (or similar connection) to the end sprinkler, in which the sprinklers are directly placed;

3-3* Pipe Schedules.

3-3.1 Except as provided in 3-3.2 and 3-3.3 the number of automatic sprinklers on a given size pipe on one floor shall not exceed the number given in Sections 3-4, 3-5, or 3-6 for a given occupancy.

3-3.2 The pipe schedule provisions do not apply to hydraulically designed systems.

3-3.3 The maximum floor area to be protected by one system on any one floor shall be as follows:

Light Hazard	52,000 sq. ft.
Ordinary Hazard	52,000 sq. ft.
[1]Solid piled storage in excess of 15 feet in height or palletized or rack storage in excess of 12 feet in height	40,000 sq. ft.
Extra Hazard	25,000 sq. ft.

[1]See NFPA Standards, Indoor General Storage, No. 231, 1974 and Rack Storage of Materials, No. 231C, 1974 for definitions of solid piled, palletized or rack storage.

Sprinkler spacing requirements contained in Chapter 4 still apply.

3-3.4 Size of Risers. Each system riser shall be sized to supply all sprinklers on the riser on any one floor as determined by the standard schedules of pipe sizes in Sections 3-4, 3-5, or 3-6.

3-3.5 Slatted Floors, Large Floor Openings, Mezzanines, and Large Platforms. Buildings having slatted floors, or large unprotected floor openings without approved stops, shall be treated as one area with reference to the pipe sizes, and the feed mains or risers shall be of the size required for the total number of sprinklers.

3-4 Schedule for Light Hazard Occupancies.

3-4.1 Branch lines shall not exceed eight sprinklers on either side of a cross main except as modified in 3-7.1.

Pipe sizes shall be as follows, except as modified by 3-4.2, 3-4.3 and 3-7.

Table 3-4.1

Steel		Copper	
1 in. pipe	2 sprinklers	1 in. tube	2 sprinklers
1¼ in. pipe	3 sprinklers	1¼ in. tube	3 sprinklers
1½ in. pipe	5 sprinklers	1½ in. tube	5 sprinklers
2 in. pipe	10 sprinklers	2 in. tube	12 sprinklers
2½ in. pipe	30 sprinklers	2½ in. tube	40 sprinklers
3 in. pipe	60 sprinklers	3 in. tube	65 sprinklers
3½ in. pipe	100 sprinklers	3½ in. tube	115 sprinklers
4 in. pipe	See 3-4.2	4 in. tube	See 3-4.2

3-4.2 The area supplied by any one 4-inch pipe or tube size on any one floor shall not exceed 52,000 square feet.

3-4.3 Each area requiring more than 100 sprinklers and without subdividing partitions (not necessarily fire walls) shall be supplied by feed mains or risers sized for ordinary hazard occupancies.

Fig. 3-4.3(A). Arrangement of Branch Lines Supplying Sprinklers Above and Below a Ceiling.

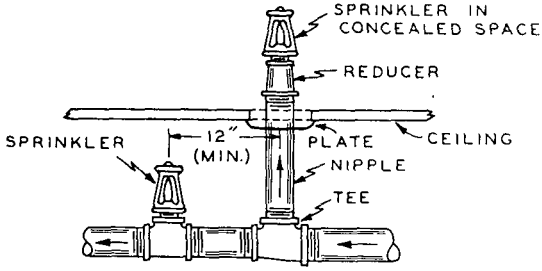


Fig. 3-4.3(B). Sprinkler on Riser Nipple from Branch Line in Lower Fire Area.

3-4.4* When sprinklers are installed above and below a ceiling and such sprinklers are supplied from a common set of branch lines, such branch lines shall not exceed eight sprinklers above and eight sprinklers below the ceiling on either side of the cross main. Pipe sizing, up to and including 2½ inch, shall be as shown in Table 3-4.4.

Table 3-4.4

	Number of Sprinklers Above and Below		
Steel		**Copper**	
1 in.	2 sprinklers	1 in.	2 sprinklers
1¼ in.	4 sprinklers	1¼ in.	4 sprinklers
1½ in.	7 sprinklers	1½ in.	7 sprinklers
2 in.	15 sprinklers	2 in.	18 sprinklers
2½ in.	50 sprinklers	2½ in.	65 sprinklers

When the total number of sprinklers above and below the ceiling exceeds 50, the pipe supplying more than 50 sprinklers shall be increased to three inch, and sized thereafter according to the schedule shown in Paragraph 3-4.1 for the number of sprinklers above or below the ceiling, whichever is larger.

3-5 Schedule for Ordinary Hazard Occupancies.

3-5.1 Branch lines shall not exceed eight sprinklers on either side of a cross main except as modified in 3-7.

Pipe sizes shall be as follows, except as modified by 3-5.2, 3-5.3 and 3-7.

Table 3-5.1

Steel		Copper	
1 in. pipe	2 sprinklers	1 in. tube	2 sprinklers
1¼ in. pipe	3 sprinklers	1¼ in. tube	3 sprinklers
1½ in. pipe	5 sprinklers	1½ in. tube	5 sprinklers
2 in. pipe	10 sprinklers	2 in. tube	12 sprinklers
2½ in. pipe	20 sprinklers	2½ in. tube	25 sprinklers
3 in. pipe	40 sprinklers	3 in. tube	45 sprinklers
3½ in. pipe	65 sprinklers	3½ in. tube	75 sprinklers
4 in. pipe	100 sprinklers	4 in. tube	115 sprinklers
5 in. pipe	160 sprinklers	5 in. tube	180 sprinklers
6 in. pipe	275 sprinklers	6 in. tube	300 sprinklers
8 in. pipe	See 3-5.2	8 in. tube	See 3-5.2

3-5.2 The area supplied by any one 8-inch pipe or tube size on any one floor shall not exceed 52,000 square feet except that for solid piled storage in excess of 15 feet in height or palletized or rack storage in excess of 12 feet the area served by any one 8-inch pipe or tube size shall not exceed 40,000 square feet. Where single systems serve both such storage and ordinary hazard areas, storage area covered shall not exceed 40,000 square feet and total area covered shall not exceed 52,000 square feet.

3-5.3 When the distance between sprinklers on the branch lines exceeds 12 feet or the distance between the branch lines exceeds 12 feet, the number of sprinklers shall be as follows for given sizes of pipe:

Table 3-5.3

Steel		Copper	
2½ in. pipe	15 sprinklers	2½ in. tube	20 sprinklers
3 in. pipe	30 sprinklers	3 in. tube	35 sprinklers
3½ in. pipe	60 sprinklers	3½ in. tube	65 sprinklers

For other pipe and tube sizes, follow 3-5.1.

3-5.4* When sprinklers are installed above and below a ceiling and such sprinklers are supplied from a common set of branch lines, such branch lines shall not exceed eight sprinklers above and eight sprinklers below the ceiling on either side of the cross main. Pipe sizing up to and including three inch shall be as shown in the following schedule:

Table 3-5.4

Number of Sprinklers Above and Below

Steel		Copper	
1 in.	2 sprinklers	1 in.	2 sprinklers
1¼ in.	4 sprinklers	1¼ in.	4 sprinklers
1½ in.	7 sprinklers	1½ in.	7 sprinklers
2 in.	15 sprinklers	2 in.	18 sprinklers
2½ in.	30 sprinklers	2½ in.	40 sprinklers
3 in.	60 sprinklers	3 in.	65 sprinklers

When the total number of sprinklers above and below the ceiling exceeds 60, the pipe supplying more than 60 sprinklers shall be increased to 3½-inch and sized thereafter according to the schedule shown in 3-5.1, for the number of sprinklers above or below the ceiling, whichever is larger.

3-6 Schedule for Extra Hazard Occupancies.

3-6.1 Branch lines shall not exceed six sprinklers on either side of cross main. The following pipe schedules are given only as a guide. See separate NFPA Standards for further guidance for specific hazards.

Table 3-6.1

Steel		Copper	
1 in. pipe	1 sprinkler	1 in. tube	1 sprinkler
1¼ in. pipe	2 sprinklers	1¼ in. tube	2 sprinklers
1½ in. pipe	5 sprinklers	1½ in. tube	5 sprinklers
2 in. pipe	8 sprinklers	2 in. tube	8 sprinklers
2½ in. pipe	15 sprinklers	2½ in. tube	20 sprinklers
3 in. pipe	27 sprinklers	3 in. tube	30 sprinklers
3½ in. pipe	40 sprinklers	3½ in. tube	45 sprinklers
4 in. pipe	55 sprinklers	4 in. tube	65 sprinklers
5 in. pipe	90 sprinklers	5 in. tube	100 sprinklers
6 in. pipe	150 sprinklers	6 in. tube	170 sprinklers
8 in. pipe	See 3-6.2	8 in. tube	See 3-6.2

3-6.2 The area served by any one 8-inch pipe or tube size on any one floor shall not exceed 25,000 square feet.

3-6.3 For open sprinkler and deluge systems pipe schedule see 3-6.1.

3-7 Special Provisions Applicable to Piping.

3-7.1 Branch Lines. When the occupancy is classified as light or ordinary hazard occupancy and when more than eight sprinklers on a branch line are necessary, lines may be increased to nine sprinklers by making the two end lengths one inch and 1¼ inch, respectively, and the sizes thereafter standard. Ten sprinklers may be placed on a branch line by making the two end lengths one and 1¼ inch, respectively, and feeding the tenth sprinkler by a 2½-inch pipe. (See 7-1.1.2.)

3-7.2 For sprinklers in storage racks see NFPA Standard Rack Storage of Materials, No. 231C–1974.

3-7.3* Provision for Flushing System. All dry pipe and preaction systems and those wet pipe systems having nonpotable water supplies shall be provided with flushing connections consisting of a threaded capped nipple four inches long on the end of cross mains. All cross mains shall terminate in 1¼-inch or larger pipe. The nipples shall be the same diameter as the end pipe but not larger than two inches.

3-7.4 Stair Towers. Stairs, towers or other construction with incomplete floors, if piped on independent risers, shall be treated as one area with reference to pipe sizes.

3-7.5 Return Bends. When piping on wet systems is concealed, with sprinklers installed in pendent position below a ceiling, return bends shall be used when the water supply to the sprinkler system is from a raw water source, millpond, or from open top reservoirs. Return bends shall be connected to the tops of branch lines in order to avoid accumulation of sediment in the drop nipples. In new systems the return bend pipe and fittings shall be one inch in size. In revamping existing systems, where it is not necessary to retain sprinklers in the concealed space, ½-inch or ¾-inch close nipples inserted in the existing sprinkler fittings may be used with one-inch pipe and fittings for the other portions of the return bend. When water supply is potable, return bends are not required on wet systems. (See Fig. 3-7.5.)

3-7.6 Dry Pipe Underground. When necessary to place pipe which will be under air pressure underground, the pipe shall be protected against corrosion (see 3-9.2), or unprotected gasketed joint cast-iron pipe may be used.

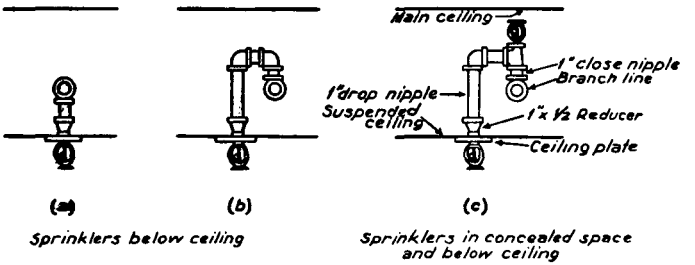


Fig. 3-7.5. Pendent Sprinklers at Suspended Ceiling.

3-7.7 Hand Hose Connections (small). Hand hose, to be used for fire purposes only, may be attached to sprinkler pipes subject to the following restrictions:

(a) Piping shall be one-inch size for runs up to 20 feet and 1¼-inch size for runs between 20 and 80 feet.

(b) Hose shall not be larger than 1½-inch.

(c) Nozzle discharge shall not exceed the discharge from two nominal ½-inch orifice sprinklers. (See 3-15.5.)

(d) Hose shall not be connected to any sprinkler pipe smaller than 2½-inch and shall not be attached to a dry-pipe system. For details of hand hose installation, see the NFPA Standard for the Installation of Standpipe and Hose Systems No. 14–1974.

3-7.8 Hose Connections for Fire Department Use. In buildings of light or ordinary hazard occupancy, 2½-inch hose valves for fire department use may be attached to wet pipe sprinkler systems subject to the following restrictions:

(a) The riser and hose valves shall be located in a fire-resistive stair enclosure.

(b) Sprinklers shall be under control of separate floor control valves located in the fire-resistive stair enclosure.

(c) The minimum size of the riser shall be 4 inches unless hydraulic calculations indicate smaller size riser will satisfy sprinkler and hose stream demand.

(d) The water supply shall satisfy demand for sprinklers and standpipes combined.

(e) For fire department connections, serving standpipe and sprinklers, refer to A-2-7.3.

3-8 System Test Pipes.

3-8.1 Wet Systems.

3-8.1.1* A test pipe of not less than 1-inch diameter terminating in a smooth bore corrosion resistant outlet giving a flow equivalent to one sprinkler shall be provided for each system.

3-8.1.2* In multistory buildings where waterflow alarm devices are provided at each riser on each floor or where more than one alarm device is provided in one sprinkler system, a test pipe shall be provided for testing each alarm device.

3-8.2* Dry-Pipe Systems. A 1-inch inspector's test with a smooth bore corrosion resistant outlet to provide a flow equivalent to one sprinkler of a type installed on the particular system shall be installed on the end of the most distant sprinkler line in the upper story and be equipped with a 1-inch shutoff valve and cast-iron or brass plug.

3-9* Protection of Piping.

3-9.1 Protection Against Freezing.

3-9.1.1 Supply Pipes. When supply pipes or risers pass through unheated basements or open spaces under buildings, they shall be protected against freezing by an enclosure heated or insulated to maintain minimum temperature of 40°F.

3-9.1.2 Feed Mains in Unheated Areas. When necessary to extend feed mains of wet pipe systems through an open area or through cold rooms, passageways or other areas exposed to freezing, the pipe shall be protected against freezing by insulating coverings, frostproof casings, or other means capable of maintaining a minimum of 40°F.

3-9.2* Protection of Pipe Against Corrosion.

3-9.2.1 Where corrosive conditions exist, such as at bleacheries, dye-houses, metalplating processes, animal pens, certain

chemical plants and at other locations, where corrosive fumes or moisture may be present, types of pipe, tube, fittings and hangers, protective coatings that resist corrosion shall be used.

3-9.2.2 Steel pipe in overhead feed mains running from one building to another where exposed to the weather, shall be galvanized, unless otherwise protected against corrosion.

3-9.2.3 When steel pipe is used underground as a connection from a system to sprinklers in a detached building, the pipe shall be protected against corrosion before being buried.

3-9.3 Protection of Piping Against Damage Where Subject to Earthquakes.

3-9.3.1* To minimize or prevent pipe breakage where subject to earthquakes, the sprinkler systems shall be protected as follows:

3-9.3.2* Mechanical groove couplings shall be provided:

(a) Within 24 inches of the top and bottom of all risers except as modified in (c).

(b) At the ceiling of each intermediate floor in multistory buildings.

(c) For risers or drops 2½ inch or larger 3 feet to 7 feet in length, one mechanical groove coupling is adequate.

(d) At each end of piping between two buildings.

(e) At each side building expansion joints.

3-9.3.3* Sleeves shall be provided around all piping extending through the walls, floors, platforms and foundations.

(a) Minimum clearance between the pipe and sleeve shall be not less than 1 inch for pipes 1 inch through 3½ inch and 2 inches for pipe sizes 4 inch and larger.

(b) The clearance between pipe and sleeve shall be filled with noncombustible flexible material such as mineral wool, fiberglass or equivalent.

(c) Floor sleeves shall extend at least 3 inches above the top of the wearing surface.

3-9.3.4* Sway Bracing Where Subject To Earthquakes.

3-9.3.4.1 Feed and cross mains shall be braced to withstand a force under tension or compression equal to 50 percent of the weight of water filled piping, utilizing a two-way sway brace in 2½ inch and larger pipe. Tops of risers shall be secured against drifting in any direction utilizing a four-way sway brace.

3-9.3.4.2 Where "U" hook hangers are used on branch lines, the pipe shall be secured to the end hanger by a wrap-around-type "U" hook. (*See Figure A-3-14.1.*)

3-9.3.4.3 U-type hangers used to support a system will satisfy most of the requirements for sway bracing except that, in general, the longitudinal hanger referred to as No. "1" in Fig. A-3-10.3.4(b) shall also be required for 2½ inch and larger piping. U-type hangers used as lateral braces shall have legs bent out 10°.

3-9.3.4.4 When feed and cross mains are hung with single rods longer than 6 inches, sway bracing shall be provided.

3-9.3.4.5 Sway bracing shall be attached directly to feed and cross mains only.

3-9.3.4.6 Fastening of piping to sections which will move differently, such as a wall and a roof, is prohibited.

3-9.3.4.7 The last piece of pipe at the end of a feed or cross main shall be provided with a transverse brace. Transverse braces may also act as longitudinal braces if they are within 24 inches of the center line of the piping braced longitudinally.

3-10 Drainage.

3-10.1 Pitching of Piping for Drainage.

3-10.1.1* All sprinkler pipe and fittings shall be so installed that the system may be drained.

3-10.1.2 On wet pipe systems, sprinkler pipes may be installed level. Trapped piping shall be drained in accordance with Section 3-11.3.

3-10.1.3 On dry pipe systems sprinkler pipe on branch lines shall be pitched at least ½-inch in 10 feet and the pipe of cross and feed mains shall be given a pitch of not less than ¼-inch in 10 feet. A pitch of ¾-inch to 1-inch shall be provided for short branch lines and ½-inch in 10 feet for cross and feed mains in refrigerated areas and in buildings of light construction where floor may settle under heavy loads.

3-10.2 System or Main Drain Connections and Drain Valves. (See Fig. 3-11.2.)

3-10.2.1 Provisions shall be made to properly drain all parts of the system.

3-10.2.2 On all risers 4 inches or larger, 2-inch drain pipes and valves shall be provided.

3-10.2.3 On risers 2½ inches to 3½ inches inclusive, drain pipes and valves not smaller than 1¼ inch shall be provided.

3-10.2.4 On smaller risers, drain pipe and valves not smaller than ¾ inch shall be provided.

3-10.2.5 All interior sectional control valves shall be provided with an auxiliary drain valve so located as to drain that portion of the system controlled by the sectional valve. These drains shall discharge either outside or to a drain connection.

3-10.2.6 The test valves required by 2-9.1 may be used as main drain valves.

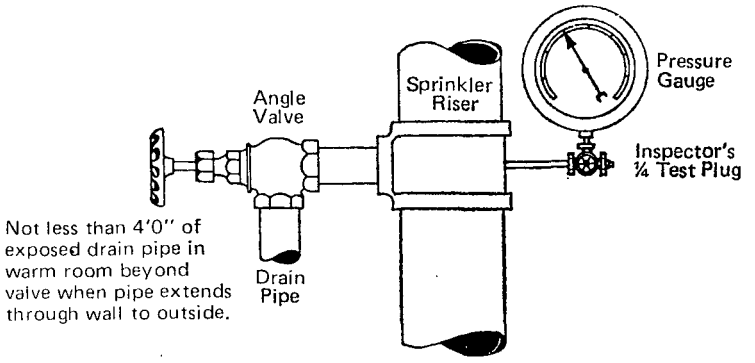


Fig. 3-10.2. Drain Connection for Sprinkler Riser.

3-10.3 Auxiliary Drains.

3-10.3.1 Auxiliary drains shall be provided when a change in piping direction prevents drainage of sections of branch lines or mains through the main drain valve. Auxiliary drains are not required for piping to a single sprinkler on a wet pipe system or to a drop nipple on a dry pipe system installed in accordance with 5-2.2.

3-10.3.2 Auxiliary drains on trapped sections of wet pipe systems shall be a minimum of one inch in size except that existing systems having ¾-inch auxiliary drains from two inch and smaller pipe do not require change.

3-10.3.3 Auxiliary Drains For Wet Pipe Systems.

3-10.3.3.1 When capacity of trapped sections of pipe is five gallons or less, the auxiliary drain shall consist of a one inch nipple and cap or brass plug except as provided for in Paragraph 3-10.3.1.

3-10.3.3.2 When capacity of trapped sections of pipe is more than five gallons, the auxiliary drain shall consist of a one inch valve complete with nipple and cap or brass plug.

3-10.3.4 Auxiliary Drains For Dry Pipe and Pre-Action Systems.

3-10.3.4.1 When capacity of trapped sections of pipe is five gallons or less, the auxiliary drain shall consist of a ½-inch valve complete with nipple and cap or brass plug, except as provided for in 3-10.3.1.

3-10.3.4.2 When capacity of trapped sections of pipe is more than five gallons, the auxiliary drain shall consist of two one inch valves, and one 2 inch by 12 inch condensate nipple or equivalent. (See Fig. 3-10.3.4.)

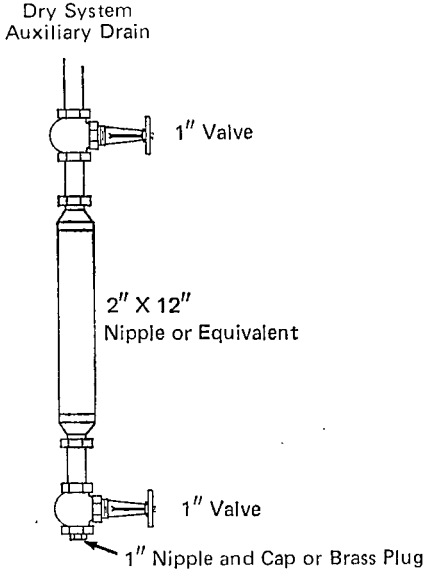


Fig. 3-10.3.4

3-10.3.5 Tie-In Drains. Tie-in drains for branch lines on dry pipe or preaction systems shall be a minimum of one inch in size. Tie-in drains are not required on wet pipe systems.

3-10.4 Discharge of Drain Valves.

3-10.4.1* Direct interconnections shall not be made between sewers and sprinkler drains of systems supplied by public water. The drain discharge shall be in conformity with any health or water department regulations.

3-10.4.2 When drain pipes are buried underground, approved corrosive resistant pipe shall be used.

3-10.4.3 Drain pipes shall not terminate in blind spaces under the building.

3-10.4.4 Drain pipes when exposed shall be fitted with a turned down elbow.

3-10.4.5* Drain pipes shall be arranged as not to expose any part of the sprinkler system to freezing conditions.

3-11 Joining of Pipe and Fittings.

3-11.1 Threaded Pipe and Fittings.

3-11.1.1 All threaded fittings and pipe shall have threads cut to ANSI Standard B2.1. Care shall be taken that the pipe does not extend into the fitting sufficiently to reduce the water-way.

3-11.1.2 Pipe shall be reamed after cutting to remove all burrs and fins.

3-11.1.3 Joint compound or tape shall be applied to the threads of the pipe and not in the fitting.

3-11.2 Welded Piping.

3-11.2.1 Sections of branch lines, crossmains, feed mains, or risers may be shop welded.

3-11.2.2 Sections of welded piping shall be joined by means of screwed flanged or flexible gasketed joints or other approved fittings.

3-11.2.3 Torch cutting shall not be permitted as a means of modifying or repairing sprinkler systems.

3-11.2.4 Welding and brazing shall be done in accordance with the methods set forth in the American National Standards Institute for Power Piping, ANSI B.31.1.0–1967 and including Addenda ANSI B.31.1.0a, 1971 and ANSI B.31.1.0b, 1971.

3-11.2.5 Certification of Welders and Brazers. Welders or brazers shall be certified by contractor as being qualified for welding and/or brazing in accordance with the requirements of ASME Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators 1968 Edition. (See Appendix E.)

3-11.2.6 When welding is planned, contractor shall specify the section to be shop welded on drawings, and the type of welding fittings to be used.

3-11.2.7 When welding fittings are used to form outlets:

(a) Holes in piping shall be cut to full diameter of the fitting.

(b) Discs shall be retrieved.

(c) Openings in piping shall be made smooth.

(d) All slag and other welding residue shall be removed.

3-11.3 Rolled Groove.

3-11.3.1 Thin-wall steel pipe with wall thickness 0.188 inches for sizes 4 inches through 8 inches and 0.120 inches for sizes 2½ inches through 3½ inches may be joined with mechanical groove couplings approved for service with grooves rolled on the pipe by an approved groove rolling machine.

3-11.4 Brazed Joints.

3-11.4.1* Joints for the connection of copper tube shall be brazed except as provided for in 3-11.4.1.1 and 3-11.4.1.2.

3-11.4.1.1 Solder joints may be permitted for wet-pipe systems in Light Hazard Occupancies where the temperature classification of the installed sprinklers is Ordinary or Intermediate.

3-11.4.1.2 Solder joints may be permitted for wet-pipe systems in Ordinary Hazard — Group 1 Occupancies where the piping is concealed.

3-11.5 Other Types.

3-11.5.1 Other types of joints shall be made or installed in accordance with the requirements of the listing thereof by a nationally recognized testing laboratory.

3-12 Fittings.

3-12.1 Type of Fittings.

3-12.1.1 Fittings used in sprinkler systems shall be of the materials listed in Table 3-12.1.1 or in accordance with 3-12.1.2. The chemical properties, physical properties and dimensions of the materials listed in Table 3-12.1.1 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 cold water (125 psi saturated steam) pressure.

3-12.1.2 Other types of fittings may be used, but only those investigated and listed for this service by a recognized testing and inspection agency laboratory.

Table 3-12.1.1

Material and Dimensions	Standard
Cast Iron	
Cast Iron Screwed Fittings, 125 and 250 lb.	ANSI B16.4 -1971
Cast Iron Pipe Flanges and Flanged Fittings	ANSI B16.1 -1967
Malleable Iron	
Malleable Iron Screwed Fittings, 150 and 300 lb.	ANSI B16.3 -1971
Steel	
Factory-Made Wrought Steel Buttweld Fittings	ANSI B16.9 -1961
Buttwelding Ends for Pipe, Valves, Flanges and Fittings	ANSI B16.25-1972
Spec. for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures	ASTM A234-1973
Steel Pipe Flanges and Flanged Fittings	ANSI B16.5 -1973
Forged Steel Fittings, Socket Welded and Threaded	ANSI B16.11-1973
Copper	
Wrought Copper and Bronze Solder-Joint Pressure Fittings	ANSI B16.22-1973
Cast Bronze Solder Joint Pressure Fittings	ANSI B16.18-1972

3-12.1.3 If fittings are of cast iron, extra heavy pattern shall be used in sizes larger than two inches where the normal pressure in the piping system exceeds 175 psi. If fittings are of malleable iron, standard weight pattern shall be acceptable in sizes up to six inches inclusive when the normal pressure in the pipe system does not exceed 300 psi. Fittings made of materials other than cast iron or malleable iron and specifically approved for use in sprinkler systems may be used at piping system pressures up to the working pressure limits specified in their listing.

3-12.1.4 Where water pressures are 175 to 300 psi, the ANSI Standards permit the use of standard wall pipe and extra heavy valves. Until pressure ratings for valves are standardized, the manufacturers' ratings shall be observed.

3-12.1.5* When risers are three inches in size or larger, a flange joint shall be used at the riser at each floor.

3-12.2* Couplings and Unions. Screwed unions shall nof be used on pipe larger than two inches. Couplings and unions ot other than screwed type shall be of types approved specifically for use in sprinkler systems. Unions, screwed or flexible gasketed couplings, or flanges may be used to facilitate installation.

3-12.3 Reducers, Bushings. A one-piece reducing fitting shall be used wherever a change is made in the size of the pipe, except hexagonal or face bushings may be used in reducing the size of openings of fittings when standard fittings of the required size are not available.

3-13 Valves.

3-13.1 Types of Valves to be Used.

3-13.1.1 All valves on connections to water supplies and in supply pipes to sprinklers shall be approved indicating valves, unless a nonindicating valve, such as an underground gate valve with approved roadway box complete with T-wrench is accepted by the authority having jurisdiction.

Such valves shall not close in less than five seconds when operated at maximum possible speed from the fully open position. This is to avoid damage to piping by water hammer.

The following may not incorporate indicating devices as part of the valve, but the valve assembly described shall qualify as an approved indicating valve:

(a) an underground gate valve of approved type equipped with an approved indicator post,

(b) an approved water control valve assembly which is normally open and requires constant energy application to close and keep closed,

(c) an approved water control valve assembly which has a reliable position indication connected to a remote supervisory station.

3-13.1.2 Drain valves and test valves shall be of approved type.

3-13.1.3 Check valves shall be of approved type and may be installed in a vertical or horizontal position.

3-13.2* Valves Controlling Sprinkler Systems.

3-13.2.1* Each system shall be provided with an approved indicating valve so located as to control all sources of water supply except fire department connections when arranged as specified in Section 2-7.3.

3-13.2.2 At least one approved indicating valve shall be installed in each source of water supply except fire department connections.

3-13.2.3 Valves controlling sprinkler systems, except underground gate valves with roadway boxes, shall be supervised open by one of the following methods:

(a) Central station, proprietary or remote station alarm service,

(b) Local alarm service which will cause the sounding of an audible signal at a constantly attended point,

(c) Locking valves open,

(d) Sealing of valves and approved weekly recorded inspection when valves are located within fenced enclosures under the control of the owner.

3-13.2.4 When there is more than one source of water supply, a check valve shall be installed in each connection, except that where cushion tanks are used with automatic fire pumps no check valve is required in the cushion tank connection.

3-13.2.5* A check valve shall be installed in each water supply connection if there is a fire department connection on the system.

3-13.2.6* When a single wet pipe sprinkler system is equipped with a fire department connection the alarm valve is considered a check valve and an additional check valve shall not be required.

3-13.2.7 In a city connection serving as one source of supply the city valve in the connection may serve as one of the required valves. An approved indicating valve or an indicator post valve shall be installed on the system side of the check valve.[1]

3-13.3* Identification of Valves. When there is more than one control valve, identification signs indicating the portion of the system controlled by each valve shall be provided.

3-14 Hangers.

3-14.1* General.

3-14.1.1 Sprinkler piping shall be substantially supported from the building structure which must support the added load of the water-filled pipe plus a minimum of 250 pounds applied at the point of hanging.

3-14.1.2 Types of hangers and installation methods shall be in accordance with the requirements of Section 3-14, unless they are certified by a registered professional engineer for the following:

(a) Designed to support five times the weight of the water-filled pipe plus 250 pounds at each point of piping support,

(b) These points of support are enough to support the sprinkler system,

(c) Ferrous materials are used for hanger components.

Detailed calculations shall be submitted, when required by the reviewing authority, showing stresses developed both in hangers and piping and safety factors allowed.

3-14.1.3 Sprinkler piping shall be supported independently of the ceiling sheathing, except as provided in 3-14.1.8.

3-14.1.4 When sprinkler piping is installed below duct-work, piping shall be substantially supported from the building structure or from the steel angles supporting the duct work, provided the angles conform to Table 3-14.1.6.

3-14.1.5 The components of hanger assemblies which directly attach to the pipe or to the building structure, except for mild steel hangers formed from rod, shall be listed.

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[1]See Figure A-3-13.2.5

3-14.1.6 For trapeze hangers, the minimum size of steel angle or pipe span between purlins or joists shall be as shown in Table 3-14.1.6, all angles to be used with longer leg vertical. Any other sizes or shapes giving equal or greater section modulus will be acceptable. The trapeze bar shall be secured to prevent slippage.

3-14.1.7 The size of hanger rods and fasteners required to support the steel angle iron or pipe indicated in Table 3-14.1.6 shall comply with Section 3-14.4.

3-14.1.8 Eye rods and ring hangers shall be secured with necessary lock washers to prevent lateral motion at the point of support. Toggle hangers shall be used only for the support of branch lines under ceilings of hollow tile or metal lath and plaster.

3-14.2 Hangers in Concrete.

3-14.2.1 Approved inserts set in concrete may be installed for the support of hangers. Wood plugs shall not be used.

3-14.2.2 Holes through concrete beams may also be considered as a substitute for hangers for the support of pipes.

3-14.2.3 Approved expansion shields for supporting pipes under concrete construction may be used in a horizontal position in the sides of beams. In concrete having gravel or crushed stone aggregate, expansion shields may be used in the vertical position to support pipes four inches or less in diameter.

3-14.2.4 For the support of pipes 5 inches and larger, expansion shields if used in the vertical position shall alternate with hangers connected directly to the structural members such as trusses and girders, or to the sides of concrete beams. In the absence of convenient structural members, pipes five inches and larger may be supported entirely by expansion shields in the vertical position, but spaced not over 10 feet apart.

3-14.2.5 Expansion shields shall not be used in ceilings of gypsum or similar soft material. In cinder concrete, expansion shields shall not be used except on branch lines where they shall alternate with through bolts or hangers attached to beams.

3-14.2.6 When expansion shields are used in the vertical position, the holes shall be drilled to provide uniform contact with the shield over its entire circumference. Depth of the hole shall be not less than specified for the type of shield used.

3-14.2.7 Holes for expansion shields in the side of concrete beams shall be above the center line of the beam or above the bottom reinforcement steel rods.

Table 3-14.1.6 Trapeze Bars — One foot, six inches to 10 foot spans.

	PIPE SIZE →	2½″	3″	3½″	4″	5″	6″	8″	10″
TRAPEZE BARS	1′-6″	1½″ x 1½″ x 3/16″ 1″ PIPE	1½″ x 1½″ x 3/16″ 1″ PIPE	1½″ x 1½″ x 3/16″ 1″ PIPE	2″ x 1½″ x 3/16″ 1″ PIPE	2″ x 1½″ x 3/16″ 1¼″ PIPE	2½″ x 1½″ x 3/16″ 1¼″ PIPE	3″ x 2″ x 3/16″ 1½″ PIPE	3″ x 2″ x ¼″ 2″ PIPE
	2′-0″	1½″ x 1½″ x 3/16″ 1″ PIPE	2″ x 1½″ x 3/16″ 1″ PIPE	2″ x 1½″ x 3/16″ 1″ PIPE	2″ x 1½″ x 3/16″ 1¼″ PIPE	2½″ x 1½″ x 3/16″ 1¼″ PIPE	2½″ x 1½″ x 3/16″ 1½″ PIPE	3″ x 2″ x 3/16″ 2″ PIPE	3″ x 2″ x ¼″ 2″ PIPE
	2′-6″	2″ x 1½″ x 3/16″ 1″ PIPE	2″ x 1½″ x 3/16″ 1″ PIPE	2″ x 1½″ x 3/16″ 1¼″ PIPE	2½″ x 1½″ x 3/16″ 1¼″ PIPE	2½″ x 1½″ x 3/16″ 1½″ PIPE	3″ x 2″ x 3/16″ 2″ PIPE	3″ x 2″ x ¼″ 2″ PIPE	3″ x 2″ x ¼″ 2″ PIPE
	3′-0″	2″ x 1½″ x 3/16″ 1″ PIPE	2″ x 1½″ x 3/16″ 1¼″ PIPE	2½″ x 1½″ x 3/16″ 1¼″ PIPE	2½″ x 1½″ x 3/16 1¼″ PIPE	3″ x 2″ x 3/16″ 1½″ PIPE	3″ x 2″ x 3/16″ 2″ PIPE	3½″ x 2½″ x ¼″ 2½″ PIPE	3½″ x 2½″ x 5/16″ 2½″ PIPE

Table 3-14.1.6 Trapeze Bars — One foot, six inches to 10 foot spans. (continued)

Span of Trapeze Bars	Pipe Size	2½" or Less	3"	3½"	4"	5"	6"	8"	10"
	4'–0"	2½ x 1½ x 3/16 1¼" Pipe	2½ x 1½ x 3/16 1¼" Pipe	2½ x 1½ x 3/16 1½" Pipe	3 x 2 x 3/16 1½" Pipe	3 x 2 x 3/16 2" Pipe	3 x 2 x ¼ 2" Pipe	3½ x 2½ x 5/16 2½" Pipe	4 x 3 x 5/16 3½" Pipe
	5'-0"	2½ x 1½ x 3/16 1¼" Pipe	2½ x 1½ x 3/16 1½" Pipe	3 x 2 x 3/16 1½" Pipe	3 x 2 x 3/16 2" Pipe	3 x 2 x¼ 2" Pipe	3½ x 2½ x 5/16 2½" Pipe	4 x 3 x 5/16 2½" Pipe	5 x 3½ x 5/16 4" Pipe
	6'–0"	2½ x 1½ x 3/16 1½" Pipe	3 x 2 x 3/16 2" Pipe	3 x 2 x 3/16 2" Pipe	3 x 2 x ¼ 2" Pipe	3½ x 2½ x 5/16 2½" Pipe	4 x 3 x 5/16 2½" Pipe	4 x 3 x 5/16 3" Pipe	5 x 3½ x 5/16 4" Pipe
	7'–0"	3 x 2 x 3/16 2" Pipe	3 x 2 x 3/16 2" Pipe	3 x 2 x ¼ 2" Pipe	3 x 2 x ¼ 2½" Pipe	3½ x 2½ x 5/16 2½" Pipe	4 x 3 x 5/16 3" Pipe	5 x 3½ x 5/16 3" Pipe	6 x 4 x ¼ 4" Pipe
	8'–0"	3 x 2 x 3/16 2" Pipe	3 x 2 x ¼ 2½" Pipe	3 x 2 x ¼ 2½" Pipe	3½ x 2½ x 5/16 2½" Pipe	3½ x 2½ x 5/16 3" Pipe	4 x 3 x 5/16 3" Pipe	5 x 3½ x 5/16 3½" Pipe	6 x 4 x ¼ 4" Pipe
	9'–0"	3 x 2 x 3/16 2" Pipe	3 x 2 x ¼ 2½" Pipe	3½ x 2½ x 5/16 2½" Pipe	3½ x 2½ x 5/16 3" Pipe	3½ x 2½ x 5/16 3½" Pipe	4 x 3 x 5/16 3½" Pipe	5 x 3½ x 5/16 4" Pipe	6 x 4 x 3/8 5" Pipe
	10'–0"	3 x 2 x ¼ 2½" Pipe	3 x 2 x ¼ 2½" Pipe	3½ x 2½ x 5/16 2½" Pipe	3½ x 2½ x 5/16 3" Pipe	4 x 3 x 5/16 3½" Pipe	5 x 3½ x 5/16 3½" Pipe	6 x 4 x ¼ 4" Pipe	6 x 4 x 3/8 5" Pipe

3-14.3 Powder Driven Studs and Welding Studs.

3-14.3.1* Powder driven studs, welding studs, and the tools used for installing these devices shall be listed by a nationally recognized testing laboratory and installed within the limits of pipe size, installation position, and construction material into which they are installed, as expressed in individual listings or approvals.

3-14.3.2 The ability of concrete to hold the studs varies widely according to type of aggregate and quality of concrete, and it shall be established in each case by testing concrete on the job to determine that the studs will hold a minimum load of 750 lbs. for two-inch or smaller pipe, 1000 lbs. for 2½, 3, or 3½-inch pipe, and 1200 lbs. for four- or five-inch pipe.

3-14.3.3 When increaser couplings are used, they shall be attached directly to the powder driven stud or welding stud.

3-14.3.4 Welded studs or other hanger parts shall not be attached by welding to steel less than U. S. Standard, 12 gage.

3-14.4 Rods and "U" Hooks.

3-14.4.1 Hanger rod size shall be the same as that approved for use with the hanger assembly and the size of rods shall not be less than that given in the following table.

Exception: Rods of smaller diameter may be used when the hanger assembly has been tested and listed by a nationally recognized testing laboratory and installed within the limits of pipe sizes expressed in individual listings or approvals. For rolled threads, the rod size shall not be less than the root diameter of the thread.

Table 3-14.4.1

Pipe Size	Dia. of Rod	Pipe Size	Dia. of Rod
Up to and including 4 in.	⅜"	5, 6 and 8 in.	½"
		10 and 12 in.	⅝"

3-14.4.2 "U" Hooks. The size of the rod material of "U" hooks shall be not less than that given in the following table:

Table 3-14.4.2

Pipe Size	Hook Material Dia.	Pipe Size	Hook Material Dia.
Up to 2 in.	5/16 in.	5 in.	½ in.
2½ in., 3 in.	⅜ in.	6 in.	⅝ in.
3½ in., 4 in.	7/16 in.	8 in.	¾ in.

3-14.4.3 Screws. For ceiling flanges and "U" hooks screw dimensions shall be not less than those given in the following table, except as provided in 3-14.4.7.

Table 3-14.4.3

Pipe Size	2 Screw Flanges
Up to 2 in.	Wood Screw No. 18 x 1½ in.
Pipe Size	**3 Screw Flanges**
Up to 2 in.	Wood Screw No. 18 x 1½ in.
2½ in., 3 in., 3½ in.	Lag Screw ⅜ in. x 2 in.
4 in., 5 in., 6 in.	Lag Screw ½ in. x 2 in.
8 in.	Lag Screw ⅝ in. x 2 in.
Pipe Size	**4 Screw Flanges**
Up to 2 in.	Wood Screw No. 18 x 1½ in.
2½ in., 3 in., 3½ in.	Lag Screw ⅜ in. x 1½ in.
4 in., 5 in., 6 in.	Lag Screw ½ in. x 2 in.
8 in.	Lag Screw ⅝ in. x 2 in.
Pipe Size	**"U" Hooks**
Up to 2 in.	Drive Screw No. 16 x 2 in.
2½ in., 3 in., 3½ in.	Lag Screw ⅜ in. x 2½ in.
4 in., 5 in., 6 in.	Lag Screw ½ in. x 3 in.
8 in.	Lag Screw ⅝ in. x 3 in.

3-14.4.4 The size bolt or lag (coach) screw used with an eye rod or flange on the side of a beam shall not be less than indicated in the following table, except as provided in Paragraph 3-14.4.7.

Table 3-14.4.4

Size of Pipe	Size of Bolt or Lag Screw	Length of Lag Screw Used with Wood Beams
Up to and including 2 in.	⅜"	2½"
2½ to 6 in. (inclusive)	½"	3"
8 in.	⅝"	3"

3-14.4.5 Drive screws shall be used only in a horizontal position as in the side of a beam. Wood screws shall not be driven. Nails are not acceptable for fastening hangers.

3-14.4.6 Screws in the side of a timber or joist shall be not less than 2½ inches from the lower edge when supporting branch lines, and not less than three inches when supporting main lines. This shall not apply to two-inch or thicker nailing strips resting on top of steel beams.

3-14.4.7 When the thickness of planking and thickness of flange does not permit the use of screws two inches long, screws 1¾ inches long may be permitted, with hangers spaced not over 10 feet apart. When the thickness of beams or joists does not permit the use of screws 2½ inches long, screws 2 inches long may be permitted, with hangers spaced not over 10 feet apart.

3-14.4.8 The minimum thickness of plank and the minimum width of lower face of beams or joists in which lag screw rods are used shall be as given in the following table:

Table 3-14.4.8

Pipe Size	Nominal Plank Thickness	Nominal Width of Beam Face
Up to 2 in.	3 in.	2 in.
2½ in. to 3½ in.	4 in.	2 in.
4 in. and 5 in.	4 in.	3 in.
6 in.	4 in.	4 in.

Lag screw rods shall not be used for support of pipes larger than six inches. All holes for lag screw rods shall be pre-drilled ⅛ inch less in diameter than the root diameter of the lag screw thread.

3-14.5 Maximum Distance Between Hangers. With steel pipe or copper tube as specified in Paragraph 3-1.1.1, the maximum distance between hangers shall not exceed 12 feet for 1- and 1¼-inch sizes nor 15 feet for sizes 1½-inch and larger except as provided in 3-14.7. See Figure 3-14.5.

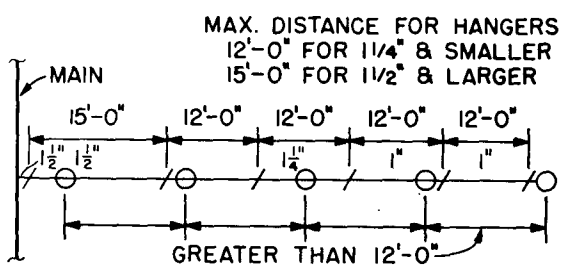


Fig. 3-14.5. Distance Between Hangers.

3-14.6 Location of Hangers on Branch Lines.

NOTE: This subsection applies to the support of steel pipe or copper tube as specified in 3-1.1.1, subject to the provisions of 3-14.5.

3-14.6.1 On branch lines there shall be at least one hanger or each length of pipe except as provided in paragraphs 3-14.6.2 o 3-14.6.6 inclusive.

3-14.6.2 The distance between the hanger and centerline of upright sprinkler shall be no less than 3 inches.

3-14.6.3 The unsupported length between the end sprinkler and the last hanger shall be not more than 36 inches for one-inch pipe, or 48 inches for 1¼-inch pipe. When these limits are exceeded, the pipe shall be extended beyond the end sprinkler and supported by an additional hanger.

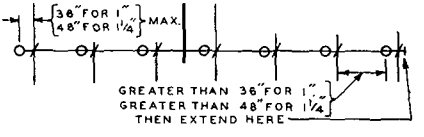


Fig. 3-14.6.3. Distance Sprinkler to Hanger.

3-14.6.4 When sprinklers are less than six feet apart, hangers may be spaced up to, but not exceeding 12 feet. See Fig. 3-14.6.4.

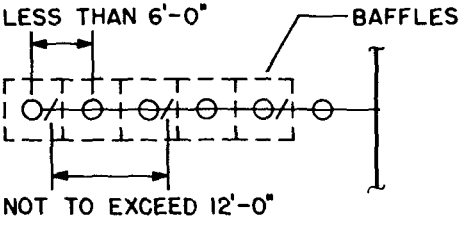


Fig. 3-14.6.4. Distance Between Hangers. (See 3-14.6.4 and 4-4.19.)

3-14.6.5 Starter lengths less than six feet do not require a hanger, except on the end line of a side-feed system, or where an intermediate cross main hanger has been omitted.

3-14.6.6* Hangers are not required on one-inch arms not over 12 inches long for copper tube, nor 24 inches long for steel pipe from branch lines or cross mains.

3-14.7 Location of Hangers on Cross Mains.

NOTE: This subsection applies to the support of steel pipe only as specified in 3-1.1.1, subject to the provisions of 3-14.5. Intermediate hangers shall not be omitted for copper tube.

3-14.7.1 On cross mains there shall be at least one hanger between each two branch lines, except intermediate hangers may be omitted as outlined in 3-14.7.2 to 3-14.7.4, inclusive.

3-14.7.2 In bays having two branch lines, the intermediate hanger may be omitted provided that a hanger attached to a purlin is installed on each branch line located as near to the cross main as the location of the purlin permits. (See Figure 3-14.7.2). Remaining branch line hangers shall be installed in accordance with 3-14.6.

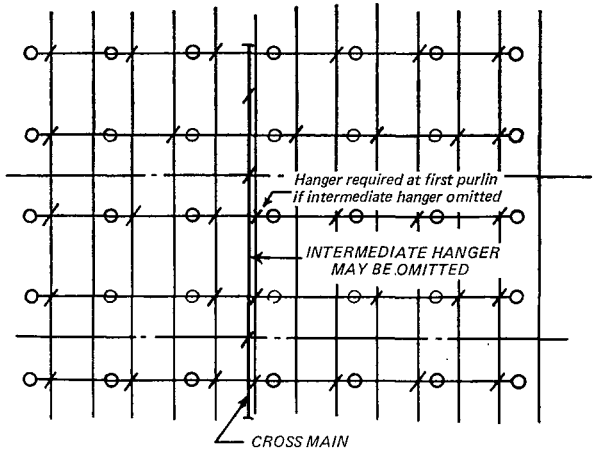


Fig. 3-14.7.2. Hangers on Cross Main.

3-14.7.3 In bays having three or more branch lines, either side or center feed, one (only) intermediate hanger may be omitted provided that a hanger attached to a purlin is installed on each branch line located as near to the cross main as the location of the purlin permits. (See Figure 3-14.7.3(A) and 3-14.7.3(B).) Remaining branch line hangers shall be installed in accordance with 3-14.6.

3-14.7.4 At the end of the cross main, intermediate trapeze hangers shall be installed unless the cross main is extended to the next framing member with an ordinary hanger installed at this point, in which event an intermediate hanger may be omitted in accordance with 3-14.7.2 and 3-14.7.3.

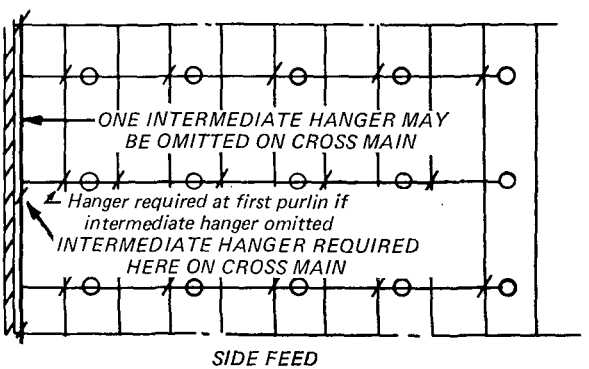


Fig. 3-14.7.3(A). Hanger Omission on Side Feed System.

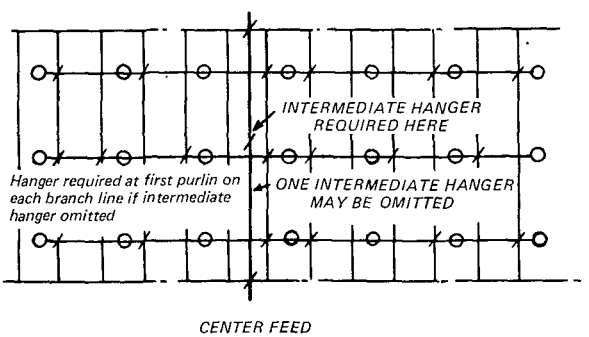


Fig. 3-14.7.3(B). Hangers on Cross Main — Center Feed System.

3-14.8 Location of Hangers on Feed Mains. On feed mains there shall be at least one hanger for each 15 feet of pipe.

NOTE: This subsection applies to the support of steel pipe or copper tube as specified in Paragraph 3-1.1.1, subject to provisions contained in Section 3-14.5.

3-14.9 Support of Risers.

3-14.9.1 Risers shall be supported by attachments directly to the riser or by hangers located on the horizontal connections close to the riser.

3-14.9.2 In buildings designed for live floor loads in excess of 125 pounds per square foot, riser supports shall be provided at the ground level and at each fourth level above. In buildings designed for live floor loads less than 125 pounds per square foot, riser supports shall be provided at ground level and at each third level above. Where risers are supported from the ground, the ground support constitutes the first level of riser support. Where risers are offset or do not rise from the ground the first ceiling level above the offset constitutes the first level of riser support.

3-14.9.3 Sprinkler and tank risers in vertical shafts, or in buildings with ceilings over 25 feet high shall have at least one support for each riser pipe section.

3-14.9.4 Clamps supporting pipe by means of set screws shall not be used.

3-15 Sprinklers.

3-15.1* Standard and Old Style Sprinklers.

3-15.1.1 Standard sprinklers may be used to replace old style sprinklers without system changes except for installation under piers and wharves where construction features require upward discharge to wet the underside of decks and structural members supporting the decks. In these cases, a sprinkler that projects water upward to wet the overhead shall be used. This can be accomplished by using the standard pendent sprinkler installed in an upright position or by the use of the old style sprinklers.

3-15.1.2 Old style sprinklers may be used to replace old style sprinklers.

3-15.1.3 Old style sprinklers shall not be used to replace standard sprinklers without a complete engineering review of the system which may result in major changes.

3-15.2 Types of Sprinklers.

3-15.2.1 Only listed sprinklers shall be used. Sprinklers shall not be altered in any respect, nor have any type of ornamentation or coatings applied after shipment from the place of manufacture.

3-15.2.2* The character of the discharge of sprinklers is such that it is necessary to use two distinct designs — one approved for the upright and the other for the pendent position.

3-15.2.3 Sprinklers used for the special purposes and locations described in 3-15.2.4 to 3-15.4, inclusive, shall be of types specifically approved for such use.

3-15.2.4 Open sprinklers may be used to protect special hazards, for protection against exposures, or in other special locations.

3-15.2.5 For locations or conditions not requiring as much water as is discharged by a nominal ½-inch orifice sprinkler, sprinklers having a smaller orifice may be used.

3-15.2.6* For locations or conditions requiring more water than is discharged by a nominal ½-inch orifice sprinkler, a sprinkler having a larger orifice may be used. Large orifice sprinklers having ½-inch iron pipe thread shall not be installed in new sprinkler systems.

3-15.2.7 In situations involving special problems of water distribution, sprinklers having a discharge other than that which is characteristic of the ordinary types may be used. These will usually have special deflectors. Sprinklers having special discharge characteristics may be required where either a fine spray or directional discharge of water is needed, (e.g., directional discharge may be needed to properly protect substructures of piers and wharves due to the arrangement of structural supporting members. See NFPA Standard for the Construction and Protection of Piers and Wharves, No. 87–1971.)

3-15.3 Corrosion-Resistant Sprinklers.

3-15.3.1 Listed Corrosion-Resistant or special coated sprinklers shall be installed in locations where chemicals, moisture or other corrosive vapors exist sufficient to cause corrosion of such devices as in paper mills, packing houses, tanneries, alkali plants, organic fertilizer plants, founderies, forge shops, fumigation, pickle and vinegar works, stables, storage battery rooms, electroplating rooms, galvanizing rooms, steam rooms of all descriptions, including

moist vapor dry kilns, salt storage rooms, locomotive sheds or houses, driveways, areas exposed to outside weather such as piers and wharves exposed to salt air, areas under sidewalks, around bleaching equipment in flour mills, all portions of cold storage buildings where a direct ammonia expansion system is used, portions of any plant where corrosive vapors prevail.

3-15.3.2 Wax-coated or Similar Sprinklers.

3-15.3.2.1 Care shall be taken in the handling and installation of wax-coated or similar sprinklers to avoid damaging the coating.

3-15.3.2.2 The color identification for coated sprinklers may be a dot on the top of the deflector, the color of the coating material or coating frame arms.

3-15.3.2.3 Color identification is not required for plated sprinklers, ceiling sprinklers or similar decorative types.

3-15.3.3 Corrosion-resistant coatings shall not be applied to sprinklers by anyone other than the manufacturer of the sprinklers, except that in all cases any damage to the protective coating occurring at the time of installation shall be repaired at once using only the coating of the manufacturer of the sprinkler in approved manner so that none of the sprinkler will be exposed after installation has been completed. Otherwise corrosion will attack the exposed metal and will in time creep under the coating.

3-15.4 Sidewall Sprinklers. Sidewall sprinklers are special sprinklers and their use shall be confined to light hazard occupancies as defined in Paragraph 1-7.1.1, unless specifically designed and listed for ordinary hazard occupancies, or unless used in accordance with 3-15.2.7.

3-15.5* Discharge Capacities. Table 3-15.5 shows the K factor, relative discharge and identification for sprinklers having different orifice sizes.

3-15.6* Temperature Ratings.

3-15.6.1 The standard temperature ratings of automatic sprinklers are shown in Table 3-15.6.1. Automatic sprinklers shall have their frame arms colored in accordance with the color code designated in Table 3-15.6.1 with the following exceptions:

Exception 1: The color identification for coated sprinklers may be a dot on the top of the deflector, the color of the coating material or colored frame arms.

Exception 2: Color identification is not required for plated sprinkler, ceiling sprinklers or similar decorative types.

Table 3-15.5

Nominal Orifice (In.)	"K"[1] Factor	Percent of Nominal ½-inch Discharge	Identification[2]
¼	1.3–1.5	25	½ in. IPT — Pintle
5/16	1.8–2.0	33.3	½ in. IPT — Pintle
3/8	2.6–2.9	50	½ in. IPT — Pintle
7/16	4.0–4.4	75	½ in. IPT — Pintle
½	5.3–5.8	100	½ in. IPT
17/32	7.4–8.2	140	¾ in. IPT or ½ in. IPT — Pintle

[1] "K" factor is the constant in the formula.

$$Q = K\sqrt{P}$$ Where Q = Flow in GPM, P = Pressure in PSI

[2]With the exception of ½-inch orifice and 17/32-inch orifice, ¾-in. IPT (iron pipe thread) sprinklers, the nominal orifice size is cast or stamped on the wrench boss of the sprinkler frame.

Table 3-15.6.1
Temperature Ratings, Classifications and Color Codings

Maximum Ceiling Temperature °F	Temperature Rating °F	Temperature Classification	Color Code
100	135 to 170	Ordinary	Uncolored
150	175 to 225	Intermediate	White
225	250 to 300	High	Blue
300	325 to 375	Extra High	Red
375	400 to 475	Very Extra High	Green
475	500 to 575	Ultra High	Orange

3-15.6.2 When higher temperature sprinklers are necessary to meet extraordinary conditions, special sprinklers as high as 650°F. are obtainable and may be used.

3-15.6.3 The use of sprinklers with temperature ratings higher than ordinary shall be in accordance with the maximum ceiling temperatures given in Table 3-15.6.1, except that intermediate or high temperature sprinklers may be used in other than light hazard occupancies. For situations involving high piled or rack storage, refer to NFPA Standards on Indoor General Storage No. 231–1974 and Rack Storage of Materials No. 231C–1974.

3-15.6.4 The following practices shall be observed when installing high temperature sprinklers, unless maximum expected temperatures are otherwise determined or unless high temperature sprinklers are used throughout.

(a) Sprinklers near unit heaters. Where steam pressure is not more than 15 pounds per square inch, sprinklers in the heater zone shall be high and sprinklers in the danger zone intermediate temperature classification.

(b) Sprinklers located within 12 inches to one side or 30 inches above an uncovered steam main, heating coil or radiator, shall be intermediate temperature classification.

(c) Sprinklers within 7 feet of a low pressure blowoff valve which discharges free in a large room, shall be high temperature classification.

(d) Sprinklers under glass or plastic skylights exposed to the direct rays of the sun shall be intermediate temperature classification.

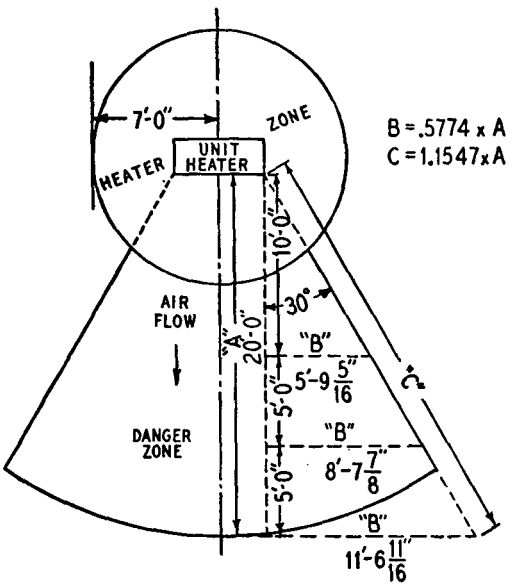


Fig. 3-15.6.4(a). Heater and Danger Zones at Unit Heaters.

Table 3-15.6.4(A)
Distance of Sprinklers from Heat Sources

Type of Heat Condition	*Ordinary Degree Rating*	*Intermediate Degree Rating*	*High Degree Rating*
1. HEATING DUCTS a. Above	a. More than 2'-6"	a. 2'-6" or less	—
b. Side and Below	b. More than 1'-0"	b. 1'-0" or less	—
c. Diffuser Downward Discharge Horizontal Discharge	c. Any distance except as shown under INTERMEDIATE	c. *Downward:* Cylinder with 1'-0" radius from edge, extending 1'-0" below and 2'-6" above c. *Horizontal:* Semi-cylinder with 2'-6" radius in direction of flow, extending 1'-0" below and 2'-6" above	—
2. UNIT HEATER a. Horizontal Discharge	—	a. *Discharge Side:* 7'-0" to 20'-0" radius pie-shaped cylinder [See Fig. 3-15.6.4 (a)] extending 7'-0" above and 2'-0" below Unit Heater; also 7'-0" radius cylinder more than 7'-0" above Unit Heater	a. 7'-0" radius cylinder extending 7'-0" above and 2'-0" below Unit Heater
b. Vertical Downward Discharge [Note: For Sprinklers Below Unit Heater See Fig. 3-15.6.4(a)]	—	b. 7'-0" radius cylinder extending upward from an elevation 7'-0" above Unit Heater	b. 7'-0" radius cylinder extending from the top of the Unit Heater to an elevation 7' 0" above Unit Heater
3. STEAM MAINS (Uncovered) a. Above	a. More than 2'-6"	a. 2'-6" or less	—
b. Side and Below	b. More than 1'-0"	b. 1'-0" or less	—
c. Blow-off Valve	c. More than 7'-0"	—	c. 7'-0" or less

Table 3-15.6.4(B)

Ratings of Sprinklers in Specified Locations

Location	*Ordinary Degree Rating*	*Intermediate Degree Rating*	*High Degree Rating*
SKYLIGHTS	—	Glass or plastic	—
ATTICS	Ventilated	Unventilated	—
PEAKED ROOF Metal or thin boards; concealed or not concealed; insulated or uninsulated	Ventilated	Unventilated	—
FLAT ROOF Metal not concealed; insulated or uninsulated	Ventilated or unventilated	Note: For uninsulated roof, climate and occupancy may require INTERMEDIATE sprinklers. Check on job.	—
FLAT ROOF Metal; concealed; insulated or uninsulated	Ventilated	Unventilated	—
SHOW WINDOWS	Ventilated	Unventilated	—

NOTE: A check of job condition by means of thermometers may be necessary.

(e) Sprinklers in an unventilated concealed space under an uninsulated roof, or in an unventilated attic, shall be of intermediate temperature classification.

(f) Sprinklers in unventilated show windows having high-powered electric lights near the ceiling shall be intermediate temperature classification.

(g) Where a locomotive enters a building, sprinklers shall be located not nearer than 5 feet from the center line of the track.

(h) For sprinklers protecting commercial-type cooking equipment and ventilation systems, temperature classifications of intermediate, high or extra high shall be provided as determined by use of a temperature measuring device (see 4-4.18.2).

3-15.6.5 In case of change of occupancy involving temperature change, the sprinklers shall be changed accordingly.

3-15.7* Stock of Spare Sprinklers.

3-15.7.1 There shall be maintained on the premises a supply of spare sprinklers (never less than six) so that any sprinklers that have operated or been damaged in any way may promptly be replaced. These sprinklers shall correspond as to types and temperature ratings with the sprinklers in the property. The sprinklers shall be kept in a cabinet located where the temperature to which they are subjected will at no time exceed 100°F.

3-15.7.2 A special sprinkler wrench shall also be provided and kept in the cabinet, to be used in the removal and installation of sprinklers.

3-15.7.3 The stock of spare sprinklers shall be as follows:

For equipments not over 300 sprinklers, not less than 6 sprinklers

For equipments 300 to 1,000 sprinklers, not less than 12 sprinklers

For equipments above 1,000 sprinklers, not less than 24 sprinklers

Stock of spare sprinklers shall include all types and ratings installed.

3-15.8* Guards and Shields. Sprinklers which are so located as to be subject to mechanical injury (in either the upright or the pendent position) shall be protected with approved guards.

3-15.9 Painting and Ornamental Finishes.

3-15.9.1* When the sprinkler piping is given any kind of coating, such as whitewash or paint, care shall be exercised to see that no automatic sprinklers are coated.

3-15.9.2* Sprinkler frames may be factory painted or enameled for the purpose of identifying sprinklers of different temperature ratings in accordance with Paragraph 3-15.6.1 or as ornamental finish in accordance with Paragraph 3-15.9.3. Otherwise, sprinklers shall not be painted and any sprinklers which have been painted, except for factory applied coatings shall be replaced with new listed sprinklers.

3-15.9.3 Ornamental finishes shall not be applied to sprinklers by anyone other than the sprinkler manufacturer and only sprinklers listed with such finishes shall be used.

3-16 Sprinkler Alarms.

3-16.1 Definition. A local alarm unit is an assembly of apparatus approved for the service and so constructed and installed that any flow of water from a sprinkler system equal to or greater than that from a single automatic sprinkler will result in an audible alarm signal on the premises.

3-16.2* Where Required. Local waterflow alarms shall be provided on all sprinkler systems having more than 20 sprinklers.

3-16.3 Water Flow Detecting Devices.

3-16.3.1 Alarm Check Valves. The alarm apparatus for a wet-pipe system shall consist of an approved alarm check valve or other approved waterflow detecting alarm device with the necessary attachments required to give an alarm.

3-16.3.2 Dry-Pipe Valves. The alarm apparatus for a dry-pipe system shall consist of approved alarm attachments to the dry-pipe valve. When a dry-pipe valve is located on the system side of an alarm valve, the actuating device of the alarms for the dry-pipe valve may be connected to the alarms on the wet-pipe system.

3-16.3.3* Preaction and Deluge Valves. The alarm apparatus for preaction and deluge systems shall consist of approved alarm attachments, actuated by a detection system independent of flow of water in the system.

3-16.3.4 Waterflow alarm indicators (paddle type) shall not be installed in dry-pipe, preaction or deluge systems. The surge of water when valve trips may seriously damage the device.

3-16.4 Attachments — General.

3-16.4.1* An alarm unit shall include an approved mechanical alarm, horn or siren, or an approved weatherproof electric gong, bell, horn or siren.

3-16.4.2* Outdoor mechanical or electrically operated bells shall be of weatherproof and guarded type.

3-16.4.3 On each alarm check valve used under conditions of variable water pressure, a retarding device shall be installed. Valves shall be provided in the connections to retarding chambers, to permit repair or removal without shutting off sprinklers; these valves shall be so arranged that they may be locked or sealed in the open position.

3-16.4.4 Dry-pipe, preaction and deluge valves shall be fitted with a test connection for electric alarm switch and/or water motor gong. This pipe connection shall be made on the water side of the system and provided with a control valve and drain for the alarm piping. A check valve shall be installed in the pipe connection to the intermediate chamber of the dry-pipe valve.

3-16.4.5 A control valve shall be installed in connection with pressure-type contactor or water-motor-operated alarm devices and such valves shall be of the type which will clearly indicate whether they are open or closed and be so constructed that they may be locked or sealed in the open position. The control valve for the retarding chamber on alarm check valves of wet-pipe systems may be accepted as complying with this paragraph.

3-16.5* Attachments — Mechanically Operated. For all types of sprinkler systems employing water-motor-operated alarms, an approved ¾-inch strainer shall be installed at the alarm outlet of the waterflow detecting device except that when a retarding chamber is used in connection with an alarm valve, the strainer shall be located at the outlet of the retarding chamber unless the retarding chamber is provided with an approved integral strainer in its outlet. Water-motor-operated devices shall be protected from the weather, and shall be properly aligned and so installed as not to get out of adjustment. All piping to these devices shall be galvanized or brass or other approved corrosion resistant material of a size not less than ¾ inch.

3-16.6 Attachments — Electrically Operated.

3-16.6.1 Electrically operated alarm attachments forming part of an auxiliary, central station, proprietary or remote station

signaling system shall be installed in accordance with the following applicable NFPA standards.

(a) Central Station Signaling Systems (NFPA No. 71–1974)

(b) Auxiliary Protective Signaling Systems (NFPA No. 72B–1974)

(c) Remote Station Protective Signaling Systems (NFPA No. 72C–1974)

(d) Proprietary Protective Signaling Systems (NFPA No. 72D–1974).

3-16.6.2* Electrically operated alarm attachments forming part of a local sprinkler waterflow alarm system shall be installed in accordance with the local alarm system provisions of NFPA Standard for Local Protective Signaling Systems, No. 72A–1974 and in accordance with the provisions of the following Paragraphs 3-16.6.3, A-3-16.6.2, and 3-16.6.4. This standard permits local electrical waterflow alarms to be of open circuit type.

3-16.6.3 Waterflow detecting devices, including the associated alarm circuits, shall be tested by an actual waterflow through use of a test connection (see Section 3-16.7).

3-16.6.4 Outdoor electric alarm devices shall be of a type specifically listed for outdoor use, and the outdoor wiring shall be in approved conduit, properly protected from the entrance of water in addition to the requirements of 3-16.6.1.

3-16.7 Drains. Drains from alarm devices shall be so arranged that there will be no danger of freezing, and so that there will be no overflowing at the alarm apparatus at domestic connections or elsewhere with the sprinkler drains wide open and under system pressure. (See Section 3-10.4).

Chapter 4 Spacing, Location and Position of Sprinklers.

4-1 General Information.

4-1.1* Basic Principles.

4-1.1.1 The basic principles for providing proper protection are namely: (1) Sprinklers installed throughout the premises, including basements, lofts and all of the locations herein specified. (2) Definite maximum protection area per sprinkler. (3) Minimum interference to discharge pattern by beams, bracing, girders, trusses, piping, lighting fixtures and air conditioning ducts. (4) Correct location of automatic sprinklers with respect to ceilings, or beams and wood joists to obtain suitable sensitivity.

4-1.1.2 The installation requirements are specific for the normal arrangement of structural members. There will be arrangements of structural members not specifically detailed by the requirements. By applying the basic principles, layouts for such construction can vary from specific illustrations provided the maximum specified for the Spacing of Sprinklers (Section 4-2) and Position of Sprinklers (Section 4-3) are not exceeded.

4-1.1.3 Special Sprinklers may be installed with larger protection areas or distances between sprinklers than are specified in Sections 4-2 and 4-5 when such installations are made in accordance with approvals or listings of a nationally recognized testing laboratory.

4-1.1.4* Clearance between sprinklers and structural member shall comply with this standard unless tests are performed which show that deviations offer no obstruction to spray discharge.

4-1.2* Partial Installations. When partial sprinkler installations are installed, the requirements of this standard shall be used in so far as they are applicable. The authority having jurisdiction shall be consulted in each case.

4-1.3 Definitions.

4-1.3.1 Smooth Ceiling Construction. The term smooth ceiling construction as used in this standard includes:

(a) Flat slab, pan type reinforced concrete, concrete joist less than three feet on centers.

(b) Continuous smooth bays formed by wood, concrete or steel beams spaced more than 7½ feet on centers — beams supported by columns, girders or trusses.

(c) Smooth roof or floor decks supported directly on girders or trusses spaced more than 7½ feet on centers.

(d) Smooth monolithic ceilings of at least ¾-inch of plaster on metal lath or a combination of materials of equivalent fire-resistive rating attached to the underside of wood or bar joists.

(e) Open web type steel beams regardless of spacing.

(f) Smooth shell type roofs, such as folded plates, hyperbolic paraboloids, saddles, domes and long barrel shells.

(g) In (b) through (f) above, the roof and floor decks may be noncombustible or combustible. Item (b) would include standard mill construction.

(h) Suspended ceilings of noncombustible construction.

(i) Suspended ceilings of combustible construction where there is a full complement of sprinklers in the space immediately above such a ceiling and the space is unfloored and unoccupied.

(j) Smooth monolithic ceilings with fire resistance less than that specified under item (d) attached to the underside of wood or bar joists.

(k) Combustible suspended ceilings arranged other than as specified under item (i).

4-1.3.2 Beam and Girder Construction. The term beam and girder construction as used in this standard includes noncombustible and combustible roof or floor decks supported by wood beams of 4 inches or greater nominal thickness or concrete or steel beams spaced 3 to 7½ feet on centers and either supported on or framed into girders. [When supporting a wood plank deck, this includes semi-mill and panel construction and when supporting (with steel framing) gypsum plank, steel deck, concrete, tile, or similar material would include much of the so-called noncombustible construction.]

4-1.3.3 Bar Joist Construction. The term bar joist construction refers to construction employing joists consisting of steel truss-shaped members. This definition includes noncombustible and combustible roof and floor decks supported on bar joists.

4-1.3.4 Panel Construction. The term panel construction as used in this standard includes ceiling panels formed by members capable of trapping heat to aid the operation of sprinklers and limited to a maximum of 300 square feet in area. Beams spaced more than 7½ feet apart and framed into girders qualifies for panel construction provided the 300 square foot area limitation is met.

4-1.3.5 Standard Mill Construction. The term standard mill construction as used in this standard refers to heavy timber construction as defined in NFPA Standard Types of Building Construction, No. 220–1961.

4-1.3.6 Semi-Mill Construction. The term semi-mill construction as used in this standard refers to a modified standard mill construction where greater column spacing is used and beams rest on girders.

4-1.3.7 Wood Joist Construction. The term wood joist construction refers to wood boards or planks on wooden beams spaced less than 3 feet on centers. Wooden beams less than 4 inches nominal thickness spaced more than 3 feet on centers are also considered as wood joist construction.

4-1.3.8 High Piled Storage. High-piled storage is defined as solid piled storage in excess of 15 feet in height or palletized or rack storage in excess of 12 feet in height. See Appendix for availability of information for sprinkler protection of high piled storage.

4-2 Spacing and Location of Sprinklers. (See also Sections 4-3 and 4-4.)

4-2.1 Distance Between the Branch Lines and Between Sprinklers on the Branch Lines.

4-2.1.1 For light hazard occupancies the distance between branch lines and between sprinklers on the branch lines shall not exceed 15 feet.

4-2.1.2* For ordinary hazard occupancies, except high-piled stock, the distance between the branch lines and between sprinklers on branch lines shall not exceed 15 feet. In buildings used for high-piled storage (as defined in 4-1.3.8) the distance between the branch lines and between sprinklers on the branch lines shall not exceed 12 feet, except in bays 25 feet wide, a spacing of 12 feet 6 inches between branch lines is permitted.

4-2.1.3 For extra hazard occupancy, the distance between the branch lines and between sprinklers on the branch lines shall not exceed 12 feet.

4-2.1.4 Distance from Walls. The distance from the walls to the end sprinklers on the branch lines shall not exceed one-half of the allowable distance between sprinklers on the branch lines. The distance from the walls to the end branch lines shall not exceed one-half the allowable distance between the branch lines. For exception relating to small rooms, refer to Paragraph 4-4.20.

4-2.2 Protection Area Limitations.

4-2.2.1 Light Hazard Occupancy.

4-2.2.1.1 Under smooth ceiling construction and under beam and girder construction (as defined in Paragraph 4-1.3.1 items (a) through (i), and 4-1.3.2) the protection area per sprinkler shall not exceed 200 square feet. For hydraulically designed sprinkler systems the protected area limit per sprinkler may be increased to 225 square feet.

4-2.2.1.2* Under open wood joist construction (as defined in 4-1.3.7) the protection area per sprinkler shall not exceed 130 square feet.

4-2.2.1.3 For other types of construction the protection area per sprinkler shall not exceed 168 square feet.

4-2.2.2 Ordinary Hazard Occupancy. For all types or construction the protection area per sprinkler shall not exceed 130 square feet, except that in buildings used for high piled storage (as defined in Paragraph 4-1.3.8) the protection area per sprinkler shall not exceed 100 square feet.

Exception: Sprinkler spacing may exceed 100 square feet, but shall not exceed 130 square feet in systems hydraulically designed in accordance with NFPA Nos. 231 and 231C (see Appendix E) for densities below 0.25 gpm per square foot.

4-2.2.3 Extra Hazard Occupancy. The protection area per sprinkler shall not exceed 90 square feet for any type of building construction, except protection area per sprinkler shall not exceed 100 square feet where the system is hydraulically designed.

4-2.3* Location of Sprinklers and Branch Lines with Respect to Structural Members.

4-2.3.1 Sprinklers may be located under beams, in bays, or combination of both, but the locations must meet the provisions outlined in 4-2.4 and 4-3.

4-2.3.2 Where there are two sets of joists under a roof or ceiling and there is no flooring over the lower set, sprinklers shall be installed above and below the lower set of joists where there is a clearance of from 6 inches to 12 inches between the top of the lower joist and bottom of the upper joist. (See Fig. 4-2.3.2.).

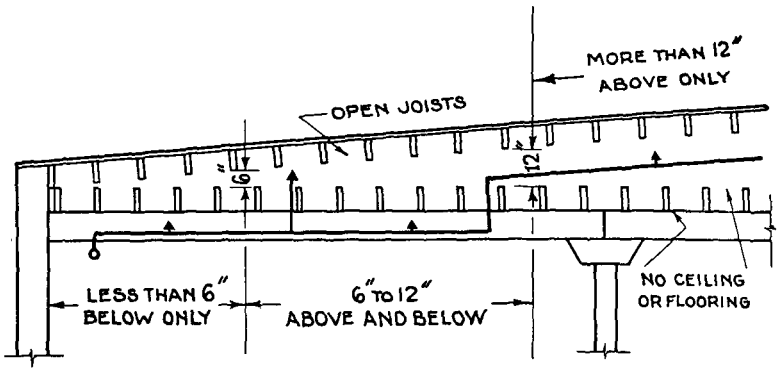


Fig. 4-2.3.2. Arrangement of Sprinklers under Two Sets of Open Joists — no sheathing on lower joists.

4-2.4 Clearance Between Sprinklers and Structural Members.

4-2.4.1 Trusses. Sprinklers shall be at least two feet laterally from truss members (web or chord) more than four inches wide, and at least one foot laterally from truss members four inches or less in width. When sprinkler lines run above or through trusses, the sprinklers may be located on center line of truss, provided chord members are not more than eight inches wide, and the deflector is at least six inches above the chord member. When sprinklers are located laterally beside chord members, clearances between the chord members and the sprinkler deflectors shall be in accordance with 4-2.4.6.

4-2.4.2 Girders. When sprinkler lines are located perpendicular to and above girders, sprinklers shall be at least three feet, nine inches from girders except that they may be located directly above girders with the top flange not more than eight inches wide, in which case the deflectors shall be at least six inches above the top of the girder.

4-2.4.3 When sprinkler deflectors are in accordance with Table 4-2.4.6, the girders may be disregarded in the spacing of the branch lines.

4-2.4.4 Open Web-Type Steel Beams. See Fig. 4-2.4.4. When branch lines are run across and through openings of open web-type steel beams, sprinklers may be spaced bay and beam provided:

(a) the distance between sprinklers and between branch lines conforms to Section 4-2.1,

(b) sprinklers in the beam openings are located within one inch horizontally of the opening center line,

(c) the branch line is located within one inch horizontally of the opening center line, and

(d) sprinklers on alternate lines are staggered.

Open Web-Type Steel Beams

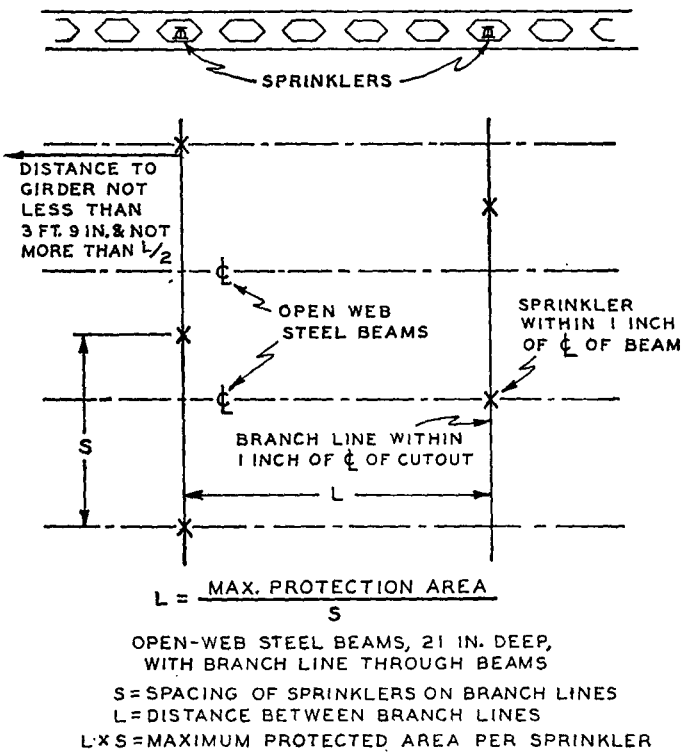


Fig. 4-2.4.4. Location of Branch Lines and Sprinklers.

4-2.4.5 Bar Joists. Sprinklers shall be at least three inches laterally from web members of open bar joists which do not exceed

one-half inch or at least six inches laterally from web members which do not exceed one inch. When the dimensions of the web member exceeds one inch, see 4-2.4.1.

4-2.4.6. Beams. Deflectors of sprinklers in bays shall be at sufficient distances from the beams, as shown in Table 4-2.4.6 and Figure 4-2.4.6 to avoid obstruction to the sprinkler discharge pattern. Otherwise the spacing of sprinklers on opposite sides of the beams shall be measured from the beam and the distance shall not exceed ½ of the allowable distance between sprinklers.

Table 4-2.4.6
Position of Deflector when Located above Bottom of Beam

Distance from Sprinkler to Side of Beam	Maximum Allowable Distance Deflector above Bottom of Beam
Less than 1 ft.	0 in.
1 ft. to less than 2 ft.	1 in.
2 ft. to less than 2 ft. 6 in.	2 in.
2 ft. 6 in. to less than 3 ft.	3 in.
3 ft. to less than 3 ft. 6 in.	4 in.
3 ft. 6 in. to less than 4 ft.	6 in.
4 ft. to less than 4 ft. 6 in.	7 in.
4 ft. 6 in. to less than 5 ft.	9 in.
5 ft. to less than 5 ft. 6 in.	11 in.
5 ft. 6 in. to less than 6 ft.	14 in.

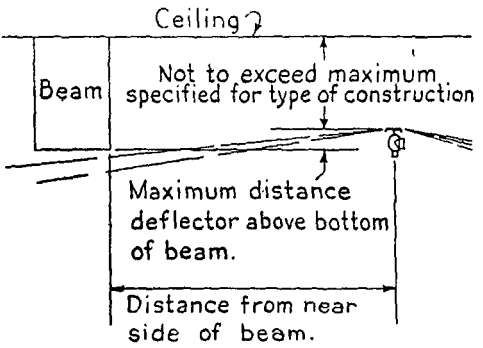


Fig. 4-2.4.6. Position of Deflector, Upright or Pendent, When Located Above Bottom of Beam.

4-2.4.7 Position of Deflectors. Deflectors of sprinklers shall be parallel to ceilings, roofs, or the incline of stairs, but when installed in the peak of a pitched roof they shall be horizontal. Low-pitched roofs having slopes not greater than one inch per foot may be considered as level in the application of this rule and sprinklers may be installed with deflectors horizontal.

4-2.5 Clear Space Below Sprinklers. A minimum of 18 inches clearance shall be maintained between top of storage and ceiling sprinkler deflectors. For in-rack sprinklers, the clear space shall be in accordance with NFPA No. 231C–1974, Rack Storage of Materials (see Appendix E).

4-3 Position of Sprinklers.

4-3.1 Smooth Ceiling Construction (as defined in 4-1.3.1.)

4-3.1.1 Deflectors of sprinklers in bays shall be located one inch to 10 inches below combustible ceilings or 12 inches below noncombustible ceilings.

4-3.1.2 Deflectors of sprinklers under beams shall be located 1 inch to 4 inches below beams, and not more than 14 inches below combustible ceilings or not more than 16 inches below noncombustible ceilings.

4-3.1.3 When sprinklers approved for pendent use are installed in the pendent position under smooth ceilings the deflectors shall be not less than 2½ inches from ceiling. Special approved type pendent sprinklers (flush type, ceiling type) may have deflectors nearer the ceiling.

4-3.2 Beam and Girder Construction. (as defined in 4-1.3.2.)

4-3.2.1 Deflectors of sprinklers in bays shall be located one inch to 16 inches below combustible or noncombustible roof or floor decks.

4-3.2.2 Deflectors of sprinklers under beams shall be located one inch to four inches below beams and not more than 20 inches below combustible or noncombustible roof or floor decks.

4-3.2.3 When concrete tee construction is encountered with the stems of the tees spaced less than 7½ feet on centers but more than three feet on centers, the sprinklers may be spaced midway between and above the bottom of the stems in violation of Paragraphs 4-3.2.1, 4-3.2.2 and 4-3.4.1 provided that Table 4-2.4.6 is followed.

4-3.3 Open Bar Joist Construction. (as defined in 4-1.3.3.) Deflectors of sprinklers shall be located one inch to 10 inches below combustible or not more than 12 inches below noncombustible roof or floor decks.

4-3.4 Panel Construction. (as defined in 4-1.3.4.)

4-3.4.1 Deflectors of sprinklers in bays formed by members, such as beams framed into girders, resulting in panels up to 300 square feet shall be located one inch to 18 inches below combustible or noncombustible roof or floor decks.

4-3.4.2 Deflectors of sprinklers under the members, such as under beams framed into girders, forming panels up to 300 square feet shall be located one inch to four inches below such members and not more than 22 inches below combustible or noncombustible roof or floor decks.

4-3.5 Open Wood Joist Construction. (as defined in 4-1.3.7.) In open joist construction with joists spaced three feet or less on centers, sprinklers shall be located with deflectors one inch to six inches below the bottom of the joists. If open joists are spaced more than three feet on centers, sprinklers shall be located with deflectors placed in accordance with Sections 4-3.1 or 4-3.2.

4-3.6 Location Under Sheathed or Suspended Ceiling Under Any Type of Construction. The position of sprinklers under sheathed or suspended ceilings with any type of construction shall be the same as for smooth ceiling construction, 4-3.1.1 and 4-3.1.3.

4-4* Locations or Conditions Involving Special Consideration.

4-4.1 Combustible Form Board. When roof or floor decks consist of poured gypsum or concrete on combustible form board supported on steel supports, the position of sprinkler deflectors shall be the same as for noncombustible construction as stated in 4-3. When combustible form board is located above suspended ceilings or in blind spaces see 4-4.4.1.

4-4.2 Metal Roof Decks. When roof decks are metal with combustible adhesives or vapor seal, the position of sprinklers shall be the same as for combustible construction.

4-4.3 Spaces Under Ground Floors. Sprinklers shall be installed in all spaces below combustible ground floors, except that

by permission of the authority having jurisdiction, sprinklers may be omitted when all of the following conditions prevail:

(a) The space is not accessible for storage purposes or entrance of unauthorized persons and is protected against accumulation of wind-borne debris;

(b) The space contains no equipment such as steam pipes, electric wiring, shafting, or conveyors;

(c) The floor over the space is tight;

(d) No flammable liquids are processed, handled or stored on the floor above.

4-4.4 Blind Spaces.

4-4.4.1 Sprinklers shall be installed in all blind spaces enclosed wholly or partly by exposed combustible construction, as in walls, floors and ceilings, except as modified by 4-4.4.2 and 4-4.4.3. In spaces formed by studs or joists, sprinklers shall be provided where there is six inches or more clearance between the inside or near edges of the studs or joists which form the opposite sides of the space; the distance from the first sprinkler to the wall, however, need not be less than specified in 4-2.1.4. In partly or wholly combustible bar joist construction, sprinklers shall be installed wherever the total depth of the space exceeds six inches between roof or floor deck and ceiling; the spacing of sprinklers in that case may be on the basis of light hazard classification provided the space is not accessible for storage or other use.

4-4.4.2 Sprinklers may be omitted from combustible blind spaces when any of the following conditions prevail:

(a) When the ceiling is attached directly to the underside of the supporting beams of a combustible roof or floor deck.

(b) When concealed space is entirely filled with a noncombustible insulation. In solid joisted construction the insulation need fill only the space from the ceiling to the bottom edge of the joist of the roof or floor deck.

(c) When there are small concealed spaces over rooms that do not exceed 50 square feet in area.

4-4.4.3 In blind spaces having exposed combustible construction or containing exposed combustibles in localized areas, the combustibles shall be protected as follows:

(a) If the exposed combustibles are in the vertical partitions or walls around all or a portion of the enclosure a single row of sprinklers spaced not over 12 feet apart nor more than six feet from the inside of the partition may be intsalled to protect the surface. The first and last sprinklers in such a row shall not be over five feet from the ends of the partitions.

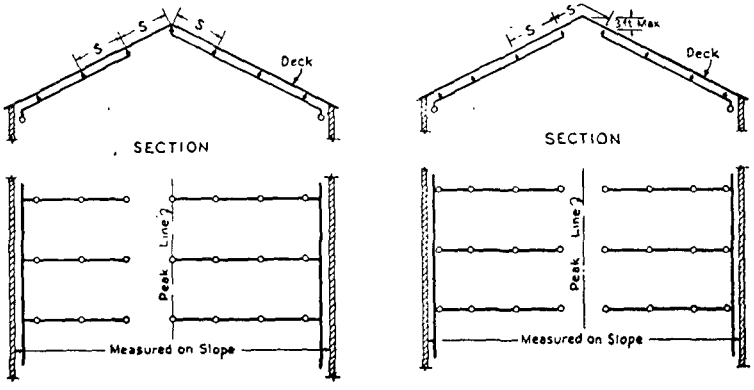
(b) If the exposed combustibles are in the horizontal plane, permission may be given to protect the area of the combustibles on a light hazard spacing and add a row of sprinklers not over six feet outside the outline of the area and not over 12 feet along the outline. When the outline returns to a wall or other obstruction, the last sprinkler shall not be over six feet from wall or obstruction.

4-4.5 Spacing of Sprinklers Under Pitched Roofs.

4-4.5.1 Branch lines parallel to peaks of pitched roofs and sprinklers on lines perpendicular to peaks shall be spaced throughout the distance measured along the slope. This will place a row of sprinklers either in the peak or one-half the spacing down the slope from the peak.

4-4.5.2 Under saw-toothed roofs, the row of sprinklers at the highest elevation shall be not more than three feet down the slope from the peak.

4-4.5.3 In 4-4.5.1 or 4-4.5.2 sprinklers in or near the peak shall have deflectors not more than three feet vertically down from the peak. (See Fig. 4-4.5.3.)



S — spacing of sprinklers on branch slopes

Fig. 4-4.5.3. Sprinklers at Pitched Roofs, Branch Lines Run Up the Slope.

4-4.5.4 In a steeply pitched roof, the distance from the peak to deflectors may be increased to maintain a horizontal clearance of not less than two feet. (See Fig. 4-4.5.4.)

4-4.6 Spacing of Sprinklers Under Curved Roof Buildings.

4-4.6.1 When roofs are curved down to the floor line, the horizontal distance measured at the floor level from the side wall or roof construction to the nearest sprinklers shall not be greater than one-half the allowable distance between sprinklers in the same direction.

4-4.6.2 Deflectors of sprinklers shall be parallel with the curve of the roof or tilted slightly toward the peak of the roof. Deflectors of sprinklers shall be located as described for beam and girder construction or for the closest comparable type of ceiling construction.

4-4.6.3 When extra hazard occupancy spacing of sprinklers is used under curved ceilings of other than fire-resistive construction, as in aircraft storage or servicing areas, the spacing as projected on the floor shall be not wider than required for extra hazard occupancies, but in no case shall the spacing on the roof or ceiling be wider than required for ordinary hazard occupancies.

4-4.7 Narrow Pockets. Girders, beams or trusses forming narrow pockets of combustible construction along walls when of a depth which will obstruct the spray discharge pattern may require additional sprinklers positioned in accordance with Table 4-2.4.6.

4-4.8 Elevators, Stairs and Shafts.

4-4.8.1 Vertical Shafts.

4-4.8.1.1 Within vertical shafts having combustible sides, sprinklers shall be provided for each 200 square feet of combustible surface, in addition to sprinklers at tops of shafts. Such sprinklers shall be installed at each floor level when shaft is trapped.

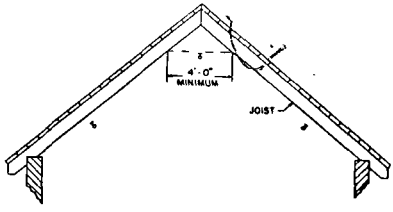


Fig. 4-4.5.4. Desirable Horizontal Clearance for Sprinklers at Peak of Pitched Roof.

4-4.8.1.2 When vertical openings are not protected by standard enclosures, sprinklers shall be so placed as to fully cover them. This necessitates placing sprinklers close to such openings at each floor level.

4-4.8.2* Stairways.

4-4.8.2.1 Stairways of combustible construction shall be sprinklered underneath whether risers are open or not.

4-4.8.2.2 Stairways of noncombustible construction with combustible storage beneath shall be sprinklered.

4-4.8.2.3* When moving stairways, large monumental staircases, or similar floor openings are unenclosed, the floor openings involved shall be protected by draft stops in combination with close spaced sprinklers.

4-4.8.3 Noncombustible stair shafts ordinarily will require sprinklers only at the top and lower tiers except when serving two or more separate fire sections when sprinklers will also be required at each floor landing.

4-4.9* Building Service Chutes. Building service chutes (linen, rubbish, etc.) shall be protected internally by automatic sprinklers. This will require a sprinkler at the top of the chute and, in addition, a sprinkler shall be installed within the chute at alternate floor levels in buildings over two stories in height. The room or area into which the chute discharges shall also be protected by automatic sprinklers.

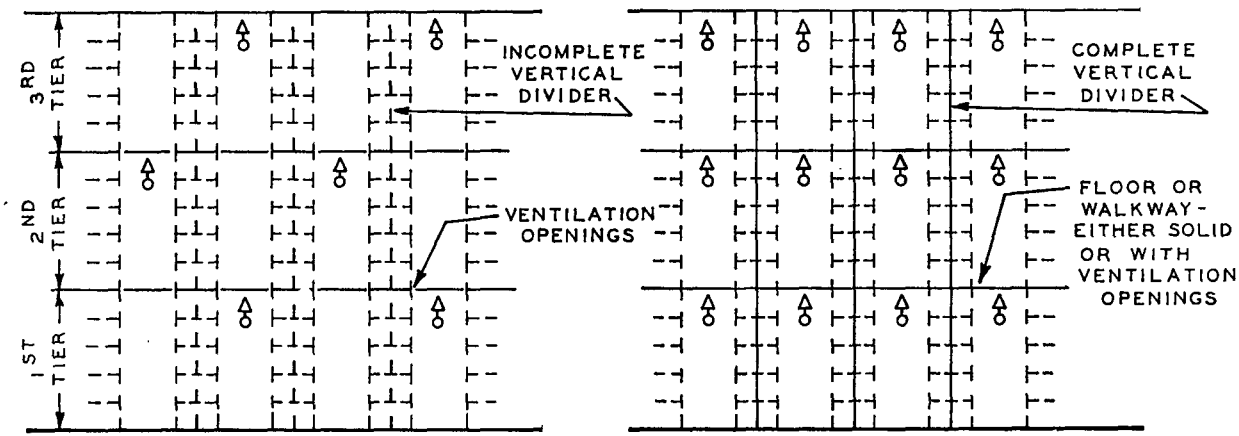
4-4.10 Exterior Canopies, Docks and Platforms.

4-4.10.1 Sprinklers shall be installed under roofs or canopies over outside loading platforms or docks.

4-4.10.2 Sprinklers shall be installed under exterior roofs or canopies except where construction is noncombustible and areas under the canopies are not used for storage.

4-4.10.3 Sprinklers shall be installed under exterior docks and platforms of combustible construction unless such space is closed off and protected against accumulation of debris.

4-4.11* Decks. Sprinklers shall be installed under decks and galleries which are over four feet wide. Slatting of decks, walkways or the use of open gratings as a substitute for such sprinklers is not acceptable.



SPRINKLERS IN MULTITIER LIBRARY BOOKSTACKS

Fig. 4-4.12

4-4.12 Library Stack Rooms. For single tier stacks where 18 in. clearance can be provided between sprinkler deflectors and top of stacks, sprinklers shall be located without regard to stacks. For multi-tier stacks and for single tier stacks where 18 in. clearance is not available between sprinkler deflectors and tops of stacks, branch lines shall be located in alternate aisle or in each aisle, depending on the arrangement of vertical shelf dividers. When vertical shelf dividers are incomplete, branch lines should be located in alternate aisles. If there are ventilation openings through floors or walkways, the location of branch lines shall be staggered in a vertical plane. When vertical shelf dividers are complete, so that lateral spread of sprinkler discharge will be prevented, branch lines shall be located in each aisle. See Fig. 4-4.12.

4-4.13* Ducts. Sprinklers shall be installed beneath ducts over four feet wide unless ceiling sprinklers can be spaced in accordance with Table 4-2.4.6.

4-4.14 Generator and Transformer Rooms. When sprinkler protection is provided in generator and transformer rooms, hoods or shield installed to protect important electrical equipment shall be noncombustible.

4-4.15* Open Grid Ceilings. The following requirements are applicable to open grid ceilings in which the openings are one-quarter inch or larger in least dimension, when the thickness or depth of the material does not exceed the least dimension of the openings and when such openings constitute at least 70 percent of the area of the ceiling material. Other types of open grid ceilings shall not be installed beneath sprinklers unless thay are listed by a nationally recognized testing laboratory and are installed in accordance with the instructions contained in each package of the ceiling material. Ceilings made of highly flammable material may spread fire faster than sprinklers can control.

(a) In light hazard occupancies when spacing of sprinklers of either standard or old style is not wider than 10 by 10 feet, a minimum clearance of at least 18 inches shall be provided between the sprinkler deflectors and the upper surface of the open grid ceiling. When spacing is wider than 10 by 10 feet but not wider than 10 by 12 feet, a clearance of at least 24 inches shall be provided from standard sprinklers and at least 36 inches from old style sprinklers. When spacing is wider than 10 by 12 feet, a clearance of at least 48 inches shall be provided.

(b) In ordinary hazard occupancies, open grid ceilings may be installed beneath sprinklers only where such use is approved by the authority having jurisdiction, and shall be installed beneath standard sprinklers only. When sprinkler spacing is not wider than

10 by 10 feet, a minimum clearance of at least 24 inches shall be provided between the sprinkler deflectors and the upper surface of the open grid ceiling. When spacing is wider than 10 by 10 feet, a clearance of at least 36 inches shall be provided.

4-4.16 Translucent Ceilings. Translucent ceilings shall not be installed beneath sprinklers unless such ceilings are listed by a nationally recognized fire testing laboratory and are installed in accordance with their listing. The authority having jurisdiction shall be consulted in all cases.

4-4.17 Fur Vaults.

4-4.17.1 Sprinklers in fur storage vaults shall be located centrally over the aisles between racks and shall be spaced not over five feet apart along the aisles.

4-4.17.2 When sprinklers are spaced five feet apart along the sprinkler branch lines, pipe sizes may be in accordance with the following schedule:

1 in. pipe.....	4 sprinklers	2 in. pipe.....	20 sprinklers
1¼ in. pipe.....	6 sprinklers	2½ in. pipe.....	40 sprinklers
1½ in. pipe.....	10 sprinklers	3 in. pipe.....	80 sprinklers

4-4.17.3 Sprinklers shall be of approved old style having orifice sizes selected to provide as closely as possible but not less than 20 gallons per minute per sprinkler, based on the water pressure available.

NOTE: See Standard on Fur Storage, Fumigation and Cleaning (NFPA No. 81, 1969). For tests of sprinkler performance in fur vaults see Fact Finding Report on Automatic Sprinkler Protection for Fur Storage Vaults of Underwriters' Laboratories, Inc., dated November 25, 1947.

4-4.18* Commercial-type Cooking Equipment and Ventilation Systems.

4-4.18.1 In cooking areas protected by automatic sprinklers, sprinklers shall be provided to protect commercial-type cooking equipment and ventilation systems that are designed to carry away grease laden vapors unless otherwise protected. (See NFPA Standard for Vapor Removal from Cooking Equipment, No. 96–1973.) Sprinklers shall be so located as to give complete coverage of cooking surfaces, within exhaust ducts, within exhaust hood plenum chamber, and under filters, if any.

4-4.18.2 Sprinklers with temperature classifications of Intermediate, High or Extra High will be required. Use of a temperature measuring device may be necessary to determine the appropriate temperature classification. Sprinkler systems shall be designed so that a cooking surface fire will operate sprinklers protecting the cooking surface prior to or simultaneously with sprinklers protecting the plenum chamber and ventilation ducts. This may be accomplished by installing sprinklers in the plenum chamber and ducts at least two temperature ratings higher than those protecting the cooking surfaces and not less than 325° F. or by use of thermal control valves.

4-4.18.3 Distance between sprinklers shall not exceed 10 feet within and under exhaust hoods and in horizontal ducts. The first sprinkler in a horizontal duct shall be installed at the duct entrance.

4-4.18.4 A standard one-half inch orifice pendent sprinkler with the frame parallel to the front edge of the deep fat fryer(s) shall be centered over each single or pair of fryers. A single sprinkler shall not protect more than 30 inches of deep fat fryer surface in any dimension. Sprinklers protecting deep fat fryers shall have their deflectors located at least one inch below the lower edge of the hood, and not less than two feet nor more than three feet six inches above the deep fat fryer cooking surface.

4-4.18.5 Other sprinklers shall be arranged so that their run-off does not fall into deep fat fryers. This may be accomplished by the use of a shield or unducted hood placed above the deep fat fryer. The shield or hood shall be placed above the sprinkler protecting the deep fat fryer and so located that it will not interfere with the sprinkler discharge.

4-4.18.6 One sprinkler shall be installed at the top of each vertical riser and an additional sprinkler shall be installed under any offset. Subject to the approval of the authority having jurisdiction, sprinklers may be omitted from a vertical riser located outside of a building provided the riser does not expose combustible material or the interior of a building and the horizontal distance between the hood outlet and the vertical riser is at least 25 feet.

4-4.18.7 Sprinklers and piping located at the top of a vertical riser, near the extremity of an exhaust duct, or in other areas subject to freezing shall be properly protected against freezing by approved means.

4-4.18.8 Release devices shall be checked at least twice a year for proper operation. Fusible links and automatic sprinklers shall be replaced annually. Other actuating devices shall be properly cleaned.

4-4.19 Baffles. Baffles (except for in-rack sprinklers, see NFPA Standard on Rack Storage of Materials No. 231C–1974) shall be installed whenever sprinklers are less than six feet apart to prevent the sprinkler first opening from wetting adjoining sprinklers, thus delaying their operation. Baffles shall be located midway between sprinklers and arranged to baffle the actuating elements. Baffles may be of sheet metal about eight inches wide and six inches high. When placed on branch line piping, the top of baffles shall extend two to three inches above the deflectors. (See Fig. 3-14.6.4.)

4-4.20* Small Rooms. In small rooms such as rest rooms, toilets, closets and offices with smooth ceilings, sprinklers may be located a maximum distance of seven feet six inches from any two walls of this room providing the total area of the room divided by the number of sprinklers does not exceed the limitation of 4-2.2.1 and 4-2.2.2. The maximum area of such a room is defined as 800 square feet for Light Hazard and 520 square feet for Ordinary Hazard room occupancies.

4-5 Sidewall Sprinklers. (See 3-15.4.)

4-5.1 Distance Between Branch Lines and Sprinklers on Branch Lines.

4-5.1.1 Distance Between Branch Lines. Rooms or bays having widths in excess of 15 feet up to 30 feet shall have sprinklers on two opposite walls or two opposite sides of bays with spacing as required in Section 4-5 and sprinklers regularly staggered. Additional branch lines shall be provided in rooms over 30 feet in width except where special sprinklers are used (see 4-1.1.3).

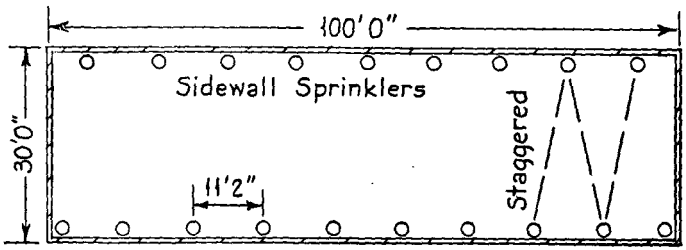


Fig. 4-5.1.1. Spacing of Sidewall Sprinklers under Smooth Ceilings, with Light Hazard Occupancy.

4-5.1.2* Distance Between Sprinklers on Branch Lines. Sidewall sprinklers shall be located not more than 10 feet apart on walls for ordinary hazard occupancies and not more than 14 feet apart for light hazard occupancies.

4-5.2 Protection Area Limitations for Light Hazard Occupancy.

4-5.2.1 With noncombustible smooth ceiling the protection area allotted per sprinkler shall not exceed 196 square feet with the distance between sprinklers on lines not in excess of 14 feet.

4-5.2.2 With combustible smooth ceiling sheathed with plasterboard, metal, or wood lath and plaster the protection area allotted per sprinkler shall not exceed 168 square feet with the distance between sprinklers on lines not in excess of 14 feet. When sheathing is combustible such as wood, fiberboard or other combustible material the protection area allotted per sprinkler shall not exceed 120 square feet with the distance between sprinklers on lines not in excess of 14 feet.

4-5.3 Protection Area Limitations for Ordinary Hazard Occupancy.

4-5.3.1 With noncombustible smooth ceiling the protection area allotted per sprinkler shall not exceed 100 square feet with the distance between sprinklers on lines not in excess of 10 feet.

4-5.3.2 With combustible smooth ceiling sheathed with plasterboard, metal, wood lath and plaster, wood, fiberboard or other combustible material, the protection area per sprinkler shall not exceed 80 square feet per sprinkler with the distance between sprinklers on lines not in excess of 10 feet.

4-5.4* Position of Sidewall Sprinklers. Sprinkler deflectors shall be at a distance from walls and ceilings not more than six inches or less than four inches, unless special construction arrangements make a different position advisable for prompt operation and effective distribution.

Chapter 5 Types of Systems

5-1 Wet-Pipe Systems.

5-1.1* Definition. 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.

5-1.2 Pressure Gages. Approved pressure gages conforming to 2-9.2.2 shall be installed in sprinkler risers, above and below each alarm check valve.

5-2 Dry-Pipe Systems.

5-2.1* Definition. A system employing automatic sprinklers attached to a piping system containing air or nitrogen under pressure, the release of which as from the opening of a sprinkler permits the water pressure to open a valve known as a dry-pipe valve. The water then flows into the piping system and out the opened sprinklers.

5-2.2 Dry Pendent Sprinklers. Automatic sprinklers installed in the pendent position shall be of the approved dry pendent type if installed in an area subject to freezing. The use of standard pendent sprinklers installed on return bends is permitted when both the sprinklers and the return bends are located in a heated area.

5-2.3 Size of Systems.

5-2.3.1 Volume Limitations.

5-2.3.1.1 Except as provided in 5-2.3.1.2, not more than 750-gallon system capacity shall be controlled by one dry-pipe valve, unless check valves are installed in branches of the system as provided for in 5-2.3.2.

5-2.3.1.2 Where the piping volume exceeds 750 gallons the system shall deliver water to the inspector's test pipe in not more than 60 seconds, starting at the normal air pressure on the system.

5-2.3.2* Check Valves in Dry Pipe Systems. Check valves may be installed in branches of the system to assist in more rapidly reducing the air pressure above the valve seat to the dry pipe valve trip point. Using such an arrangement, no system branch shall have a capacity exceeding 600 gallons, nor shall the total of a system branch plus common piping exceed 750 gallons. A hole ⅛-inch in diameter shall be drilled in the clapper of each check valve to permit equalization of air pressure among the various

parts of the system. An approved indicating drain valve, connected by a bypass around each check valve shall be provided as a means for draining the system. All check valves shall be located in heated enclosures to prevent the formation of ice.

5-2.4* Quick-Opening Devices.

5-2.4.1 When Required. Dry-pipe valves controlling systems having a capacity of more than 500 gallons shall be provided with an approved quick-opening device.

5-2.4.2 The quick-opening device shall be located as close as practical to the dry-pipe valve. To protect the restriction orifice and other operating parts of the quick-opening device against submergence, the connection to the riser shall be above the point at which water (priming water and back drainage) is expected when the dry-pipe valve and quick opening device are set, except where design features of the particular quick-opening device made these requirements unnecessary.

5-2.4.3 A soft disc globe or angle valve shall be installed in the connection between the dry-pipe sprinkler riser and the quick-opening device provided to accelerate operation of dry-pipe valve.

5-2.4.4 A check valve shall be installed between the quick-opening device and the intermediate chamber of the dry-pipe valve. Should the quick-opening device require pressure feedback from the intermediate chamber, a valve of the type which will clearly indicate whether it is opened or closed may be installed in place of that check valve. This valve shall be constructed so that it may be locked or sealed in the open position.

5-2.4.5 An approved antiflooding device shall be installed in the connection between the dry-pipe sprinkler riser and the quick-opening device, unless the particular quick-opening device has built-in antiflooding design features.

5-2.5* Location and Protection of Dry-Pipe Valve.

5-2.5.1 The dry-pipe valve and supply pipe shall be protected against freezing and mechanical injury.

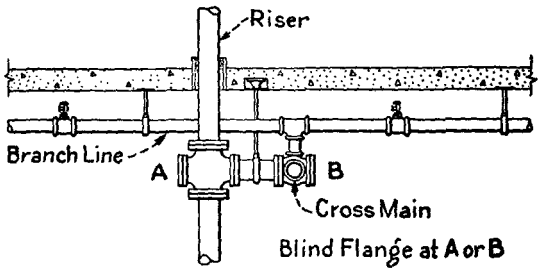
5-2.5.2 Valve rooms shall be lighted and heated.

5-2.5.3 The supply for the sprinkler in the dry-pipe valve enclosure shall be from the dry side of the system.

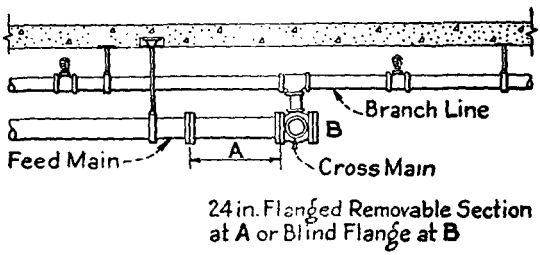
5-2.5.4 Protection against accumulation of water above the clapper shall be provided for a low differential dry-pipe valve. This may be an automatic high water level signaling device or an automatic drain device.

5-2.6* Cold Storage Rooms.

5-2.6.1 Fittings for Inspection Purposes.



(a) Elevation at Riser and Cross Main



(b) Elevation at Feed Main and Cross Main

Fig. 5-2.6.1(A). Fittings to Facilitate Examination of Feed Mains, Risers, and Cross Mains in Freezing Areas.

5-2.6.1.1 Fittings for inspection purposes shall be provided whenever a cross main connects to a riser or feed main. This may be accomplished by a blind flange on a fitting (tee or cross) in the riser or cross main or a flanged removable section 24 inches long in the feed main as shown in Fig. 5-2.6.1(A). Such fittings in conjunction with the flushing connections specified in 3-7.3 would permit examination of the entire lengths of the cross mains. Branch lines may be examined by backing the pipe out of fittings.

5-2.6.1.2 Whenever feed mains change direction, facilities shall be provided for direct observation of every length of feed main within the refrigerated area. This may be accomplished by means of two-inch capped nipples or blind flanges on fittings.

5-2.6.1.3 Fittings for inspection purposes shall be provided whenever a riser or feed main passes through a wall or floor from a warm room to a cold room. This may be accomplished at floor penetrations by a tee with a blind flange in the cold room and at wall penetrations by a 24-inch flanged removable section in the warm room as shown in Fig. 5-2.6.1(B).

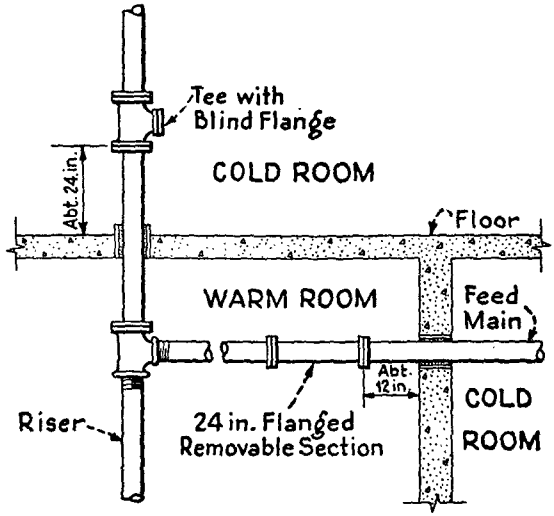


Fig. 5-2.6.1(B). Fittings in Feed Main or Riser Passing Through Wall or Floor from Warm Room to Cold Room.

5-2.6.2 A local low air-pressure alarm shall be installed on sprinkler systems supplying freezer sections.

5-2.6.3 Piping in cold storage rooms shall be installed with pitch, as outlined in Section 3-11.1.

5-2.6.4 The air supply for dry-pipe systems in cold storage plants shall be taken from the freezers of lowest temperature or through a chemical dehydrator. Compressed nitrogen gas from cylinders may be used in place of air in dry-pipe systems to eliminate introducing moisture.

5-2.7 Air Pressure and Supply.

5-2.7.1 Maintenance of Air Pressure. Air or nitrogen pressure shall be maintained on dry-pipe systems throughout the year.

5-2.7.2* Air Supply. The compressed air supply shall be from a source available at all times and having a capacity capable of restoring normal air pressure in the system within 30 minutes, except for low differential dry-pipe systems where this time may be 60 minutes. Where low differential dry-pipe valves are used, the air supply shall be maintained automatically.

5-2.7.3 Air Filling Connection. The connection pipe from the air compressor shall not be less than three-quarter inch and

shall enter the system above the priming water level of the dry-pipe valve. A check valve shall be installed in this air line and a shutoff valve of renewable disc type shall be installed on the supply side of this check valve.

5-2.7.4 Relief Valve. An approved relief valve shall be provided between compressor and controlling valve set to relieve at a pressure five pounds in excess of maximum air pressure which should be carried in the system.

5-2.7.5 Shop Air Supply. When the air supply is taken from a shop system having a normal pressure greater than that required for dry-pipe systems and an automatic air maintenance device is not used, the relief valve shall be installed between two control valves in the air line and a small air cock, which is normally left open shall be installed in fitting below relief valve.

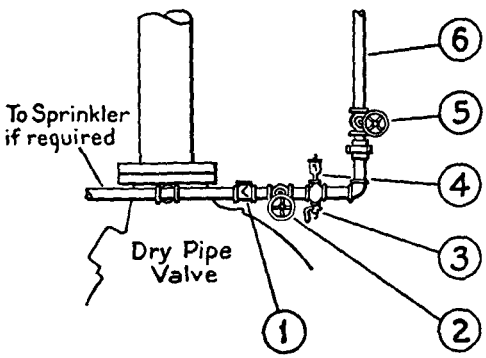


Fig. 5-2.7.5. Air Supply from Shop System.

1. Check Valve
2. Control Valve (Renewable Disc Type)
3. Small Air Cock (Normally Open)
4. Relief Valve
5. Same as No. 2
6. Air Supply

5-2.7.6 Automatic Air Compressor. When a dry-pipe system is supplied by an automatic air compressor or plant air system any device or apparatus used for automatic maintenance of air pressure shall be of a type specifically approved for such service and capable of maintaining the required air pressure on the dry-pipe system. More than one dry-pipe system shall not be connected to a single automatic air maintenance device when the air supply piping to the systems is subdivided only by check valves.

5-2.7.7 Air Pressure to be Carried. The air pressure to be carried shall be in accordance with the instruction sheet furnished

with the dry-pipe valve, when available, or 20 lbs. in excess of the calculated trip pressure of the dry-pipe valve, based on the highest normal water pressure of the system supply. The permitted rate of air leakage shall be as specified in 1-11.4.2.

5-2.7.8 When used, nitrogen shall be introduced through a pressure regulator set to maintain system pressure in accordance with 5-2.7.7.

5-2.8 Pressure Gages. Approved pressure gages conforming to 2-9.2.2 shall be connected:

(a) On the water side and air side of dry-pipe valve

(b) At the air pump supplying the air receiver

(c) At the air receiver

(d) In each independent pipe from air supply to dry-pipe system

(e) At exhausters and accelerators.

5-3 Pre-Action and Deluge Systems.

5-3.1 Definitions.

Pre-Action System means a system employing automatic sprinklers attached to a piping system containing air that may or may not be under pressure, with a supplemental fire detection system installed in the same areas as the sprinklers; actuation of the fire detection system as from a fire, opens a valve which permits water to flow into the sprinkler piping system and to be discharged from any sprinklers which may be open.

Deluge System means a system employing open sprinklers attached to a piping system connected to a water supply through a valve which is opened by the operation of a fire detection system installed in the same areas as the sprinklers; when this valve opens water flows into the piping system and discharges from all sprinklers attached thereto.

5-3.2* Description. Pre-action and deluge systems are normally without water in the system piping and the water supply is controlled by an automatic valve operated by means of fire detection devices and provided with manual means for operation which are independent of the sprinklers. Systems may have equipment of the types described in (a) through (f) below. (See Paragraph 5-3.5.1.)

(a) Automatic sprinklers with both sprinkler piping and fire detection devices automatically supervised,

(b) Automatic sprinklers with sprinkler piping and fire detection devices not automatically supervised,

(c) Open sprinklers with only fire detection devices automatically supervised,

(d) Open sprinklers with fire detection devices not automatically supervised,

(e) Combination of open and automatic sprinklers with fire detection devices automatically supervised,

(f) Combination of open and automatic sprinklers with fire detection devices not automatically supervised.

5-3.3* General.

5-3.3.1 A supply of spare fusible elements for heat-responsive devices, not less than two of each temperature rating, shall be maintained on the premises for replacement purposes.

5-3.3.2 When hydraulic release systems are used, it is possible to water column the deluge valve or deluge-valve actuator if the heat-actuated devices (fixed temperature or rate-of-rise) are located at extreme heights above the valve. Refer to the manufacturer for height limitations of a specific deluge valve or deluge valve actuator.

5-3.3.3 All new pre-action or deluge systems shall be tested hydrostatically as specified in 1-11.3.1. In testing deluge systems, plugs shall be installed in fittings and replaced with open sprinklers after the test is completed, or automatic sprinklers may be installed and the operating parts removed after test is completed.

5-3.4 Location and Spacing of Fire Detection Devices. Spacing of fire detection devices shall be in accordance with their listing by nationally recognized testing laboratories or in accordance with manufacturer's specification.

5-3.5 Pre-Action Systems.

5-3.5.1 Size of Systems. Not more than 1,000 closed sprinklers shall be controlled by any one pre-action valve.

5-3.5.2 Supervision. Sprinkler piping and fire detection devices shall be automatically supervised when there are more than 20 sprinklers on the system.

5-3.5.3 Pipe Schedule. See 3-4, 3-5, 3-6 and Chapter 7.

5-3.5.4 Pendent Sprinklers. Automatic sprinklers on pre-action systems installed in the pendent position shall be of the approved dry pendent type if installed in an area subject to freezing.

5-3.6* Deluge Systems. The fire detection devices or systems shall be automatically supervised when there are more than 20 sprinklers on the system.

5-3.7 Devices for Test Purposes and Testing Apparatus.

5-3.7.1 When fire detection devices installed in circuits are located where not readily accessible, an additional fire detection device shall be provided on each circuit for test purposes at an accessible location and shall be connected to the circuit at a point which will assure a proper test of the circuit.

5-3.7.2 Testing apparatus capable of producing the heat or impulse necessary to operate any normal fire detection device shall be furnished to the owner of the property with each installation. Where explosive vapors or materials are present, hot water, steam or other methods of testing not involving an ignition source shall be used.

5-3.7.3 Pressure Gages. Approved pressure gages conforming to Paragraph 2-9.2.2 shall be installed as follows:

(a) Above and below pre-action valve and below deluge valve.

(b) On air supply to pre-action and deluge valves.

5-4 Combined Dry-Pipe and Pre-Action Systems.

5-4.1 General.

5-4.1.1* Definition. A Combined Dry-Pipe and Pre-Action Sprinkler System means a system employing automatic sprinklers attached to a piping system containing air under pressure with a supplemental fire detection system installed in the same areas as the sprinklers; operation of the fire detection system, as from a fire, actuates tripping devices which open dry-pipe valves simultaneously and without loss of air pressure in the system. Operation of the fire detection system also opens approved air exhaust valves at the end of the feed main which facilitates the filling of the system with water which usually precedes the opening of sprinklers. The fire detection system also serves as an automatic fire alarm system.

5-4.1.2 Combined automatic dry-pipe and pre-action systems shall be so constructed that failure of the fire detection system shall not prevent the system from functioning as a conventional automatic dry-pipe system.

5-4.1.3 Combined automatic dry-pipe and pre-action systems shall be so constructed that failure of the dry-pipe system of

automatic sprinklers shall not prevent the fire detection system from properly functioning as an automatic fire alarm system.

5-4.1.4 Provisions shall be made for the manual operation of the fire detection system at locations requiring not more than 200 feet of travel.

5-4.1.5 Except as indicated in 5-2.2, automatic sprinklers installed in the pendent position shall be of the approved dry pendent type.

5-4.2 Dry-Pipe Valves in Combined Systems.

5-4.2.1 Where the system consists of more than 600 sprinklers or has more than 275 sprinklers in any fire area, the entire system shall be controlled through two 6-inch dry-pipe valves connected in parallel and shall feed into a common feed main. These valves shall be checked against each other. (See Fig. 5-4.2.)

5-4.2.2 Each dry-pipe valve shall be provided with an approved tripping device actuated by the fire detection system. Dry-pipe valves shall be cross connected through a one-inch pipe connection to permit simultaneous tripping of both dry-pipe valves. This one-inch pipe connection shall be equipped with a gate valve so that either dry-pipe valve can be shut off and worked on while the other remains in service.

5-4.2.3 The check valves between the dry-pipe valves and the common feed main shall be equipped with one-half inch bypasses so that a loss of air from leakage in the trimmings of a dry-pipe valve will not cause same to trip until the pressure in the feed main is reduced to the tripping point. A gate valve shall be installed in each of these bypasses so that either dry-pipe valve can be completely isolated from the main riser or feed main and from each other.

5-4.2.4 Each combined dry-pipe and pre-action system shall be provided with approved quick opening devices at the dry pipe valves.

5-4.3* Air Exhaust Valves. One or more approved air exhaust valves of two-inch or larger size controlled by operation of a fire detection system shall be installed at the end of the common feed main. (See Fig. A-5-4.3.) These air exhaust valves shall have soft seated globe or angle valves in their intakes, also approved strainers shall be installed between these globe valves and the air exhaust valves.

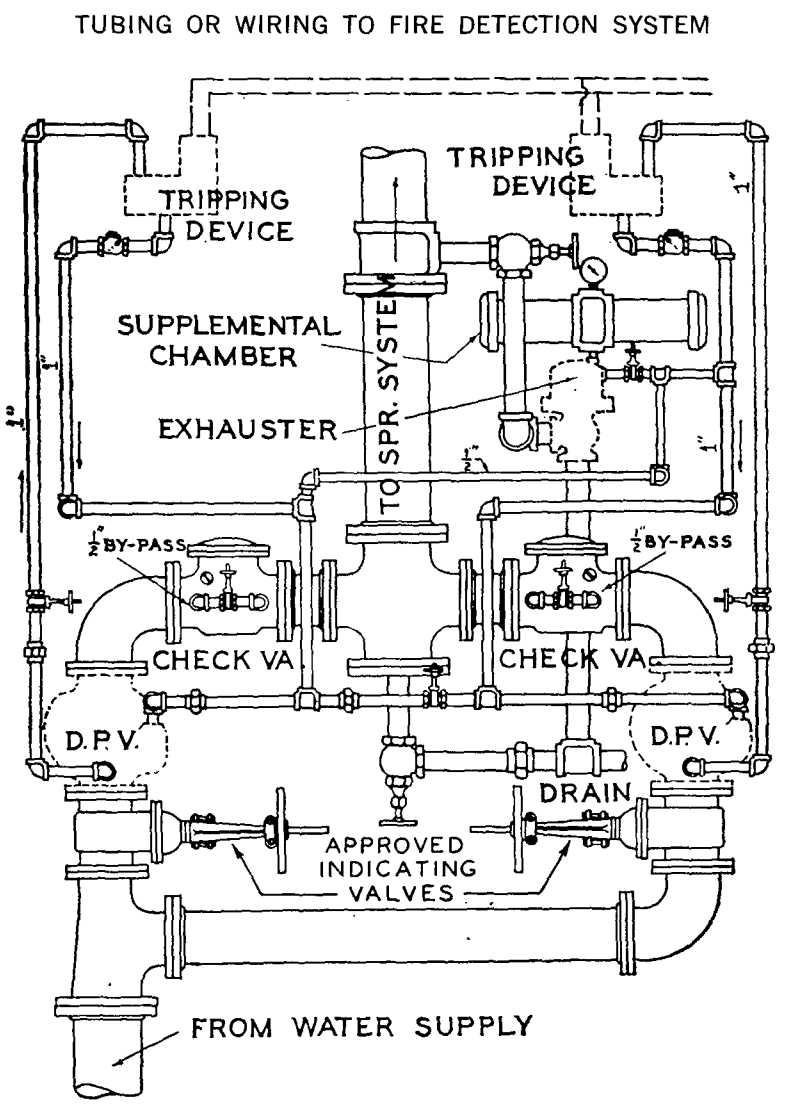


Fig. 5-4.2. Header for Combined Dry-Pipe and Pre-Action Sprinkler System Standard Trimmings Not Shown.

5-4.4 Subdivision of System Using Check Valves.

5-4.4.1 Where more than 275 sprinklers are required in a single fire area, the system shall be divided into sections of 275 sprinklers or less by means of check valves. If system is installed in more than one fire area or story, not more than 600 sprinklers shall be supplied through any one check valve. Each section shall have a 1¼-inch drain on the system side of each check valve supplemented by a drum drip.

5-4.4.2 Section drain lines and drum drips shall be located in heated areas or inside of thermostatically controlled electrically heated cabinets of sufficient size to enclose drain valves and drum drips for each section. Drum drips shall also be provided for all low points except that heated cabinets need not be required for 20 sprinklers or less.

5-4.4.3 Air exhaust valves at end of feed main and associated check valves shall be protected against freezing.

5-4.5 Time Limitation. The sprinkler system shall be so constructed and the number of sprinkler heads controlled shall be so limited that water shall reach the furthest sprinkler within a period of time not exceeding one minute for each 400 feet of common feed main from the time heat responsive system operates. Maximum time permitted not to exceed three minutes.

5-4.6 Inspector's Test Connection. The end section shall have an inspector's test connection as required for dry-pipe systems.

5-5 Antifreeze Systems.

5-5.1 Definition. Antifreeze system means a system employing automatic sprinklers attached to a piping system containing an antifreeze solution and connected to a water supply. The antifreeze solution, followed by water, discharges immediately from sprinklers opened by a fire.

5-5.2* Where Used. The use of antifreeze solutions SHALL be in conformity with any state or local health regulations.

5-5.3 Antifreeze Solutions.

5-5.3.1 When sprinkler systems are supplied by public water connections the use of antifreeze solutions other than water solutions of pure glycerine (C.P. or U.S.P. 96.5 percent Grade) or propylene glycol shall not be permitted. Suitable glycerine-water and propylene glycol-water mixtures are shown in Table 5-5.3.1.

Table 5-5.3.1
Antifreeze Solutions

TO BE USED IF PUBLIC WATER IS CONNECTED TO SPRINKLERS.

MATERIAL	SOLUTION (BY VOLUME)	SPEC. GRAV. AT 60 F.	FREEZING POINT F.
Glycerine C.P. or U.S.P. Grade*	50% Water	1.133	—15
	40% Water	1.151	—22
	30% Water	1.165	—40
	Hydrometer Scale 1.000 to 1.200		
Propylene Glycol	70% Water	1.027	+ 9
	60% Water	1.034	— 6
	50% Water	1.041	—26
	40% Water	1.045	—60
	Hydrometer Scale 1.000 to 1.120 (Subdivisions 0.002)		

*C.P. — Chemically Pure.
U.S.P. — United States Pharmacopoeia 96.5%.

Table 5-5.3.2
Antifreeze Solutions

SUITABLE FOR USE IF PUBLIC WATER IS NOT CONNECTED TO SPRINKLERS.

MATERIAL	SOLUTION (BY VOLUME)	SPEC. GRAV. AT 60 F.	FREEZING POINT F.
Glycerine	If glycerine is used, see Table 5-5.2.1.		
Diethylene Glycol	50% Water	1.078	—13
	45% Water	1.081	—27
	40% Water	1.086	—42
	Hydrometer Scale 1.000 to 1.120 (Subdivisions 0.002)		
Ethylene Glycol	61% Water	1.056	—10
	56% Water	1.063	—20
	51% Water	1.069	—30
	47% Water	1.073	—40
	Hydrometer Scale 1.000 to 1.120 (Subdivisions 0.002)		
Propylene Glycol	If propylene glycol is used, see Table 5-5.2.1.		
Calcium Chloride 80% "Flake" *Fire Protection Grade** Add corrosion inhibitor of sodium bichromate ¼ oz. per gal. water	Lb. $CaCl_2$ per Gal. of Water		
	2.83	1.183	0
	3.38	1.212	—10
	3.89	1.237	—20
	4.37	1.258	—30
	4.73	1.274	—40
	4.93	1.283	—50

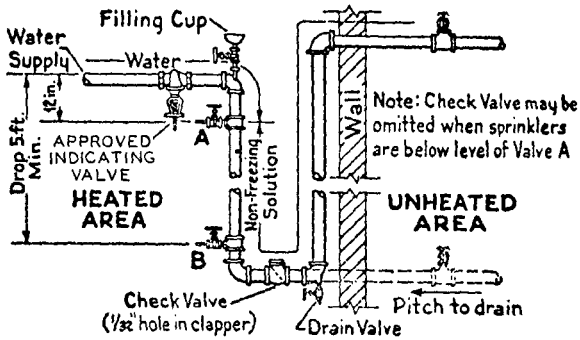
*Free from magnesium chloride and other impurities.

5-5.3.2 If public water is not connected to sprinklers, the commercially available materials indicated in Table 5-5.3.2 are suitable for use in antifreeze solutions.

5-5.3.3* An antifreeze solution shall be prepared with a freezing point below the expected minimum temperature for the locality. The specific gravity of the prepared solution shall be checked by a hydrometer with suitable scale.

5-5.4* Arrangement of Supply Piping and Valves. All permitted antifreeze solutions are heavier than water. At the point of contact (interface) the heavier liquid will be below the lighter liquid in order to prevent diffusion of water into the unheated areas. In most cases, this necessitates the use of a five-foot drop pipe or U-loop as illustrated in Fig. 5-5.4. The preferred arrangement is to have the sprinklers below the interface between the water and the antifreeze solution.

If sprinklers are above the interface, a check valve with 1/32-inch hole in the clapper shall be provided in the U-loop. A water control valve and two small solution test valves shall be provided as illustrated in Fig. 5-5.4. An acceptable arrangement of filling cup is also shown.



NOTE: The 1/32-inch hole in the check valve clapper is needed to allow for expansion of the solution during a temperature rise and thus prevent damage to sprinkler heads.

Fig. 5-5.4. Arrangement of Supply Piping and Valves.

5-5.5* Testing. Before freezing weather each year, the solution in the entire system shall be emptied into convenient containers and brought to the proper specific gravity by adding concentrated liquid as needed. The resulting solution may be used to refill the system.

Chapter 6 Outside Sprinklers for Protection Against Exposure Fires

6-1 Water Supply and Control.

6-1.1 Water Supply.

6-1.1.1* Sprinklers installed for protection against exposure fires shall be supplied from a standard water supply as defined in Chapter 2, or other supply such as manual valves, pumps or fire department connections when approved by the authority having jurisdiction.

6-1.1.2 When automatic systems of sprinklers are installed water supplies shall be from an automatic source.

6-1.1.3 When water supply feeds other fire protection appliances, it shall be capable of furnishing total demand for such appliances as well as the outside sprinkler demand.

6-1.1.4 When fire department connections are used for water supply, they shall be so located that they will not be affected by the exposing fire.

6-1.2 Control.

6-1.2.1 Each system of outside sprinklers shall have an independent control valve. Where more than one valve is required, the division between sprinklers on each valve shall be vertical and not horizontal, except as noted in Section B-6.2.3.

6-1.2.2 Manually controlled open sprinklers shall be used only where constant supervision is present.

6-1.2.3 Automatic systems may be of the open or closed sprinkler head type. Closed sprinklers in areas subject to freezing shall be on dry pipe or nonfreezing systems when not prohibited by local public health authorities.

6-1.2.4* Automatic systems of open sprinklers shall be controlled by the operation of fire detection devices designed for the specific application.

6-2 System Components.

6-2.1* Valves.

6-2.1.1 Control valves shall be of the approved indicating type and shall be distinctively marked by letters not less than ½ inch high to clearly explain their use.

6-2.1.2 Drain Valve. Each system of outside sprinklers shall have a separate drain valve installed on system side of each control valve. Drain valves shall be in accordance with Section 3-11.2, except that in no case shall valves be smaller than one inch.

6-2.1.3 Check Valves. When sprinklers run on two adjacent sides of a building, protecting against two separate and distinct exposures, with separate control valves for each side, the end lines shall be connected together with check valves so located so that one sprinkler around the corner will operate. The intermediate pipe between the two check valves shall be arranged to drain. As an alternate solution, an additional sprinkler shall be installed on each system located around the corner from the system involved.

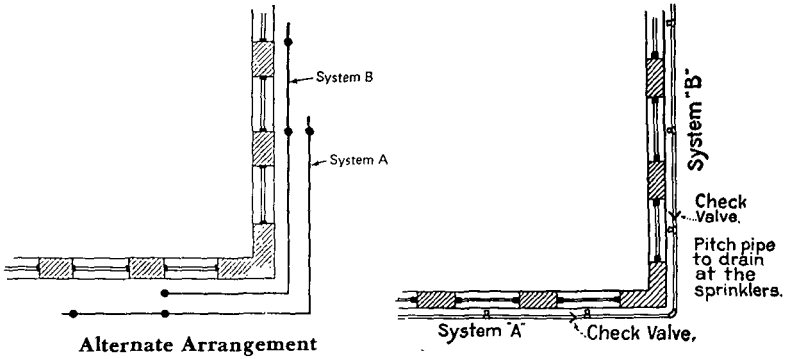


Fig. 6-2.1.4. Arrangement of Check Valves.

6-2.1.4 When one exposure affects two sides of the protected structure, the system shall not be subdivided between the two sides, but rather shall be arranged to operate as a single system.

6-2.2 Pipe and Fittings. Approved corrosion-resistant pipe and fittings shall be used for the equipment as far back as the control valve on the water supply.

6-2.3 Strainers. An approved strainer shall be provided in the riser or feed main which supplies sprinklers having orifices smaller than ⅜ inch.

6-2.4 Gage Connections. Pressure gage shall be installed just below control valve of each system.

6-3 Sprinklers.[1] Only sprinklers of such type as are approved for window, cornice, sidewall or ridge pole service shall be installed for such use except where adequate coverage by use of other types of approved sprinklers and/or nozzles has been demonstrated. Sprinklers may be of small orifice (¼ inch, 5/16 inch and ⅜ inch), or large orifice (½ inch, ⅝ inch and ¾ inch).

6-4 Piping System.

6-4.1* Pipe sizes of lines, risers, feed mains, and water supply shall be hydraulically calculated in accordance with Chapter 7 to furnish a minimum of seven psi at any sprinkler with all sprinklers facing the exposure operating, or pipe sizes shall be in accordance with Section 6-4.2 and 6-4.3.

6-4.2 Branch line sizes on pipe schedule systems shall be as follows:

Table 6-4.2
Maximum Number of Sprinklers Supplied on Line

Size of Pipe Inches	Orifice Size — Inches						
	¼	5/16	⅜	7/16	½	⅝	¾
1	4	3	2	2	1	1	1
1¼	8	6	4	3	2	2	1
1½		9	6	4	3	3	2
2				5	4	4	3

6-4.3 Risers and feed main sizes on pipe schedule systems shall be as follows for central feed risers:

Pipe Size	Number of Sprinklers		
	⅜" or smaller orifice	½" orifice	¾" orfiice
1½	6	3	2
2	10	5	4
2½	18	9	7
3	32	16	12
3½	48	24	17
4	65	33	24
5	120	60	43
6		100	70

[1]For additional information on outside sprinklers see Appendix B, Section B-6.1.

6-5 Testing and Flushing.

6-5.1 Tests.

6-5.1.1 All piping shall be tested hydrostatically as specified in 1-11.3.

6-5.1.2 Operating tests shall be made of the system when completed, except where such tests may risk water damage.

6-5.2 Flushing. Flushing shall be conducted in accordance with Section 1-11.2.

Chapter 7 Hydraulically Designed Sprinkler Systems

7-1 General.

7-1.1 Definition.

7-1.1.1 A hydraulically designed sprinkler system is one in which pipe sizes are selected on a pressure loss basis to provide a prescribed density (gallons per minute per square foot) distributed with a reasonable degree of uniformity over a specified area. This permits the selection of pipe sizes in accordance with the characteristics of the water supply available. The stipulated design density and area of application will vary with occupancy hazard.

7-1.1.2 The design basis for such a system supersedes the rules in the sprinkler standard governing pipe schedules, except that all systems continue to be limited by area, and pipe sizes shall be no less than 1-inch nominal for ferrous piping and ¾-inch nominal for copper tubing. The size of pipe, number of sprinklers per branch line and number of branch lines per cross main are otherwise limited only by the available water supply. However, sprinkler spacing and all other rules covered in this and other applicable standards shall be observed.

7-1.2* Nameplate Data. Unless an alternate means of identification is provided by owner, the installer shall properly identify a hydraulically designed automatic sprinkler system by a permanently attached placard indicating the location, and the basis of design (discharge density over designed area of discharge, including gallons per minute and residual pressure demand at base of riser). Such signs shall be placed at the controlling alarm valve, or dry pipe valve, for the system containing the hydraulically designed layout.

7-2 Information Required.

7-2.1 Basic Design Information. Basic design criteria for hydraulically designed sprinkler systems shall be obtained from this or other applicable standards. Where no standards exist, the authority having jurisdiction shall be consulted.

7-2.2 Sprinkler System Requirements. The following information shall be included when applicable:

(a) Area of water application..... sq. ft.

(b) Minimum rate of water application (density)..... gpm/sq. feet.

(c) Area per sprinkler..... sq. ft.

(d) Allowance for inside hose and outside hydrants..... gpm.

(e) Allowance for in-rack sprinklers..... gpm.

7-2.3 Water Supply Information. The following information should be included:

(a) Description of existing or proposed water supply.

(b) Water flow data with existing or proposed water supply including:

(i) Location and elevation of static and residual test gage.

(ii) Flow location.

(iii) Static pressure.....psi.

(iv) Residual pressure.....psi.

(v) Flow .....gpm.

7-2.4 Information Required on the Drawing.

7-2.4.1 In addition to the requirements of Section 1-9, the drawings shall also contain the information mentioned in the remainder of this Section 7-2.4.

7-2.4.2 Hydraulic Reference Points. Reference points may be shown by a number and/or letter designation and shall correspond with comparable reference points shown on the hydraulic calculation sheets.

7-2.4.3 Sprinklers. Description of sprinklers used.

7-2.4.4 System Design Criteria. The minimum rate of water application (density), the design area of water application and the water required for hose streams both inside and outside shall be included.

7-2.4.5 Actual Calculated Requirements. The total quantity of water and the pressure required shall be noted at a common reference point for each system.

7-2.4.6 Elevation Data. Relative elevations of sprinklers, junction points and supply or reference points shall be noted.

7-3 Data Sheets and Abbreviations.

7-3.1 General. Hydraulic calculations shall be prepared on form sheets that include a summary sheet, detailed work sheets and a graph sheet. (See copy of typical forms, Figures A-7-3.3 and A-7-3.4.)

7-3.2 Summary Sheet. The summary sheet shall contain the following information, when applicable:

(a) Date

(b) Location

(c) Name of owner and occupant

(d) Building number or other identification

(e) Description of hazard

(f) Name and address of contractor or designer

(g) Name of approving agency

(h) System design requirements

(1) Design area of water application.....sq. ft.

(2) Minimum rate of water application (density)..... gpm per square feet.

(3) Area per sprinkler.....square feet.

(i) Total water requirements as calculated including allowance for inside hose and outside hydrants.

(j) Water supply information.

7-3.3* Detailed Work Sheets. Detailed work sheets (for sample work sheet, refer to Fig. A-7-3.3) or computer printout sheets shall contain the following information:

(a) Sheet number.

(b) Sprinkler description and discharge constant (K).

(c) Hydraulic reference points.

(d) Flow in gpm.

(e) Pipe size.

(f) Pipe lengths, center to center of fittings.

(g) Equivalent pipe lengths for fitting and devices.

(h) Friction loss in psi per foot of pipe.

(i) Total friction loss between reference points.

(j) Elevation head in psi between reference points.

(k) Required pressure in psi at each reference point.

(l) Velocity pressure and normal pressure if included in calculations.

(m) Notes to indicate starting points, reference to other sheets or to clarify data shown.

7-3.4* Graph Sheet. Water supply curves and system requirements, plus hose demand when applicable, shall be plotted on semi-logarithmic graph paper so as to present a graphic summary of the complete hydraulic calculation.

7-3.5 Abbreviations and Symbols. The following standard abbreviations and symbols shall be used on the calculation form:

Symbol or Abbreviation	*Item*
p	Pressure in psi
gpm	U.S. Gallons per minute.
q	Flow increment in gpm to be added at a specific location.
Q	Summation of flow in gpm at a specific location.
P_t	Total pressure in psi at a point in a pipe.
P_f	Pressure loss due to friction between points indicated in location column.
P_e	Pressure due to elevation difference between indicated points. This can be a plus value or a minus value. Where minus, the (—) shall be used; where plus, no sign need be indicated.
P_v	Velocity pressure in psi at a point in a pipe.
P_n	Normal pressure in psi at a point in a pipe.
E	90° Ell.
EE	45° Ell.
Lt.E	Long Turn Elbow
Cr	Cross
T	Tee — flow turned 90°
GV	Gate Valve
BV	Butterfly Valve
Del V	Deluge Valve
DPV	Dry-Pipe Valve
ALV	Alarm Valve
CV	Swing Check Valve
WCV	Butterfly (Wafer) Check Valve
St.	Strainer
psi	Pounds per square inch
v	Velocity of water in pipe in feet per second.

7-4 Calculation.

7-4.1 Friction Loss Formula. Pipe friction losses shall be determined on the basis of Hazen and Williams formula.

$$p = \frac{4.52 \quad Q^{1.85}}{C^{1.85} \quad d^{4.87}}$$

Table 7-4.2

Equivalent Pipe Length Chart

Fittings and Valves	*Fittings and Valves Expressed in Equivalent Feet of Pipe.*												
	1 in.	*1¼ in.*	*1½ in.*	*2 in.*	*2½ in.*	*3 in.*	*3½ in.*	*4 in.*	*5 in.*	*6 in.*	*8 in.*	*10 in.*	*12 in.*
45° Elbow	1	1	2	2	3	3	3	4	5	7	9	11	13
90° Standard Elbow	2	3	4	5	6	7	8	10	12	14	18	22	27
90° Long Turn Elbow	2	2	2	3	4	5	5	6	8	9	13	16	18
Tee or Cross (Flow Turned 90°)	5	6	8	10	12	15	17	20	25	30	35	50	60
Butterfly Valve	–	–	–	6	7	10	–	12	9	10	12	19	21
Gate Valve	–	–	–	1	1	1	1	2	2	3	4	5	6
Swing Check*	5	7	9	11	14	16	19	22	27	32	45	55	65

Use with Hazen and Williams' C = 120 only. For other values of C, the figures in Table 7-4.2 should be multiplied by the factors indicated below:

Value of C	100	120	130	140
Multiplying factor	0.713	1.00	1.16	1.32

(This is based upon the friction loss through the fitting being independent of the C factor applicable to the piping.)

Specific friction loss values or equivalent pipe lengths for alarm valves, dry-pipe valves, deluge valves, strainers and other devices shall be made available to the authority having jurisdiction.

*Due to the variations in design of swing check valves, the pipe equivalents indicated in the above chart to be considered average.

where p is the frictional resistance in pounds pressure per square inch per feet of pipe, Q is the gallons per minute flowing and d is the actual internal diameter of pipe in inches with C as the friction loss coefficient.

7-4.2 Equivalent Pipe Lengths of Valves and Fittings. Table 7-4.2 shall be used to determine the equivalent length of pipe for fittings and devices unless manufacturer's test data indicates other factors are appropriate.

7-4.3* Calculation Procedure.

7-4.3.1* The design area shall be the hydraulically most remote area and usually includes sprinklers on both sides of the cross main.

Exception No. 1: Where the design area under consideration involves a corridor protected by one line of sprinklers, the maximum number of sprinklers that need be calculated is seven.

Exception No. 2: For gridded systems, the design area shall be the hydraulically most remote area which approaches a square.

Exception No. 3: When cross mains are looped, the design area shall be that area hydraulically most remote from the water feed to the loop.

7-4.3.1.1 Feed mains, cross mains and branch lines within the same system may be looped or gridded to divide the total water flowing to the design area.

7-4.3.1.2 System piping shall be hydraulically designed using design densities and areas of operation in accordance with Table 2-2.1 (B) as required for the occupancies involved.

7-4.3.1.2.1 The density shall be calculated on the basis of floor area.

7-4.3.1.3* Each sprinkler in the design area and the remainder of the hydraulically designed system shall discharge at a flow rate at least equal to the stipulated minimum water application rate (density). Begin calculations at the hydraulically most remote sprinkler.

7-4.3.1.4 Calculate pipe friction loss in accordance with the Hazen and Williams formula with "C" values from Table 7-4.3.1.4.

Table 7-4.3.1.4

Pipe or Tube	Hazen-Williams "C" Value*
Unlined Cast Iron	100
Black Steel (Dry systems)	100
Black Steel (Wet systems)	120
Copper tube & Cement lined Cast Iron	140

*The authority having jurisdiction may recommend other "C" values.

7-4.3.1.4.1 Include pipe, fittings and devices such as valves, meters and strainers and calculate elevation changes which affect the sprinkler discharge.

7-4.3.1.4.2 Calculate the loss for a tee or a cross where flow direction change occurs based on the equivalent pipe length of the piping segment in which the fitting is included. The tee at the top of a riser nipple shall be included in the branch line; the tee at the base of a riser nipple shall be included in the riser nipple; and the tee or cross at a cross main-feed main junction shall be included in the cross main. Do not include fitting loss for straight thru flow in a tee or cross.

7-4.3.1.4.3 Calculate the loss of reducing elbows based on the equivalent feet value of the smallest outlet. Use the equivalent feet value for the "standard elbow" on any abrupt ninety-degree turn, such as the screw-type pattern. Use the equivalent feet value for the "long turn elbow" on any sweeping ninety-degree turn, such as a flanged, welded or mechanical joint-elbow type (see Table 7-4.2).

7-4.3.1.4.4 Friction loss shall be excluded for tapered reducers, for reducing elbows serving a sprinkler at the end of a branch line, and for all fittings directly supplying a sprinkler.

7-4.3.1.5 Orifice plates or sprinklers of different orifice sizes shall not be used for balancing the system, except for special use such as exposure protection, small rooms or enclosures or directional discharge. (See 4-4.20 for definition of small rooms.)

7-4.3.1.6 Water allowance for inside hose shall be added to the system requirements at the base of the riser.

7-4.3.1.7 Water allowance for outside hose shall be added at the connection to the city water main or at the yard hydrant nearest the riser, whichever is closer.

7-4.3.1.8 Sprinkler discharge in closets, washrooms and similar small compartments requiring only one sprinkler may be omitted from hydraulic calculations within the area of application. [Sprinklers in these small compartments shall, however, be capable of discharging minimum densities in accordance with Table 2-2.1(B)*.]

7-4.3.2 Minimum operating pressure of any sprinkler shall be 7 psi.

Chapter 8 High-Rise Buildings

8-1 Application and Scope. This chapter deals with automatic sprinkler system design for life safety and fire protection in high rise buildings of noncombustible, protected noncombustible or fire-resistive construction as defined in NFPA Standard, Standard Types of Building Construction, No. 220–1961, which are used predominantly for light hazard occupancies. It is intended to cover totally sprinklered buildings only, and shall not apply to partially sprinklered buildings.

8-2 Definitions.

High-Rise Building means one in which fire must be fought internally because of height.

8-3 Design Criteria.

8-3.1 The installation may be either a pipe schedule system or a hydraulically designed system. Pipe schedule systems shall comply with Chapters 1 through 6 of this standard. Hydraulically designed systems shall comply with Chapters 1 through 7 of this standard as modified by 8-3.2 through 8-3.4 and shall comply with Chapter 8.

8-3.2 In light hazard occupancies, special sprinklers may be installed with larger protection areas than indicated in 4-2.2.1.1 or greater distances between sprinklers or branch lines than indicated in 4-2.1.1 when such installations are made in accordance with approvals or listings of a nationally recognized testing laboratory.

8-4 Water Supplies.

8-4.1 Acceptable water supplies are as follows:

(a) Public water system where pressure and discharge caacity meet the design requirements of the system as calculated.

(b) Automatic fire pumps supplied under head from a water supply source adequate to meet hydraulically designed system requirements, including public mains, reservoirs and wells.

(c) Pressure tanks.

(d) Gravity tanks.

8-4.2 Each water supply source shall be automatic and of adequate capacity and pressure to supply the sprinkler system calculated demand for a period of not less than 30 minutes.

8-4.3 Hose connections may be supplied from sprinkler risers. See paragraphs 3-7.7 and 3-7.8.

8-4.4 Where hose connections are supplied from sprinkler risers, total supply shall be a minimum of 500 gpm and in accordance with NFPA Standard, Installation of Standpipes and Hose Systems, No. 14–1974. Calculated sprinkler system demand need not be added to this supply.

8-5 Alarms.

8-5.1 A separate and distinct supervisory signal shall be provided to indicate a condition that will impair the satisfactory operation of the sprinkler system. This shall include, but need not be limited to monitoring of control valves, fire pump power supplies and running conditions, water tank levels, and temperatures. Pressure supervision shall also be provided on pressure tanks.

8-5.2 When each sprinkler system on each floor is equipped with a separate waterflow device, it shall be connected to an alarm system in such a manner that operation of one sprinkler will actuate the alarm system, and the location of the operated flow device shall be indicated on an annunciator and/or register. Annunciator or register shall be located at grade level at the normal point of fire department access, at a constantly attended building security control center, or both locations.

8-5.3 When the location within the protected building where supervisory or alarm signals are received is not under constant supervision by qualified personnel in the employ of the owner, a connection shall be provided to transmit a signal to a remote monitoring station.

8-5.4 Alarm and supervisory systems in connection with the sprinkler system shall be installed in accordance with NFPA Standards Central Station Signaling Systems (NFPA No. 71–1974), Remote Station Protective Signaling Systems (NFPA No. 72C–1974), or Proprietary Protective Signaling Systems (NFPA No. 72D–1974), as appropriate.

Appendix A

The following notes bearing the same number as the text of the *Standard for the Installation of Sprinkler Systems* to which they apply, contain useful explanatory material and references to standards.

This Appendix is not a part of this NFPA Standard for the Installation of Sprinkler Systems but is included for information purposes only.

A-1-5.1 Impairments. Before shutting off a section of the fire service system to make sprinkler system connections, notify the authority having jurisdiction, plan the work carefully, and assemble all materials to enable completion in shortest possible time. Work started on connections should be rushed to completion without interruption, and protection restored as promptly as possible. During the impairment, provide emergency hose lines, additional fire pails and extinguishers, and maintain extra watch service in the areas affected.

When changes involve shutting off water from any considerable number of sprinklers for more than a few hours, temporary water supply connections should be made to sprinkler systems so that reasonable protection can be maintained. In adding to old systems or revamping them, protection should be restored each night so far as possible. The members of the private fire brigade as well as public fire department should be notified as to conditions.

A-1-7.3.3 When hazards in those buildings or portions of buildings of this occupancy group are severe, the authority having jurisdiction should be consulted for special rulings regarding water supplies, types of equipment, pipe sizes, types of sprinklers and sprinkler spacing.

A-1-7.4 New installations protecting extra hazard occupancies should be hydraulically designed in all cases where standards giving design criteria are available. Pipe schedule systems are normally satisfactory in existing installations and in small segregated areas.

A-1-8.1(a) Workmanship. A sprinkler system is a specialized fire protection system and requires knowledgeable and experienced design and installation.

A-1-8.1(b) Sprinkler Systems in Buildings Subject to Flood. When sprinkler systems are installed in buildings subject to recurring floods the location of control valves, alarm devices, dry pipe valves, pumps; compressors, power and fuel supplies should be such that system operation will be uninterrupted by high water.

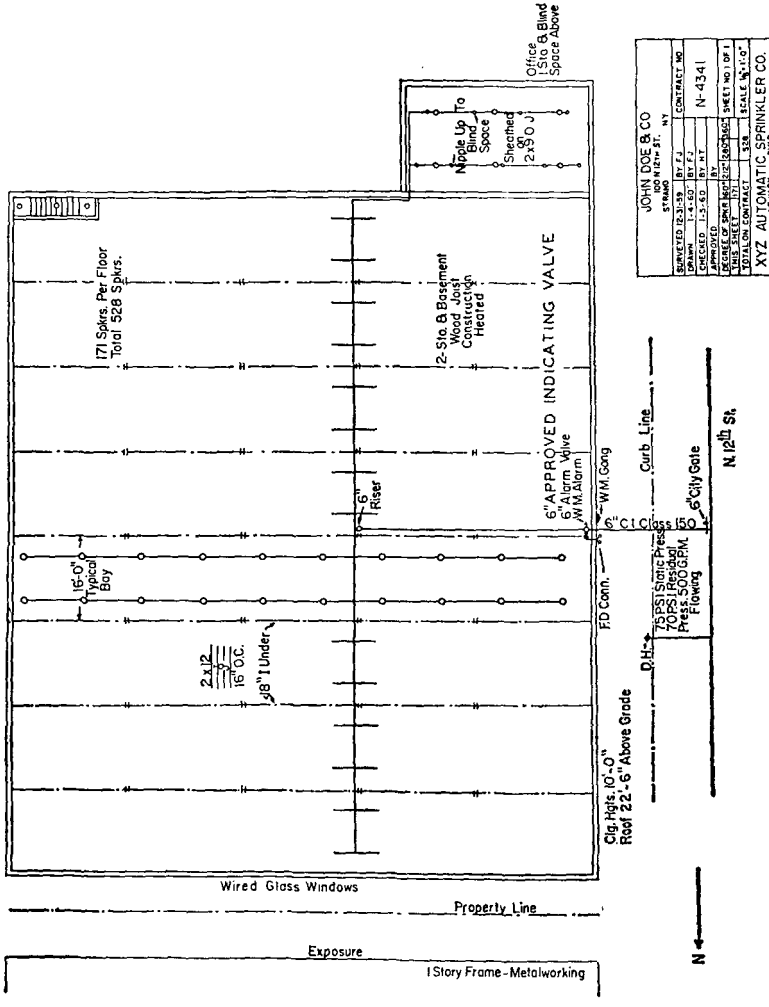


Fig. A-1-9 Typical Preliminary Plan.

A-1-8.1.2 Under special conditions used equipment may be reused by the original owner, subject to the approval of the authority having jurisdiction. Second hand alarm valves, retarding chambers, circuit closers, water motor alarms, dry pipe valves, quick opening devices and other devices may be used as replacement equipment in existing systems subject to the approval of the authority having jurisdiction.

A-1-9 Preliminary layouts should be submitted for review to the authority having jurisdiction before any equipment is installed or remodeled in order to avoid error or subsequent misunderstanding. Any material deviation from approved plans will require permission of the authority having jurisdiction.
Preliminary layouts should show:

(a) Name of owner and occupant

(b) Location, including street address

(c) Point of compass

(d) Construction and occupancy of each building

NOTE: Data on special hazards should be submitted as they may require special rulings.

(e) Building height in feet

(f) If it is proposed to use a city main as a supply, whether the main is dead-end or circulating, size of the main and pressure in psi; and if dead-end, direction and distance to nearest circulating main

(g) Distance from nearest pumping station or reservoir

(h) In cases where reliable up-to-date information is not available, a water-flow test of the city main should be conducted in accordance with Section B-2-1.1. (The preliminary plan should specify who conducted the test, date and time, the location of the hydrants where flow was taken and where static and residual pressure readings were recorded, the size of main supplying these hydrants, and the results of the test, giving size and number of open hydrant butts flowed; also data covering minimum pressure in connection with city main should be included.)

(i) Data covering waterworks systems in small towns in order to expedite the review of plans

(j) Fire walls, fire doors, unprotected window openings, large unprotected floor openings, and blind spaces

(k) Distance to and construction and occupancy of exposing buildings — e.g., lumber yards, brick mercantiles, fire-resistive office buildings, etc.

(l) Spacing of Sprinklers, number of sprinklers in each story or fire area and total number of sprinklers, number of sprinklers on each riser and on each system by floors, total area protected by each system on each floor, total number of sprinklers on each dry pipe system or preaction or deluge system and if extension to present equipment, number of sprinklers on riser per floor, sprinklers already installed

(m) Capacities of dry pipe systems with the bulk pipe included (*See Table A-5-2.3*), and if an extension is made to an existing dry pipe system, the total capacity of the existing and also extended portion of the system

(n) Weight or class, and size and material of any proposed underground pipe

(o) Whether property is located in a flood area requiring consideration in the design of sprinkler system

(p) Name and address of party submitting the layout.

A-1-11.3.1 Systems that have been modified or repaired to any appreciable extent should be hydrostatically tested at not less than 50 psi in excess of normal static pressure for two hours.

To reduce the possibility of serious water damage in case of a break, pressure may be maintained by a small pump, the main controlling gate meanwhile being kept shut during test.

A-2-1 Water supplies should have adequate pressure, capacity and reliability.

The water supply needed for various occupancies, including extra hazard occupancies is determined by evaluating the number of sprinklers which may be expected to operate from any one fire plus quantities needed simultaneously for hose streams.

Determination of the water supply needed for extra hazard occupancies will require special consideration of the four factors: (1) area of sprinkler operation, (2) density of discharge, (3) required time of discharge, and (4) amount of water needed simultaneously for hose streams.

When the occupancy presents a possibility of intense fires requiring extra heavy discharge, this may be obtained by an increase in the pressure and volume of the water supply, by a closer spacing of sprinklers, by the use of larger pipe sizing, or by a combination of these methods. In such cases, consideration should be given to hydraulically designed systems. See Chapter 7.

When separately published standards on various subjects contaid specific provisions for water supplies, these should be consulten. (See Appendix E for availability of Standards.)

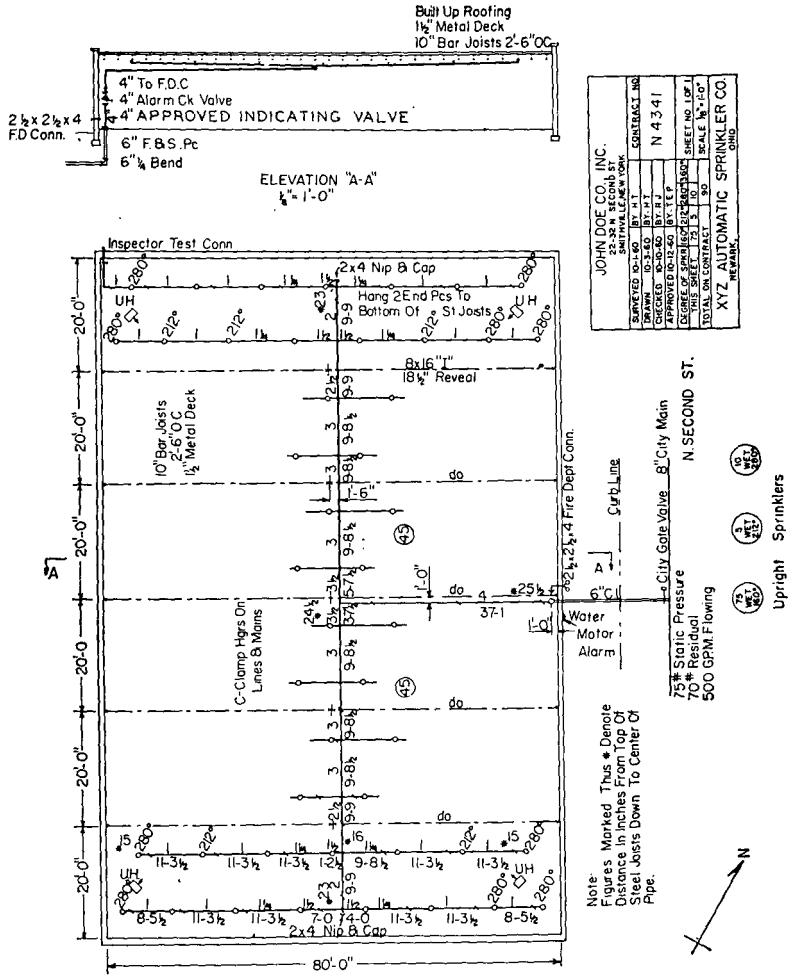


Fig. A1-9.2(A). Typical Working Plans.

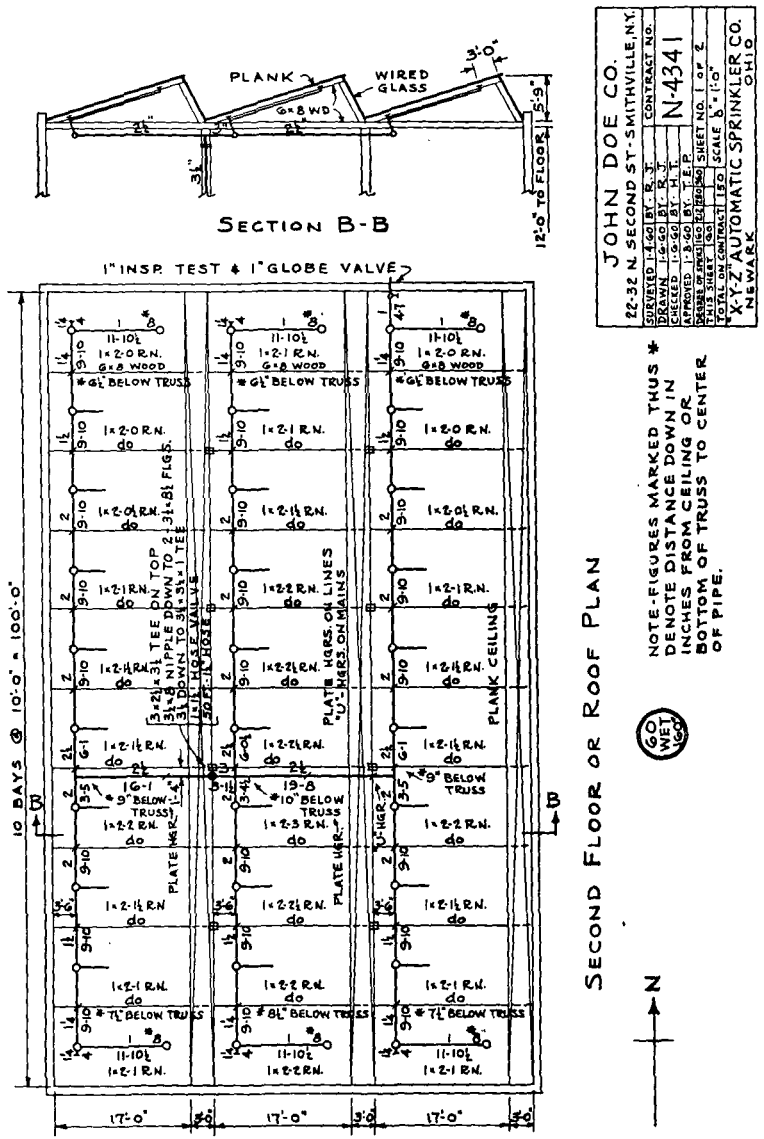
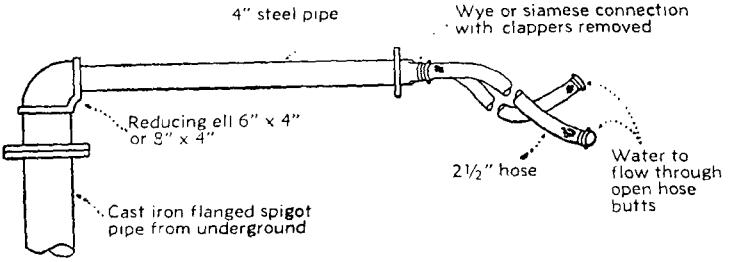
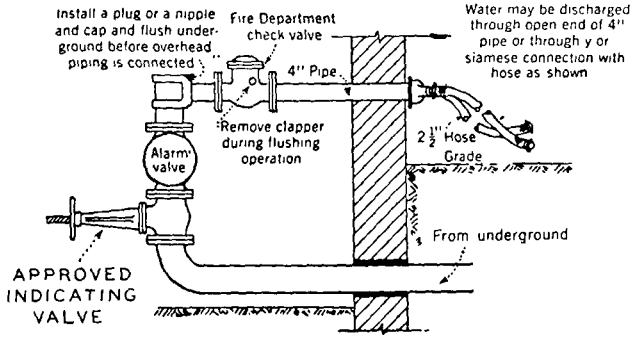


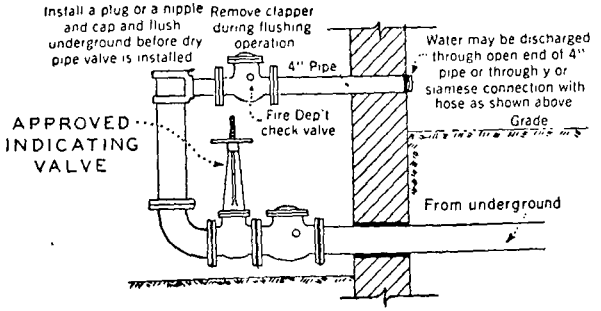
Fig. A1-9.2(B). Typical Working Plans (cont.)

A-1-11.2



Employing horizontal run of 4-inch pipe and reducing fitting near base of riser.





Employing fire department connections.

Fig. A-1-11.2. Methods of Flushing Water Supply Connections.

A-2-2 The water supply requirement for sprinkler protection is determined by the number of sprinklers expected to operate in event of fire. The primary factors affecting the number of sprinklers which might open are:

(1) Occupancy
(2) Combustibility of contents
(3) Area shielded from proper distribution of water
(4) Height of stock piles
(5) Combustibility of construction (ceilings and blind spaces)
(6) Ceiling heights and draft conditions
(7) Horizontal and vertical cutoffs
(8) Wet or dry sprinkler system
(9) High water pressure
(10) Housekeeping
(11) Temperature rating of sprinklers
(12) Water flow alarm and response thereto.

A-2-2.1(B) The second note under Table 2-2.1(B)* is included to compensate for possible delay in operation of sprinklers from fires in concealed spaces found in wood frame, brick veneer, and ordinary construction.

A-2-3.1.1 Reliability of public water supply should take into account probable minimum pressure condition prevailing during such periods as at night, or during summer months when heavy usage may occur, also possibility of interruption by floods, or ice conditions in winter.

Pressure Regulating Valves.

Pressure regulating valves should not be used except with permission of the authority having jurisdiction.

A-2-3.2 In private underground piping systems for buildings of other than Light Hazard Occupancy, any dead-end pipe which supplies both sprinklers and hydrants should be not less than 8 inches in size.

A-2-5 See sections dealing with sprinkler equipment supervisory and water flow alarm services in the Standard for Central Station Signaling Systems (NFPA No. 71–1974), the Standard for Local Protective Signaling Systems (NFPA No. 72A–1974), the Standard for Auxiliary Protective Signaling Systems (NFPA No. 72B–1974), Remote Station Protective Signaling Systems for Fire Alarm and Supervisory Service (NFPA No. 72C–1974), or the Standard for Proprietary Protective Signaling Systems (NFPA No. 72D–1974). See also separately published Standard for the Installation of Centrifugal Fire Pumps (NFPA No. 20–1974), and Outside Protection (NFPA No. 24–1973).

A-2-5.1 An automatically controlled vertical turbine pump taking suction from a reservoir, pond, lake, river or well complies with 2-5.1.

A-2-6.3 The air pressure to be carried and the proper proportion of air in the tank may be determined from the following formulas, in which,

P = Air pressure carried in pressure tank.
A = Proportion of air in tank.
H = Height of highest sprinkler above tank bottom.

When tank is placed above the highest sprinkler $P = \frac{30}{A} - 15$.

A = ⅓ then P = 90 —15 = 75 pounds per sq. in.
A = ½ then P = 60 —15 = 45 pounds per sq. in.
A = ⅔ then P = 45 —15 = 30 pounds per sq. in.

When tank is below level of the highest sprinkler

$$P = \frac{30}{A} - 15 + \frac{0.434H}{A}$$

A = ⅓ then P = 75 + 1.30H
A = ½ then P = 45 + 0.87H.
A = ⅔ then P = 30 + 0.65H.

The respective air pressures above are calculated to ensure that the last water will leave the tank at a pressure of 15 lbs. per square inch when the base of the tank is on a level with the highest sprinkler, or at such additional pressure as is equivalent to a head corresponding to the distance between the base of the tank and the highest sprinkler when the latter is above the tank.

The final pressure required at the pressure tank for systems designed from Table 2-2.1(B) will normally be higher than the 15 psi anticipated in the previous paragraph. The following formula should be used to determine the tank pressure and ratio of air to water in hydraulically designed systems.

$$P_i = \frac{P_f + 15}{A} - 15$$

where
P_i = Tank Pressure
P_f = Pressure Required from Hydraulic Calculations
A = Proportion of Air

Example: Hydraulic calculations indicate 75 psi is required to supply the system. What tank pressure will be required?

$$P_i = \frac{75 + 15}{.5} - 15$$

$P_i = 180 - 15 = 165$ psi

In this case, the tank would be filled with 50 per cent air and 50 per cent water and the tank pressure would be 165 psi. If the pressure is too high the amount of air carried in the tank will have to be increased.

Location of Pressure Tanks. Pressure tanks should be located above the top level of sprinklers but may be located in the basement or elsewhere.

A-2-7.2 For hydraulically designed sprinkler systems, the size of the fire department connection should be sufficient to supply the sprinkler water demand developed from Table 2-2.1(B).

A-2-7.3 Fire department hose connections should be located on the street side of the building and arranged so that hose lines can be readily and conveniently attached to the inlet without interference from any nearby objects including buildings, fences, posts, or other fire department connections.

A-2-8.2 When the system riser is close to an outside wall, underground fittings of proper length should be used in order to avoid pipe joints located in or under the wall. When the connection passes through the foundation wall below grade, a one- to three-inch clearance should be provided around the pipe and the clear space filled with asphalt mastic or similar flexible waterproofing material. Also see Appendix B, Section B-3-2.

A-2-9.1

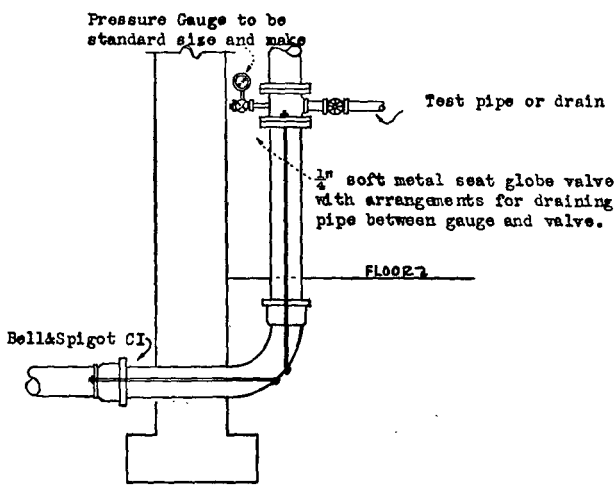


Fig. A-2-9.1 Test Pipe on Water Supply with Outside Control. Also applicable to an interior riser.

A-3-2

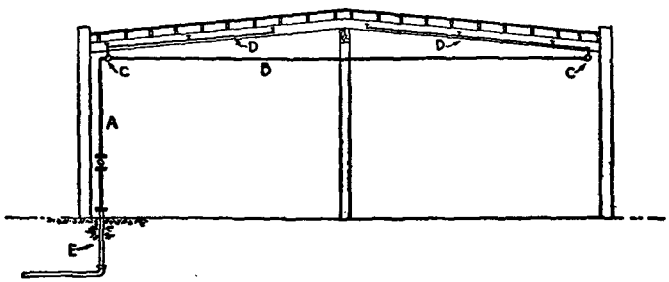


Fig. A-3-2 Building Elevation Showing Parts of Sprinkler Piping System. A — Riser; B — Feed Main; C — Cross Main; D — Branch Lines; E — Underground Supply.

A-3-3 Long Runs of Pipe. When the construction or conditions introduce unusually long runs of pipe or many angles, in risers or feed mains, an increase in pipe size over that called for in the schedules may be required to compensate for increased friction losses.

A-3-4.4 For example, a 2½-inch steel pipe, which is permitted to supply 30 sprinklers, may supply a total of 50 sprinklers where not more than 30 sprinklers are above or below the ceiling.

A-3-5.4 For example, a three-inch steel pipe, which is permitted to supply 40 sprinklers, may supply a total of 60 sprinklers where not more than 40 sprinklers are above or below the ceiling.

A-3-7.3

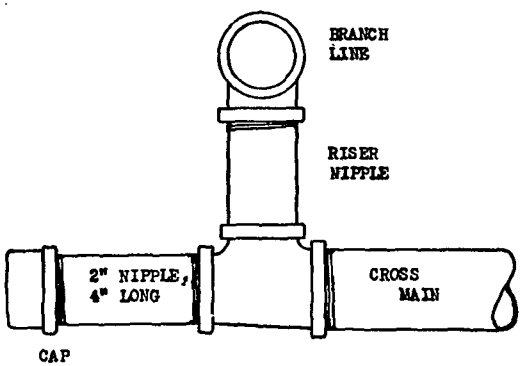
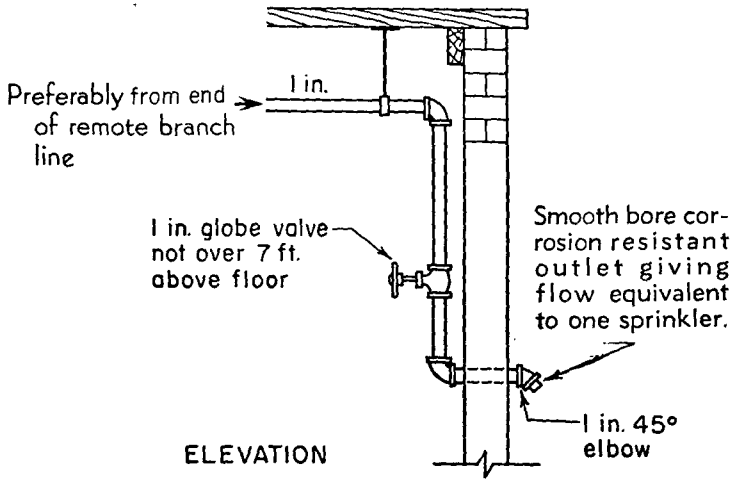


Fig. A-3-7.3 Flushing Connection.



NOTE: Not less than 4 feet of exposed test pipe in warm room beyond valve when pipe extends through wall to outside.

Fig. A-3-8.1.1 (a).

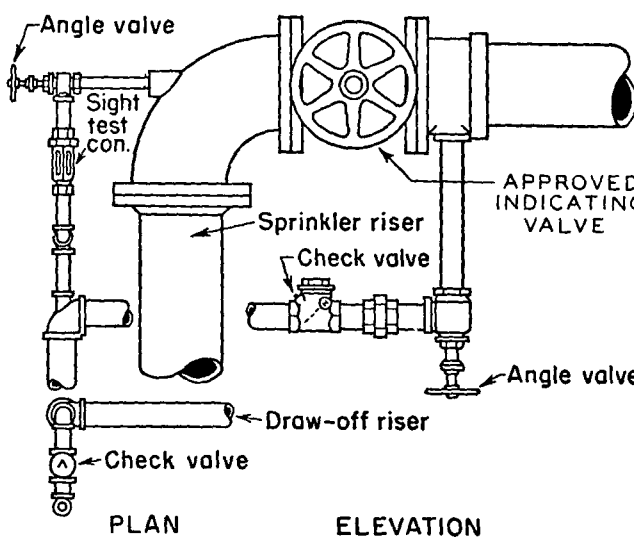


Fig. A-3-8.1.1 (b) One-Inch System Test Pipes on Wet-Pipe Systems.

Connect to top of main riser or to sprinkler pipe in the highest part of system. The drawing on the upper portion of the page shows the preferred arrangement. In special cases, the connection may be made in the manner shown in the lower drawing.

A-3-8.1.1 This test pipe should be in the upper story, and the connection should preferably be piped from the end of the most remote branch line. The discharge should be at a point where it can be readily observed. In locations where it is not practical to terminate the test pipe outside the building, the test pipe may terminate into a drain capable of accepting full flow under system pressure. (See A-3-10.4.1.) In this event, the test connection should be made using an approved sight test connection containing a

A-3-8.1.2

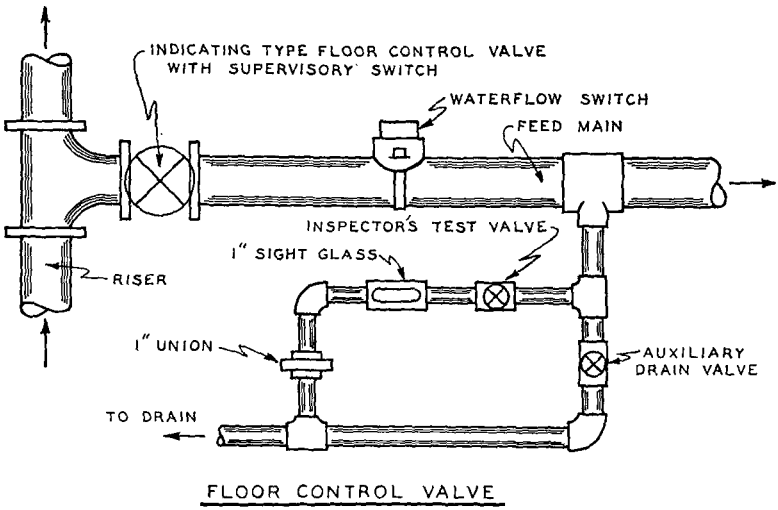


Fig. A-3-8.1.2 Floor control valve.

A-3-8.2

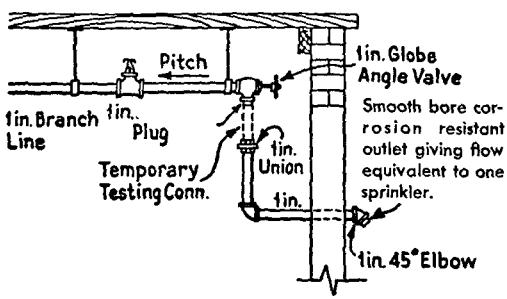


Fig. A-3-8.2 One-inch System Test Pipes on Dry-Pipe Systems.

smooth bore corrosion resistant orifice giving a flow equivalent to one sprinkler. (See Figs. A-3-8.1.1(a) and A-3-8.1.1(b)) The test valve should be located at an accessible point, and preferably not over seven feet above the floor. The control valve on the test connection should be located at a point not exposed to freezing.

A-3-9 Protection of Piping Against Damage Due to Impact. Sprinkler piping should be located so as to minimize the possibility of damage due to impact by mobile material handling equipment and other vehicles. For example, risers adjacent to structural columns and out of vehicle travel routes are generally safe, as are feed mains and cross mains shielded by heavy structural members such as girders.

A-3-9.2 If corrosive conditions are not of great intensity and humidity is not abnormally high, good results can be obtained by a protective coating of red lead and varnish or by a good grade of commercial acid-resisting paint. The paint manufacturer's instructions should be followed in the preparation of the surface and in the method of application.

Where moisture conditions are severe but corrosive conditions are not of great intensity, copper tube or galvanized steel pipe, fittings and hangers may be suitable. The threaded ends of steel pipe should be painted.

In instances where the piping is not readily accessible and where the exposure to corrosive fumes is severe, either a protective coating of high quality may be employed or resort may be made to the use of some form of corrosion resisting material.

A-3-9.3 Protection of Piping Against Damage Where Subject to Earthquakes.

A-3-9.3.1 Protection against damage where subject to earthquakes should be provided in some areas. The history, intensity and the frequency of earthquakes should be considered in determining the need for protection of piping against earthquake damage. The authority having jurisdiction should be consulted relative to definite areas requiring protection.

A-3-9.3.2 Breakage of sprinkler piping caused by building movement can be greatly lessened and may be prevented by increasing the flexibility between major parts of the sprinkler system. One part of the piping should never be held rigidly and another be free to move without provisions for relieving the strain.

Flexibility can be provided by the use of mechanical groove couplings at critical points and allowing clearances at walls and floors. Mechanical groove couplings are generally unnecessary in risers which are under 3 feet in length.

A pair of mechanical groove couplings with a length of pipe between, readily permits a considerable offset in any direction.

Tank or pump risers should be treated the same as sprinkler risers for their portion within a building. The discharge pipe of tanks on buildings should have a control valve above the roof line so any pipe break within the building can be controlled.

A-3-9.3.3 While clearances are necessary around the sprinkler piping to prevent breakage due to building movement, suitable provision should also be made to prevent passage of water, smoke or fire.

Drains, fire department connections and other auxiliary piping connected to risers should not be cemented into walls or floors; similarly, pipes which pass horizontally through walls or foundations should not be cemented solidly or strains will accumulate at such point.

Where supplies or short lengths of pipe extend through suspended ceilings, they should not be fastened to the ceiling framing members.

Mineral wool or other suitable material used to pack clearances between pipe and sleeves and walls should be held in place with pipe collars on each side.

A-3-9.3.4 All piping outside of buildings which is not buried should be securely anchored to prevent swaying.

In most cases, specially placed U-type hangers, or pipe clamps with rods or angle braces, will satisfy bracing requirements. Any properly detailed design will be acceptable. Fig. A-3-9.3.4(a) illustrates some acceptable arrangements of sway bracing.

In design of sway braces, the slenderness ratio No. l/r should not exceed 200 where "l" is the distance between the center lines of support and "r" is the least radius of gyration, both in inches. For example, a flat bar 2 inches by $\frac{3}{8}$ inches should not be over 1 foot, 9 inches between fastenings. The maximum length of shapes used for sway bracing is shown in Table A-3-9.3.4.

Table A-3-9.3.4

Item	Max. Length $l/r=200$	Item	Max. Length $l/r=200$
ANGLES		FLATS	
1 ½ x 1 ½ x ¼ in.	4 ft. 10 in.	1 ½ x ¼ in.	1 ft. 2 in.
2 x 2 x ¼ in.	6 ft. 6 in.	2 x ¼ in.	1 ft. 2 in.
2 ½ x 2 x ¼ in.	7 ft. 0 in.	2 x ⅜ in.	1 ft. 9 in.
2 ½ x 2 ½ x ¼ in.	8 ft. 2 in.	PIPE	
3 x 2 ½ x ¼ in.	8 ft. 10 in.	1 in.	7 ft. 0 in.
3 x 3 x ¼ in.	9 ft. 10 in.	1 ¼ in.	9 ft. 0 in.
RODS		1 ½ in.	10 ft. 4 in
¾ in.	3 ft. 1 in.	2 in.	13 ft. 1 in.
⅞ in.	3 ft. 7 in.		

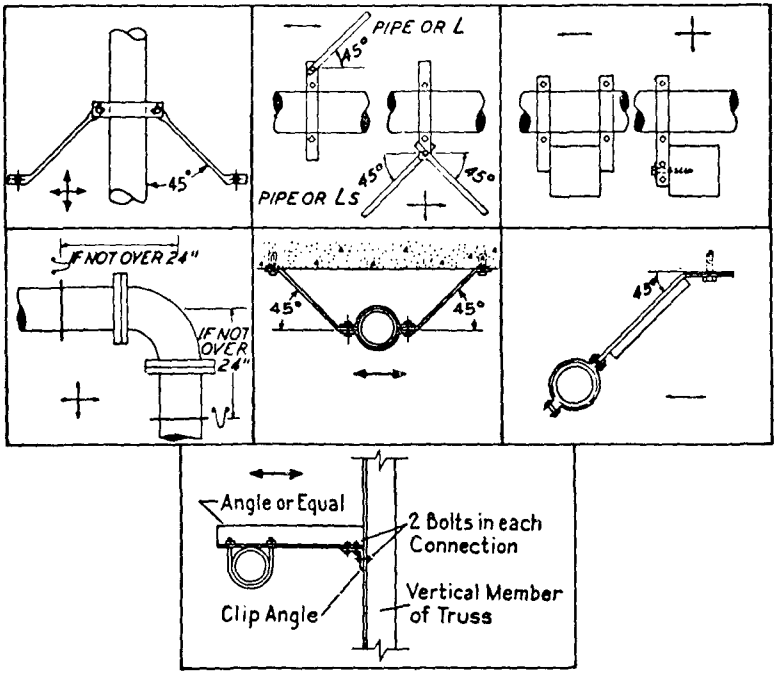
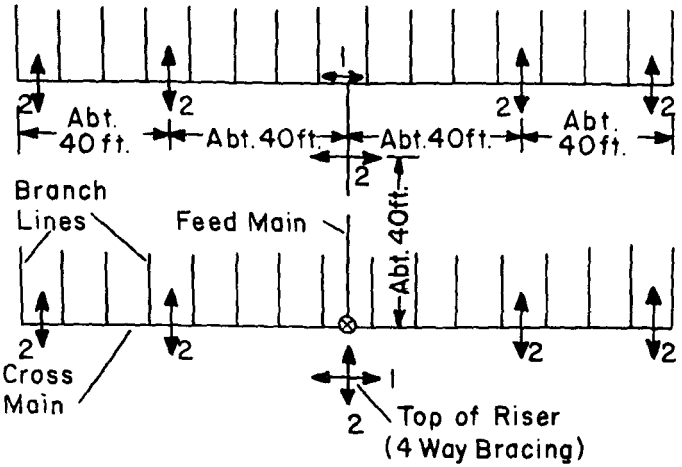
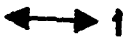


Fig. A-3-9.3.4 (a) Acceptable Types of Sway Bracing.





Indicates suitable location of hangers to oppose the movement of feed and cross mains in the direction along the main. One hanger will be sufficient for each main unless it is of exceptional length or contains offsets or changes in direction. Two-inch and smaller pipes do not require this type of bracing.

Indicates suitable location of hangers to oppose transverse (perpendicular to pipe) movement of feed and cross mains. They should be located at intervals of 30 to 40 feet. The end hanger of this type should be on the last piece of cross or feed main.

Fig. A-3-9.3.4(b) Typical Locations of Sway Bracing Hangers.

A-3-10.1.1 All piping should be arranged where practicable to drain to the main drain valve.

A-3-10.4.1 When possible, the main sprinkler riser drain should discharge outside the building at a point free from the possibility of causing water damage. When not possible to discharge outside the building wall, the drain should be piped to a sump which in turn should discharge by gravity or be pumped to a waste water drain or sewer. The main sprinkler riser drain connection should be of a size to carry off water from the fully open drain valve while it is discharging under normal water system pressures. When this is not possible, a supplementary drain of equal size should be provided for test purposes with free discharge, located at or above grade.

A-3-10.4.5 When exterior ambient temperatures are subject to freezing, 32° F. or less, at least 4 feet of pipe should be installed beyond the valve, in a warm room.

A-3-11.4.1 The fire hazard of the brazing process should be suitably safeguarded.

A-3-12.1.5

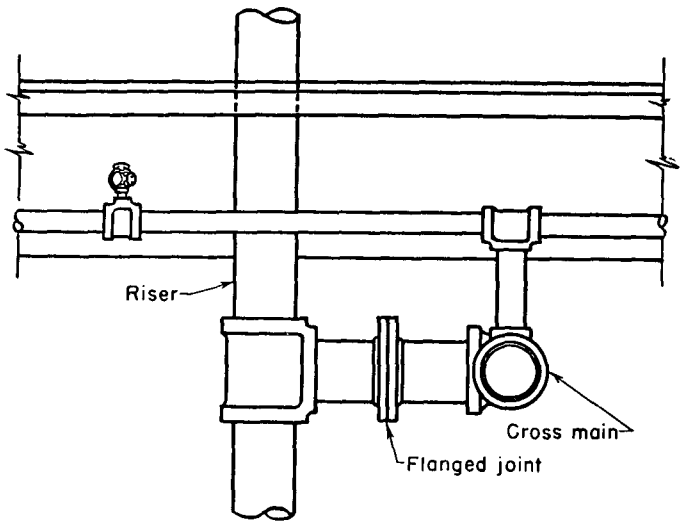


Fig. A-3-12.1.5 One Arrangement of Flanged Joint at Sprinkler Riser.

A-3-12.2 Approved flexible connections are permissible and encouraged for sprinkler installations in racks to reduce possibility of physical damage. When flexible tubing is used it should be located so that it will be protected against mechanical injury.

A-3-13.2 Valves Controlling Water Supplies.

A-3-13.2.1 A water supply connection should not extend into or through a building unless such connection is under the control of an outside approved indicating valve or an inside approved indicating valve located near outside wall of the building.

All valves controlling water supplies for sprinkler system, or portions thereof including floor control valves should be accessible to

authorized persons during emergencies. Permanent ladders, clamped treads on risers, chain-operated hand wheels, or other accepted means should be provided when necessary.

Outside control valves are suggested in the following order of preference:

a. Approved indicating valves at each connection into the building at least 40 feet from buildings if space permits.

b. Control valves installed in a cut-off stair tower or valve room accessible from outside.

c. Valves located in risers with indicating posts arranged for outside operation.

d. Key operated valves in each connection into the building.

A-3-13.2.5 Pits for underground valves, except those located at the base of a tank riser, are described in the Standard for Outside Protection (NFPA No. 24–1973). For pits protecting valves located at the base of a tank riser, refer to the Standard for Water Tanks for Private Fire Protection (NFPA No. 22–1974).

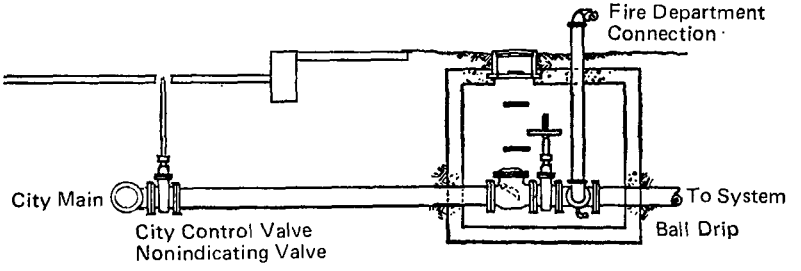


Fig. A-3-13.2.5 Pit for Gate Valve, Check Valve and Fire Department Connection.

A-3-13.2.6 When a system having only one dry-pipe valve is supplied with city water and fire department connection it will be satisfactory to install the main check valve in water supply connection immediately inside of the building; in case there is no outside control the system indicating valve should be placed at the wall flange ahead of all fittings.

A-3-13.3 All control, drain, and test valves should be provided with identification signs.

A-3-14.1 Branch line hangers under metal decking may be attached by drilling or punching vertical members and using through bolts. The distance from the bottom of the bolt hole to the bottom of the vertical member should be not less than $\frac{3}{8}$-inch.

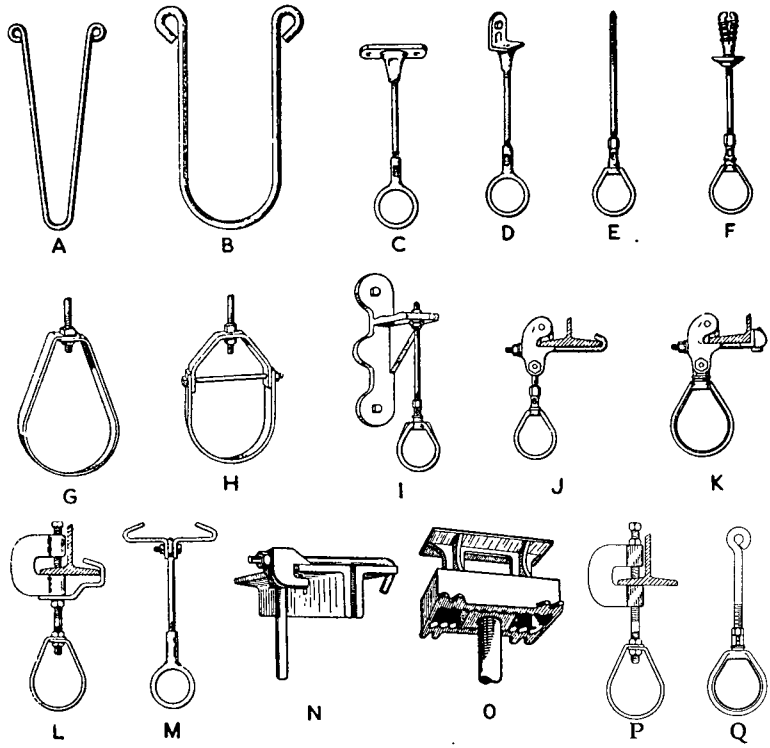
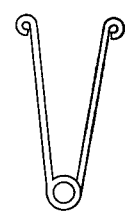


Fig. A-3-14.1 Common Types of Acceptable Hangers.

A — U-type Hanger for Branch Lines.
B — U-type Hanger for Cross Mains and Feed Mains.
C — Adjustable Clip for Branch Lines.
D — Side Beam Adjustable Hanger.
E — Adjustable Coach Screw Clip for Branch Lines.
F — Adjustable Swivel Ring Hanger with Expansion Shield.
G — Adjustable Flat Iron Hanger.
H — Adjustable Clevis Hanger.
I — Cantilever Bracket.
J — "Universal" I-beam Clamp.
K — "Universal" Channel Clamp.
L — C-type Clamp with Retaining Strap.
M — Center I-beam Clamp for Branch Lines.
N — Top Beam Clamp.
O — "CL-Universal" Concrete Insert.
P — C-type Clamp without Retaining Strap.
Q — Eye Rod and Ring Hanger.
R — Wrap-around U Hook.



A-3-14.3.1 Powder-driven studs should not be used in steel less than 3/16-inch total thickness.

A-3-14.6.6 To take care of the thrust in a steeply pitched roof branch line, a clamp should be installed on the pipe just above the lowest hanger.

A-3-15.1 The standard sprinkler is the type commonly manufactured since 1953, incorporating a uniform, hemispherical discharge pattern. Water is discharged in all directions below the plane of the deflector. Little or no water is discharged upward to wet the ceiling. Sprinkler deflectors are stamped as follows:

Upright Sprinkler Marked SSU

Pendent Sprinkler Marked SSP

The old style sprinkler is the type commonly manufactured before 1953. It discharged approximately 50 percent of the water upward to the ceiling.

A-3-15.2.2 Upright sprinklers should be installed with the frame parallel to the branch line pipe to reduce to minimum the obstruction of the discharge pattern.

A-3-15.2.6 Large orifice sprinklers should not be used with pipe schedule systems unless their use is acceptable to the authority having jurisdiction and supported by hydraulic calculations.

A-3-15.5 The following Table A-3-15.5 shows the nominal discharge capacities of approved sprinklers having a nominal 1/2-inch orifice at various pressures up to 100 psi.

Table A-3-15.5

Pressure at Sprinkler Lb. Per Sq. In.	Discharge Gal. Per Min.	Pressure at Sprinkler Lb. Per Sq. In.	Discharge Gal. Per Min.
10	18	35	34
15	22	50	41
20	25	75	50
25	28	100	58

A-3-15.6 Information regarding the highest temperature that may be encountered in any location in a particular installation may be obtained by use of a thermometer that will register the highest temperature encountered, which should be hung for several days in the questionable location with the plant in operation.

When an occupancy hazard normally may be expected to produce a fast developing fire or a rapid rate of heat release, the use of sprinklers of high temperature classification, as a means of limiting the total number of sprinklers which might open in a fire,

is recommended. Since the number of sprinklers which might be expected to open will be reduced where the water pressure effective in first operating sprinklers is at least 75 psi without the disadvantage of a potential increase in fire damage, this alternative should be given first consideration.

NOTE: Fire tests have shown that the number of sprinklers which might be expected to open, particularly under conditions where fast-developing fires may expected can be limited by the use of sprinklers of High Temperature Classification. This may be of advantage in reducing the number of sprinklers which would otherwise open outside the area directly involved in a fire and decrease the over-all water demand. However, some increase in fire damage and fire temperatures may be expected when sprinklers of Intermediate or High Temperature Classification are used.

Some occupancies employ high temperature fumigation processes requiring consideration in the selection of sprinkler temperature ratings.

A-3-15.7 For equipment aboard vessels or in isolated locations, a greater number of sprinklers should be provided to permit equipment to be put back into service promptly after a fire. When a great number of sprinklers are likely to be opened by a flash fire, a greater number of sprinklers should be provided.

A-3-15.8 Sprinklers under open grating should be provided with shields. Shields over automatic sprinklers should not be less, in least dimension, than four times the distance between the shield and fusible element, except special sprinklers incorporating a built in shield need not comply with this requirement if approved for the particular application.

A-3-15.9.1 When painting sprinkler piping or painting in areas near sprinklers, the sprinklers may be protected by covering with a bag which should be removed immediately after the painting has been finished.

A-3-15.9.2 Painting of sprinklers may retard the thermal response of the fusible element, may interfere with the free movement of parts and may render the sprinkler inoperative. Moreover, painting may invite the application of subsequent coatings, thus increasing the possibility of a malfunction of the sprinkler.

A-3-16.2 Central station, auxiliary, remote station, or proprietary protective signaling systems are a highly desirable supplement to local alarms, especially from a safety to life standpoint. (See Section 8-5.)

Identification Signs. Approved identification signs should be provided for outside alarm devices. The sign should be located near the device in a conspicuous position and should be worded as follows: SPRINKLER FIRE ALARM—WHEN BELL RINGS CALL FIRE DEPARTMENT OR POLICE. (See Fig. A-3-16.2.)

Fig. A-3-16.2 Identification Sign.

A-3-16.3.3 A mechanical alarm (water motor gong) may also be required.

A-3-16.4.1 Audible alarms are normally located on the outside of the building. Approved electric gong, bells, horns, or sirens inside the building or a combination inside and outside are sometimes advisable.

A-3-16.4.2 All alarm apparatus should be so located and installed that all parts are accessible for inspection, removal, and repair, and should be substantially supported.

A-3-16.5 Water-motor-operated devices should be located as near as practicable to the alarm valve, dry-pipe valve or other waterflow detecting device. The total length of the pipe to these devices should not exceed 75 feet nor should the water-motor-operated device be located over 20 feet above the alarm device or dry-pipe valve. If absolutely necessary to exceed 75 feet, the pipe line to the water-motor-operated device should be increased one or more sizes to compensate for loss of pressure due to hydraulic friction.

A-3-16.6.2 Switches which will silence electric alarm sounding devices by interruption of electrical current are not desirable; however, if such means are provided, then the electrical alarm sounding device circuit should be arranged so that when the sounding device is electrically silenced, that fact shall be indicated by means of a conspicuous light located in the vicinity of the riser or alarm control panel. This light shall remain in operation during the entire period of the electrical circuit interruption.

A-4-1.1 All needless ceiling sheathing, hollow siding, tops of high shelving, partitions or decks should be removed. Sheathing of paper and similar light flammable materials is particularly objectionable.

A-4-1.1.4 New partitions, closets, decks, etc., should be put in place, or provided for, so that the sprinkler equipment may conform to same.

A-4-1.2 Installation of sprinklers throughout the premises is necessary for protection of life and property. In some cases partial sprinkler installations covering hazardous sections and other areas are specified in codes or standards or are required by authorities having jurisdiction, for minimum protection to property or to provide opportunity for safe exit from the building.

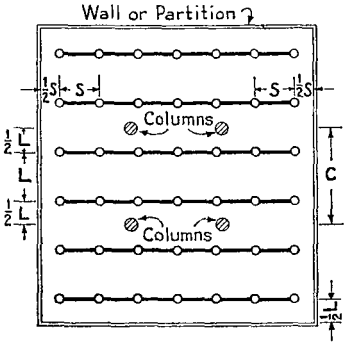
When buildings or portions of buildings are of combustible construction or contain combustible material, standard fire barriers should be provided to separate the areas which are sprinkler protected from adjoining unsprinklered areas. All openings should be protected in accordance with applicable standards and no sprinkler piping should be placed in an unsprinklered area unless the area is permitted to be unsprinklered by this Standard.

Water supplies for partial systems should be adequate and designed with due consideration to the fact that in a partial system more sprinklers may be opened in a fire which originates in an unprotected area and spreads to the sprinklered area than would be the case in a completely protected building. Fire originating in nonsprinklered area may overpower the partial sprinkler system.

A-4-2.1.2 For examples of sprinkler layouts under smooth ceiling construction, refer to Figures A-4.2.1.2(A) and A-4.2.1.2(B).

Flat Slab or Pan Type Reinforced Concrete

Maximum Spacing: 130 Square Feet Per Sprinkler
LXS = 130 or less



KEY

C = Column spacing.
L = Distance between branch lines, limit 15 feet.
S = Distance between sprinklers on branch lines, limit 15 feet.

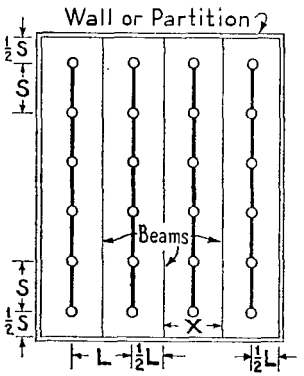
EXAMPLES

C	L	S (Max.)	C	L	S (Max.)
21 ft. 8 in.	10 ft. 10 in.	12 ft. 0 in.	21 ft. 9 in.	10 ft. 0 in.	12 ft. 1 in.
24 ft. 2 in.	12 ft. 1 in.	10 ft. 9 in.			

Fig. A-4-2.1.2(A) Layout of Sprinklers Under Smooth Ceiling Construction — Ordinary Hazard Occupancy.

Continuous Smooth Bays with Beams Supported on Columns

Maximum Spacing: 130 Square Feet Per Sprinkler
L x S = 130 or less



KEY

L = Distance between branch lines, limit 15 feet.
S = Distance between sprinklers on branch lines limit 15 feet.
X = Width of bay.

EXAMPLES

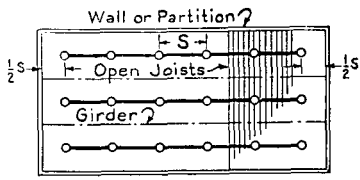
X	L	S (Max.)	X	L	S (Max.)
10 ft. 10 in.	10 ft. 10 in.	12 ft. 0 in.	10 ft. 9 in.	10 ft. 0 in.	12 ft. 1 in.
12 ft. 1 in.	12 ft. 1 in.	10 ft. 0 in.			

A-4-2.1.2(B) Layout of Sprinklers Under Smooth Ceiling Construction — Ordinary Hazard Occupancy.

A-4-2.2.1.2

Joists Above Girders or Framed into Girders; Branch Lines Uniformly Spaced between Girders

Maximum Spacing: 130 Square Feet Per Sprinkler
L x S = 130 or less



KEY

L = Distance between branch lines, limit 15 feet.
S = Distance between sprinklers on branch lines, limit 15 feet.
Y = Maximum distance between girders.

EXAMPLES

Y	L	S (Max.)	Y	L	S (Max.)
10 ft. 9 in.	10 ft. 9 in.	12 ft. 1 in.	10 ft. 10 in.	10 ft. 10 in.	12 ft. 0 in.
			12 ft. 1 in.	12 ft. 1 in.	10 ft. 9 in.

Fig. A-4-2.2.1.2 Layout of Sprinklers Under Open Wood Joist Construction — Light and Ordinary Hazard Occupancies.

A-4-2.3 The arrangement of branch lines depends upon such construction features as the distance between girders or trusses, columns of mushroom type reinforced concrete, and beams of standard mill construction. Each space or bay should usually be treated as a unit, installing the same number of branch lines uniformly in each space. When single branch lines will suffice, they should be placed midway in each bay or space. The arrangement of branch lines also depends upon the structural members available and suitable for the attachment of hangers and upon the need for properly locating sprinkler deflectors in accordance with Sections 4-2.4 and 4-3.

The direction in which branch lines are usually run in the common types of ceiling construction and framing is shown in Table A-4-2.3.