NFPA No.

13

File 10 Series:
Fire Extinguishing Appliances

Standard
for the Installation of
SPRINKLER SYSTEMS

May

1958

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NATIONAL FIRE PROTECTION ASSOCIATION
International

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National Fire Protection Association

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The National Fire Protection Association was organized in 1896 to promote the science and improve the methods of fire protection and prevention, to obtain and circulate information on these subjects and to secure the cooperation of its members in establishing proper safeguards against loss of life and property by fire. Its membership includes two hundred national and regional societies and associations (list on outside back cover) and seventeen thousand individuals, corporations, and organizations. Anyone interested may become a member; membership information is available on request.

This pamphlet is one of a large number of publications on fire safety issued by the Association including periodicals, books, posters and other publications; a complete list is available without charge on request. All NFPA standards adopted by the Association are published in six volumes of the **National Fire Codes** which are re-issued annually and which are available on an annual subscription basis. The standards, prepared by the technical committees of the National Fire Protection Association and adopted in the annual meetings of the Association, are intended to prescribe reasonable measures for minimizing losses of life and property by fire. All interests concerned have opportunity through the Association to participate in the development of the standards and to secure impartial consideration of matters affecting them.

NFPA standards are purely advisory as far as the Association is concerned, but are widely used by law enforcing authorities in addition to their general use as guides to fire safety.

Definitions

The official NFPA definitions of shall, should and approved are:

SHALL is intended to indicate requirements.

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

APPROVED refers to approval by the authority having jurisdiction.

Units of measurements used here are U. S. standard. 1 U. S. gallon = 0.83 Imperial gallons = 3.785 liters.

Approved Equipment

The National Fire Protection Association does not "approve" individual items of fire protection equipment, materials or services. The standards are prepared, as far as practicable, in terms of required performance, avoiding specifications of materials, devices or methods so phrased as to preclude obtaining the desired results by other means. The suitability of devices and materials for installation under these standards is indicated by the listings of nationally recognized testing laboratories, whose findings are customarily used as a guide to approval by agencies applying these standards. Underwriters' Laboratories, Inc., Underwriters' Laboratories of Canada and the Factory Mutual Laboratories test devices and materials for use in accordance with the appropriate standards, and publish lists which are available on request.

Sprinkler Systems

No. 13 — May 1958

This 1958 edition supersedes all previous editions. The changes enumerated below are to the 1956 standard, the latest previous edition.

CHANGES IN 1958 EDITION

SECTION 1. GENERAL INFORMATION

Revision of the paragraph on distribution from standard sprinklers in the Foreword. 103: definition of limited water supply systems expanded and reference to laboratory listing of these systems deleted. 104(a)1: explanatory material on light hazard occupancies expanded. 112: recommended flows for flushing underground connections increased. 114(c): new material on working test of dry pipe valves. Sprinkler contractors' certificate revised.

SECTION 3. WATER SUPPLIES AND FIRE DEPARTMENT CONNECTIONS

Complete revision of this section with considerably more information on adequate water supply.

SECTION 4. PIPING

415(a): editorial revision to clarify intent. 419: U-bends required when water supply is from raw source. Figure 419 revised. 432: reference added to use of gasketed joint cast-iron pipe. 435: requirement to terminate cross mains in 1¼-inch or larger pipe added; explanatory note added. 443(b): reference to deluge systems added. Figure 451 revised. 451: location of test pipe broadened.

SECTION 5. VALVES, PIPE FITTINGS AND HANGERS

511: recommendation for valve supervision and reference to vertical installation of check valves added. 521(g): reference to use of reducing flanges deleted. 531(d): minimum size for straps added. 531(e): reference to ⅛-inch steel straps for "C"-clamps deleted. 533: complete revision but Table 533 moved to paragraph 531. 535(b): new paragraph on rods for hangers. 536(c): requirements for holding ability of powder-driven studs revised.

SECTION 6. SPRINKLERS

602(d): new paragraph on large orifice sprinklers. 611(b): new tables added. Figure 611 revised. 622(c): recommendations on corrosion-resistant coatings expanded. 643: new paragraph on heat collectors.

SECTION 7. LOCATION AND SPACING OF SPRINKLERS

712(k): new paragraph on overhead doors as an obstruction. 713(a): editorial revision for clarity. 713(b)4: new paragraph on concealed spaces. 721(b): reference to concrete beams added. 721(e): new paragraph on poured gypsum roof or floor decks. 723: new material on staggering sprinklers and installations in storage buildings and spacing under metal roof decks added. 731(c): new paragraph on poured gypsum or concrete roof and floor decks. 733: new paragraph on storage buildings added. 742: reference to staggering revised. 743: reference to staggering across joists

added. 750: split into two sections, 750 and 755, and completely revised. 762: note on metal roof decks added. 764: paragraph on storage buildings added. 766: reference to obstruction by joists added. 773: new paragraph on prefabricated metal buildings. 776 (old 775): completely revised. 777 (old 776): completely revised. 778(b): reference to vertical shafts with noncombustible sides added.

SECTION 8. DRY-PIPE SYSTEMS

822(b): deleted, but table retained. 858(b): reference to priming material other than water added. 863(a): minimum size of pipe connection from air compressor added. 865(a): editorially revised for clarity.

SECTION 10. PRE-ACTION AND DELUGE SYSTEMS

1033: new paragraph on pendent type sprinklers.

SECTION 11. COMBINED DRY-PIPE AND PRE-ACTION SYSTEMS

1116: new paragraph on pendent type sprinklers.

SECTION 12. SPRINKLER ALARMS

1241: wording on alarm sign made mandatory.

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HISTORY

This 1958 edition contains revisions recommended by the National Fire Protection Association Committee on Automatic Sprinklers and adopted by the NFPA at Annual Meeting on May 21, 1958. It supersedes the 1956 edition, the latest previous edition.

This Standard for the Installation of Sprinkler Systems was first printed under the direction of the Committee on Automatic Sprinklers in 1896. It has since been revised at frequent intervals to keep it up to date, and new material has been added from time to time. Official records of NFPA action will be found in the NFPA Proceedings from 1896 to 1956. A summary of the history of editions prior to 1953 will be found in the National Fire Codes, Vol. IV, Edition of 1951.

CONTENTS.

EDITOR'S NOTE: In this standard the word SECTION is used to designate main chapters. The word Section also is used to designate groups of paragraphs. This dual use of the same term has appeared in prior editions and is continued here to avoid the confusion involved in changing terms.

STANDARD FOR THE INSTALLATION OF SPRINKLER SYSTEMS

SECTION 1. GENERAL INFORMATION.

100. Foreword.

These standards are in general the minimum for the installation of sprinkler systems for fire protection in buildings housing one or more of the following or similar Light, Ordinary or Extra Hazard Occupancies, except where additional rules are amendatory of these standards for Extra Hazard Occupancies as covered by separate standards.

During the years 1952 and 1953 sprinklers were redesigned which resulted in greatly improved water distribution.

The redesign of the deflectors was the principal reason for the improvement. As a result of these changes water is discharged in all directions below the plane of the deflector. The spray pattern is roughly that of a half sphere completely filled with water spray. Little or no water is discharged upward to wet the ceiling.

The distribution pattern for approved standard sprinklers is more uniform than from the old type sprinklers and at a distance four feet below the deflector covers a circular area of useful intensity of water discharge of a diameter of about sixteen feet when discharging at fifteen gallons per minute. The area covered is generally independent of the type of ceiling and tends to be larger at distances over four feet and smaller at distances less than four feet.

The 1955 issue of the Standards for the Installation of Sprinkler Systems was revised principally on the basis of improved water distribution by the redesigned sprinkler which up to that time was known as the spray type.

This redesigned sprinkler shall henceforth be known as the standard sprinkler.

The former so-called conventional or regular sprinkler shall henceforth be known as the old type sprinkler.

Standard sprinklers may be used to replace old type sprinklers without system changes.

Old type sprinklers may be used to replace old type sprinklers.

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

101. Other Pamphlets.

Separately published standards referred to herein deal with fire pumps, tanks, and various other related features. A selected list of other publications related to the installation of sprinkler systems is published at the end of these standards.

102. Classification of Sprinkler Systems.

These standards cover automatic sprinkler systems of the types described below, also systems of outside sprinklers for protection against exposure fires covered specifically in SECTION 13. Manually operated deluge systems, used for certain special hazard conditions, are not specifically covered in these standards but certain provisions of these standards will be found applicable. The types of automatic sprinkler systems are:

(a) WET PIPE SYSTEM. A system employing automatic sprinklers attached to a piping system containing water and connected to a water supply so that water discharges immediately from sprinklers opened by a fire.

(b) DRY PIPE SYSTEM. A system employing automatic sprinklers attached to a piping system containing air under pressure, the release of which as from the opening of sprinklers 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.

(c) PRE-ACTION SYSTEM. A system employing automatic sprinklers attached to a piping system containing air that may or may not be under pressure, with a supplemental heat responsive system of generally more sensitive characteristics than the automatic sprinklers themselves, installed in the same areas as the sprinklers; actuation of the heat responsive 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.

(d) DELUGE SYSTEM. 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 heat responsive 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.

(e) COMBINED DRY PIPE AND PRE-ACTION SPRINKLER SYSTEM. A system employing automatic sprinklers attached to a piping system containing air under pressure with a supplemental heat responsive system of generally more sensitive characteristics than the automatic sprinklers themselves, installed in the same areas as the sprinklers; operation of the heat responsive 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 heat responsive 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 heat responsive system also serves as an automatic fire alarm system.

(f) LIMITED WATER SUPPLY SYSTEM. A system employing automatic sprinklers and conforming to these standards but supplied by a pressure tank of limited capacity.

103. Sprinkler Systems — Special Types.

Sprinkler systems employing limited water supplies, reduced pipe sizes and other departures from the requirements for standard systems contemplated by these rules shall not be classified as standard sprinkler systems. Systems of this type may include those pressurized with air or nitrogen. The authority having jurisdiction may recognize the degree of protection afforded by special types of sprinkler systems.

104. Classification of Occupancies.

(a) LIGHT HAZARD OCCUPANCIES: This class includes buildings housing occupancies such as

Apartments	Libraries
Asylums	Museums
Churches	Nursing, Convalescent
Clubs	and Care Homes
Colleges and Universities	Office Buildings
Dormitories	Prisons
Dwellings	Public Buildings
Hospitals	Rooming Houses
Hotels	Schools
Institutions	Tenements

(1) The rules for installation of sprinkler systems in Light Hazard Occupancies shall apply to all portions of the occupancies listed above or similar light hazard occupancies, except that in certain sections of the above occupancies such as attics, basements, kitchens, laundries, storage areas, and work rooms, ordinary hazard spacing with light hazard pipe sizing and water supplies shall be required. Finished rooms that may be located in attics or basements such as living quarters, bars, lounges, etc. may be treated as Light Hazard Occupancy.

(2) The rules for installation of sprinkler systems in Light Hazard Occupancies may also apply in small stores and similar occupancies incidental to the properties listed above, provided such occupancies do not individually exceed 3,000 square feet in floor area in any one store in any floor and provided floor openings are properly protected.

(3) It is important that sprinkler systems designed for Light Hazard Occupancies shall not be installed in any building, the occupancy of which is likely to be changed subsequently to a classification not so listed.

(b) ORDINARY HAZARD OCCUPANCIES: This class includes buildings housing occupancies such as

Abrasive Works
Automobile Garages, Sales & Service

Bakeries
Beverage Manufacturing
Bleacheries
Boiler Houses
Bottling Works
Breweries
Brick Tile and Clay Products

Canneries
Cement Plants
Cereal Mills
Chemical Works — Low-Hazard
Chemical Works — Ordinary Hazard
Clothing Factories
Cold Storage Warehouses
Confectionery Products Manufacturing
Cotton and Woolen Mills

Dairy Products Mfg. & Processing
Distilleries
Dry Cleaning
Dyeing and Print Works

Electric Generating Stations

Feed Mills
Flour Mills
Foundries
Fur Processing

Glass and Glass Products Factories
Grain Elevators, Tanks and Warehouses

Ice Manufacturing

Laundries
Leather Goods Manufacturing
Lithographing

Macaroni Factories
Machine Shops
Meat Packing and Curing
Mercantiles
Metal Working
Millinery Manufacturing
Mining Properties

Paper and Pulp Mills
Pharmaceutical Manufacturing
Piers and Wharves
Power Plants
Printing and Publishing

Restaurants
Rope, Cordage and Twine Factories

Shoe Factories
Slaughter Houses
Smelters
Steel Mills
Sugar Refining

Tanneries
Textile Knitting & Weaving Mills
Theatres and Auditoriums
Tire Manufacturing
Tobacco Products Manufacturing

Warehouses and Storage Buildings
General
Household Furniture
Tobacco

Watch and Jewelry Manufacturing
Waterworks and Pumping Stations
Wineries

Where hazards in those buildings or portions of buildings of the above occupancies are severe as determined by the authority having jurisdiction, extra hazard rules shall apply.

(c) EXTRA HAZARD OCCUPANCIES: This class includes only those buildings or portions of buildings housing occupancies where the hazard is severe as determined by the authority having jurisdiction. These include occupancies such as

Aircraft Hangars
Chemical Works — Extra Hazard
Cotton Picker and Opening Operations
Explosives and Pyrotechnics Manufacturing
Linoleum & Oil Cloth Manufacturing
Linseed Oil Mills
Oil Refineries
Paint Shops
Pyroxylin Plastic Manufacturing and Processing
Shade Cloth Manufacturing
Solvent Extracting
Varnish Works
and other occupancies involving processing, mixing, storage and dispensing of volatile flammable liquids

Where severe hazards are not otherwise adequately protected, the authority having jurisdiction should be consulted for special rulings regarding water supplies, types of equipment, supplementary systems if required, pipe sizes, types of sprinklers, and sprinkler spacing.

107. Preliminary Layouts.

Before an equipment is installed or remodeled, in order to avoid error or subsequent misunderstanding, preliminary layouts shall be submitted for approval to the authority having jurisdiction. Any material deviation from approved plans will require special permission. Preliminary layouts should show:

Name of owner and occupant.

Location, including street address.

Point of compass.

Construction and Occupancy of each building.

NOTE: Data on special hazards should be submitted as they may require special rulings.

Building height in feet.

If it is proposed to use a city main as a supply, sketch should show whether the main is dead-end or circulating, size of the main and pressure in pounds; and if dead-end, distance to nearest circulating main.

Distance from nearest pumping station or reservoir should also be indicated.

A test of the city main in the vicinity of building should be conducted by the contractor. The preliminary plan should specify the location of the hydrants where flow was taken and where static and residual pressure readings were recorded, the size of mains supplying these hydrants, and the result 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. (Also see section 310.)

Data covering waterworks systems in small towns would expedite the review of plans.

Fire walls, fire doors, unprotected window openings. Large unprotected floor openings, blind spaces.

Distance to and construction and occupancy of exposing buildings — *e.g.*, lumber yards, brick mercantiles, fire-resistive office buildings, etc.

Spacing of Sprinklers. Number of sprinklers in each story or fire area and total number of sprinklers. Number of sprinklers on each riser and total per floor. Total number of sprinklers on each dry pipe system or pre-action or deluge system. If extension to present equipment, number of sprinklers on riser per floor, and if dry pipe system total number of sprinklers already installed.

Capacities of dry pipe systems should be indicated, with the bulk pipe included. Such capacity may be expressed either in gallons or equivalent number of sprinklers (as 200 actual sprinklers plus 100 sprinklers bulk run equivalent.) See table 822. If an extension is made to an existing dry pipe system, indicate the total capacity of the existing and also extended portion of the system.

Weight or class and size of any proposed underground pipe.

Indicate if property is located in a flood area requiring consideration in the design of sprinkler system.

Name and address of party submitting the layout.

108. Working Plans

Before an equipment is installed or remodeled, complete working plans shall be submitted for approval to the authority having jurisdiction. Any material deviation from approved plans will require special permission.

Submission of working plans for approval before starting installation will avoid subsequent expensive changes, and give owners and contractors the benefit of the latest fire protection engineering experience.

Working plans should 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:

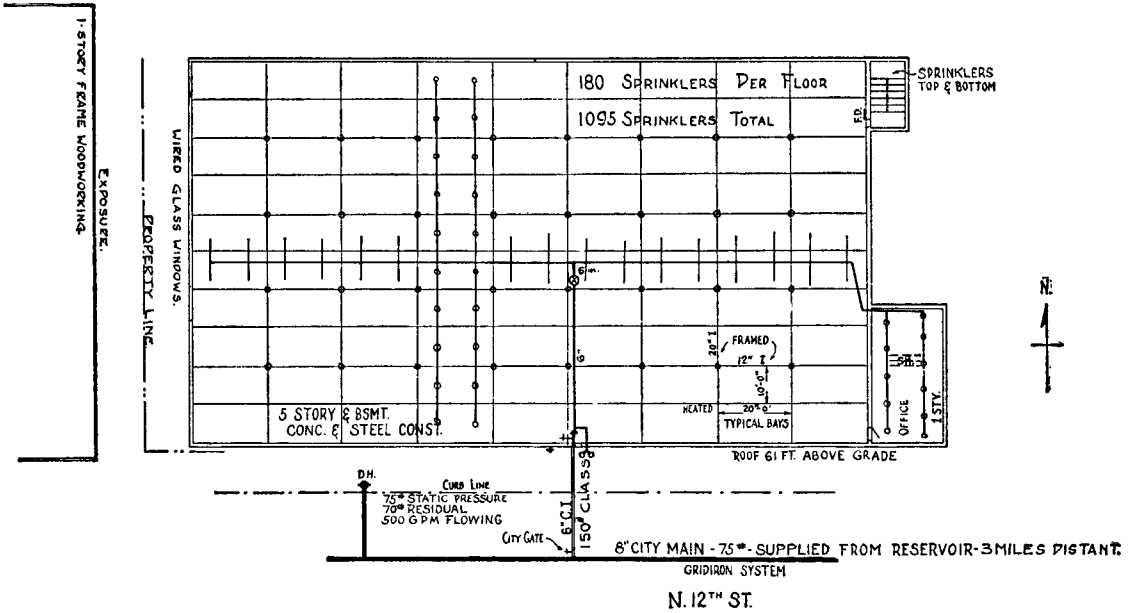


Fig. 107. Typical Preliminary Layout.

Name of owner and occupant.

Location, including street address.

Point of compass.

Ceiling construction.

Location of fire walls.

Location of partitions.

Location and size of blind spaces, closets, benches, tables, desks, etc. See section 201, and paragraphs 712, 713, 714, 715, 716, 717, 718, 719.

NOTE: Indicate on plans any questionable small enclosures in which no sprinklers are to be installed.

Size of city main in street, pressure and whether dead-end or circulating. and if dead-end, distance to circulating main; city main test results. See section 310.

Other sources of water supply, with pressure or elevation.

Make and type of sprinkler.

Number of sprinklers on each riser and total per floor.

Make, type, model and size of alarm or dry pipe valve.

Make, type, model and size of pre-action or deluge valve.

Kind and location of alarm bells.

Total number of sprinklers on each dry-pipe system or pre-action or deluge system.

Approximate capacity in gallons of each dry-pipe system.

Cutting lengths of pipe.

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

Crosses, riser nipples and size.

Type of hangers, inserts and sleeves.

All control gates, checks, drain pipes and test pipes.

Small hand hose and hose equipment.

Where plans include underground pipe the weight or class and size of pipe, the type of valves, valve pits, and the depth that the top of the pipe is to be laid below grade should be given.

Provision for flushing. See section 435.

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 should be indicated on the plans to show the total number of sprinklers to be supplied and to make all conditions clear.

Name and address of contractor.

109. Devices.

(a) The authority having jurisdiction should be consulted as to approved devices and materials.

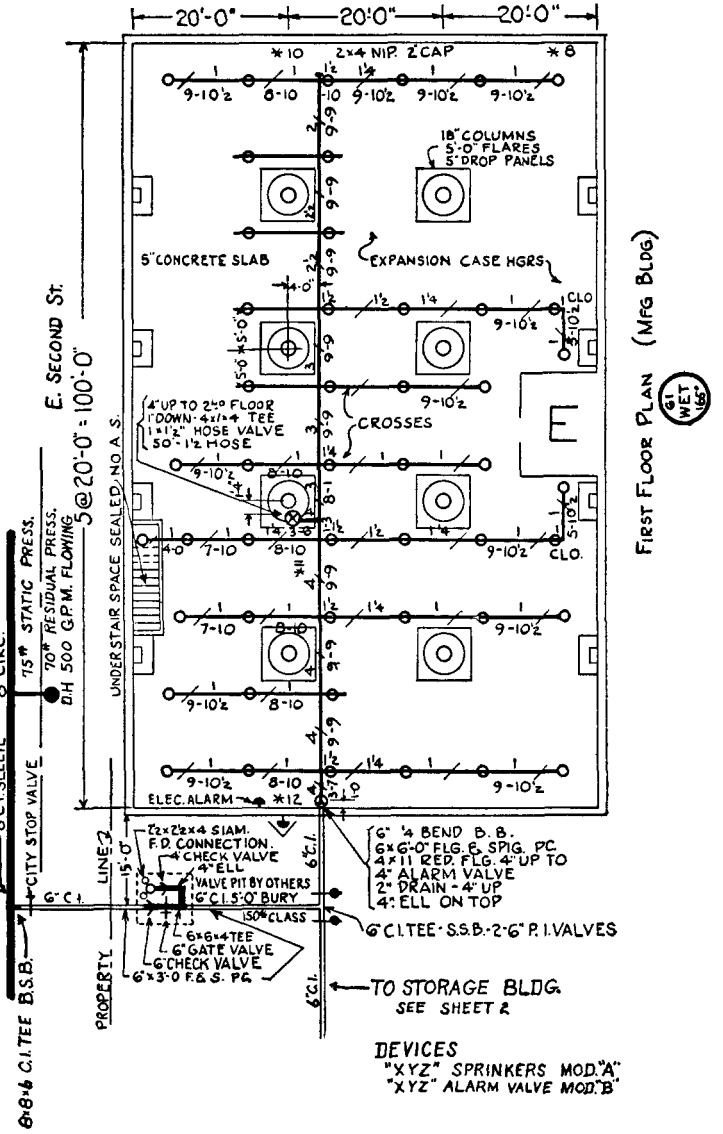
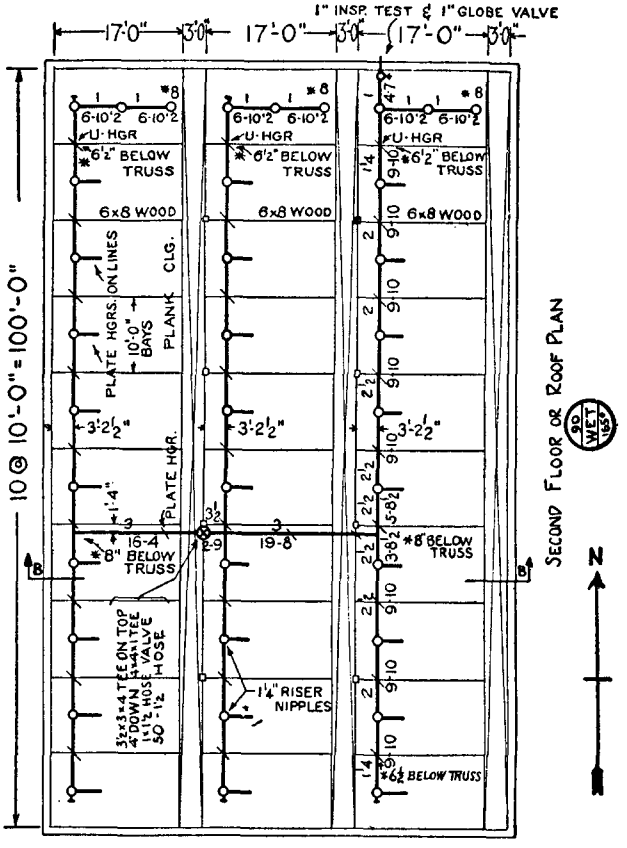
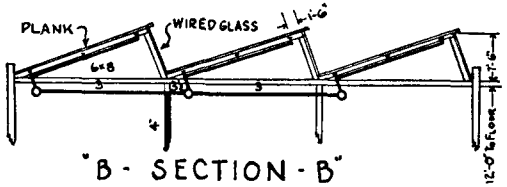


Fig. 108-1. Typical Working Plan.





"B - SECTION - B"

GENERAL NOTES -
GRADE TO HIGHEST SPRINKER-30FT.
OCCUPANCY - GLOVE MFG.
FIGURES MARKED THUS * DENOTE DISTANCE CENTER OF PIPE BELOW CEILING OR TRUSS.
DIMENSION SHOWN BENEATH PIPE IS CUTTING MEASURE.

JOHN DOE COMPANY 22-32 E. SECOND ST, SMITHVILLE, N.Y.					
SURVEYED 2-22-40	BY	T.R.P.			CONTRACT NO.
DRAWN 2-26-40	BY	C.E.N.			5550
APPROVED 2-29-40	BY	L.A.E.			
SPRINKLER DEG. 165°	212	280	360		SCALE: ○○○○ = 1 FT.
No OF SPRINKLERS 151					SHEET No 1 OF 2
"XYZ" SPRINKLER CO. NEWARK, O.					

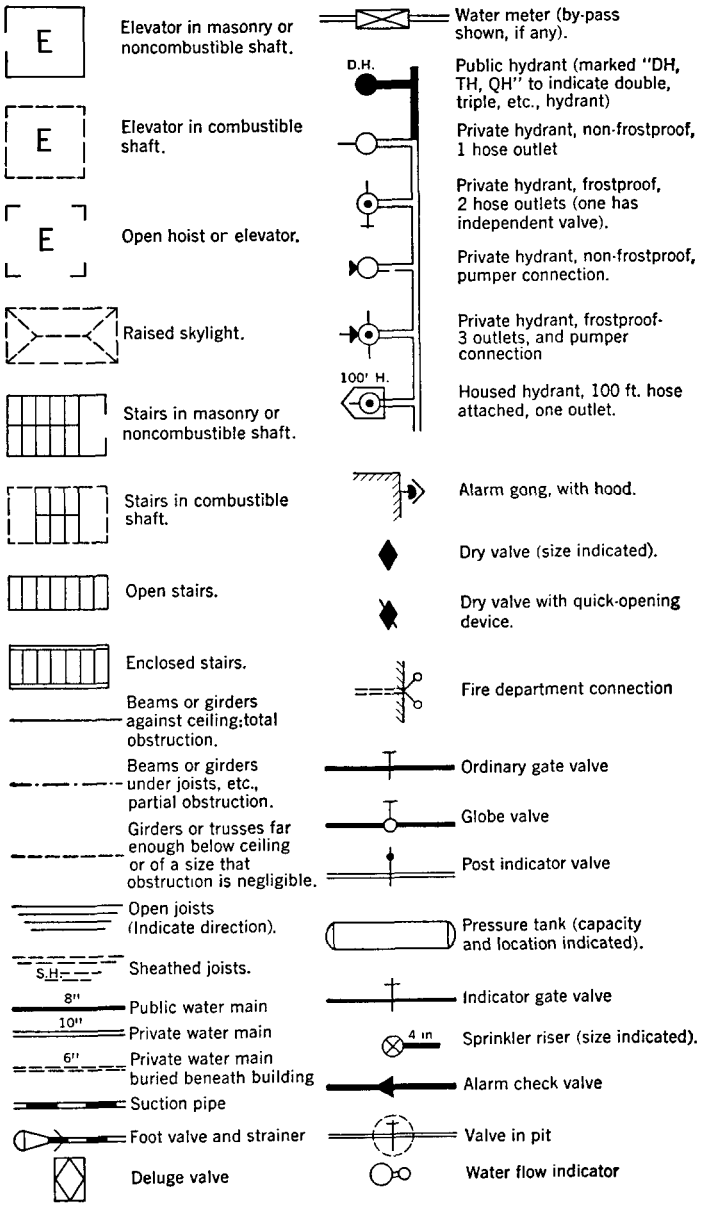


Fig. 108-2. Standard Plan Symbols.

(b) Second-hand sprinklers shall not be used. When special conditions warrant, listed devices such as alarm valves, retarding chambers, circuit closers, water motors, dry pipe valves, and quick opening devices, etc., may be reused, but if reused they should be reconditioned by the original manufacturer. On request of the authority having jurisdiction, the original manufacturer shall furnish a certificate, stating that such specified devices have been reconditioned and tested and are considered satisfactory for reuse.

(c) For the installation of fire pumps, gravity and pressure tanks, valves and other related devices, see separately published pamphlets listed at the end of this standard.

110. Design and Installation.

(a) **Sprinkler system layout and installation should be entrusted to none but fully experienced and responsible parties. Sprinkler system installation is a trade in itself. Inspectors cannot be expected to act as working superintendents or correct errors.**

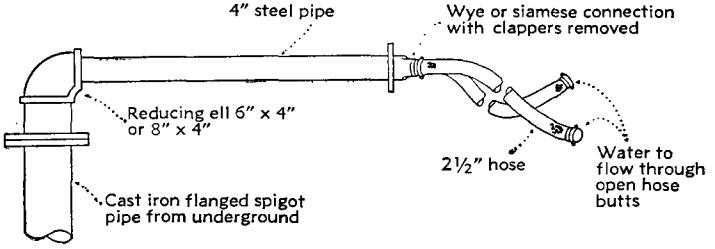
(b) Before shutting off a section of the fire service system to make sprinkler system connections, notify the authority having jurisdiction, plan the work carefully, and assemble all materials to enable completion in shortest possible time. Work started on connections should be rushed to completion without 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.

(c) When changes involve shutting off water from any considerable number of sprinklers for more than a few hours, temporary 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 familiar with conditions.

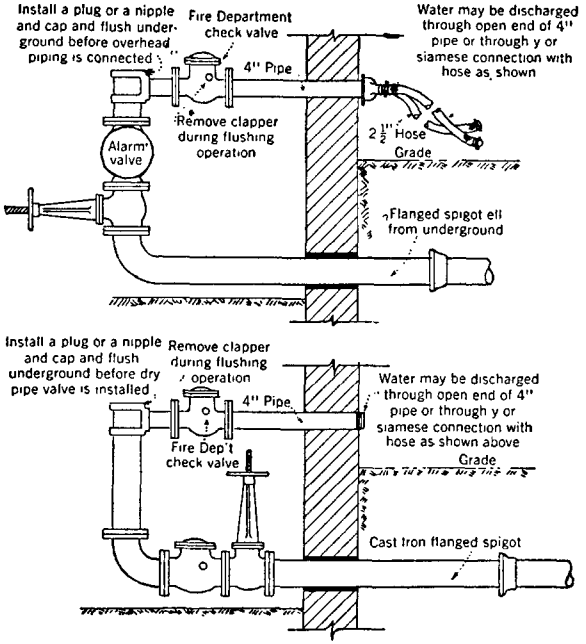
111. Sprinkler Systems in Buildings Subject to Flood.

Where sprinklers are installed in buildings subject to recurring floods, special attention shall be given (1) to the arrangement of piping and location of valves so that valves will be accessible during high water, (2) to the location of alarm devices and equip-

ment so as to keep as much of the equipment as possible operable during high water, and (3) to the location and protection of pumps and air compressors and their power supply so as to provide every reasonable safeguard against interruption.



Employing horizontal run of 4-inch pipe and reducing fitting near base of riser.



Employing fire department connections.

Fig. 112. Methods of Flushing Water Supply Connections.

112. Flushing of Underground Connections.

Underground mains to inside sprinklers shall be flushed out thoroughly before connecting the sprinkler riser. A flow sufficient to produce water velocities of 5 to 6 feet per second is needed to move the larger obstructing materials from underground piping. The following flows in gallons per minute will be needed: 6-inch pipe, 750 gallons per minute; 8-inch pipe, 1000 gallons per minute; 10-inch pipe, 1500 gallons per minute; 12-inch pipe, 2000 gallons per minute. Where the supply will not produce the stipulated flow rate, at least the maximum flow available should be obtained by employing adequate discharge means.

113. Hydrostatic Tests.

(a) 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.

The amount of leakage in underground piping should be measured at the specified test pressure by pumping from a calibrated container.

Leakage should not exceed the following:

Pipe Size	6-inch	8-inch	10-inch	12-inch	16-inch
Leakage, quarts per 10 joints per hour	2½	3¼	4	5	6½

(b) Piping between the check valve in the fire department inlet pipe and the outside connection should be tested the same as the balance of the system.

(c) Brine or other corrosive chemicals shall not be used for testing systems.

(d) To prevent the possibility of serious water damage in case of a break, pressure should be maintained by a small pump, the main controlling gate being meanwhile kept shut.

(e) In testing extensions to old systems a special type of self-indicating blank shall be used whenever a blank gasket has to be used for testing purposes. This testing blank shall have lugs painted red protruding out beyond the flange in such a way as to

clearly indicate its presence. Sprinkler installing companies shall have all blank gaskets numbered so as to keep track of their use and assure their return after the work is completed.

114. Tests of Dry Pipe Systems.

(a) New dry pipe systems shall be tested hydrostatically as specified in paragraph 113 (a), except that at seasons of the year which will not permit testing with water they shall be tested for two hours with at least 50 lbs. per sq. in. air pressure. 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 injuring the valve.

(b) 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 of over 1½ pounds for the 24 hours shall be stopped.

(c) A working test of the dry pipe valve and quick opening device, if installed, should be made before acceptance.

115. Tests of Drainage Facilities.

Tests of drainage facilities shall be made by opening the main drain valve while the control valve is wide open.

116. Conduct of Tests.

All tests should be made by contractor in presence of inspector of the authority having jurisdiction. When inspector is not available and permission is granted by the authority having jurisdiction, tests may be witnessed by owner or his representative and test certificate signed by same.

117. Approval of Sprinkler Systems.

Before asking final approval of an automatic sprinkler equipment by the authority having jurisdiction the installing company should 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.

118. Sprinkler Contractor's Certificate Covering Materials and Tests.

To .....
(Name of Approving Body)

.....
(Street Address) (City) (State)

(This form, properly executed, should be submitted to the authority having jurisdiction when requesting inspection and approval of the completed sprinkler equipment. Sprinkler contractor shall conduct all required tests in the presence of property or plant owner or representative designated by owner.)

.....
(Name of Plant or Property Owner)

Location: .....
(Street Address) (City) (State)

Name of Contractor: .....

SPRINKLER PLANS:

Submitted for acceptance? Yes..... No.....

Accepted by .....
(Organization) (Date)

SPRINKLERS:

Buildings equipped .....

No. of sprinklers (total).....Make.....

Type .....Year .....

Are high-temperature sprinklers installed near unit heaters and over hot processes? Yes..... No.....

SPRINKLER ALARMS:

What buildings are equipped? .....

Number of alarm check valves..... Flow indicators .....

Give maximum time to operate through 1-inch system test valve Min..... Sec.....

All alarms left in service? Yes..... No.....

DRY PIPE OR DELUGE VALVES:

What areas or buildings are controlled? .....

Number installed.....Make and model.....

How many quick opening devices provided? .....

Were approved trimmings provided, including gauges, auxiliary drains, alarms, etc? Yes..... No.....

Report of Test WITHOUT Quick Opening Device

Air pressure.....lbs. Water pressure.....lbs.

Dry valve tripped at.....lbs. in.....Minutes.....Seconds

Water at 1-inch system test valve.....Minutes.....Seconds

Report of Test WITH Quick Opening Device

Air pressure.....lbs. Water pressure.....lbs.

Dry valve tripped at.....lbs. in..... Minutes.....Seconds

Water at 1-inch system test valve..... Minutes.....Seconds

Deluge system supervised? Yes..... No.....

Operation: Pneumatic..... Hydraulic..... Electric.....

Has an accessible thermostat been provided in each circuit for testing: Yes..... No.....

Does deluge valve release operate from each circuit? Yes..... No.....Give maximum time..... Min.....Sec.

Does deluge valve release operate from the manual trip and/or remote control station? Yes..... No.....

Is installation of dry-pipe or deluge equipment complete? Yes..... No.....

Were system and alarms left in service? Yes..... No.....

REMARKS:.....

.....

UNDERGROUND PIPE AND FITTINGS:

Type and class pipe used.....

Type of joint .....

Are all fittings properly strapped or backed? Yes..... No.....

Have proper clearances been provided at walls and footings? Yes..... No.....

HYDRANTS:

Type and make .....

Are all hydrants properly set? Yes..... No.....

Was provision made for drainage? Yes..... No.....

All operate satisfactorily? Yes..... No.....

FLUSHING OF UNDERGROUND PIPING:

Where an outside underground piping system constitutes a part of an installation, such system shall be thoroughly flushed out under pressure at recommended flows through hydrants or blow-offs before connections are made to sprinkler risers.

Existing or new underground mains to inside sprinklers shall be flushed out thoroughly ***before connecting the sprinkler riser.*** *A flow of at least 750 gallons per minute should be established in 6-inch lines, a flow of at least 1000 gallons per minute in an 8-inch line, a flow of at least 1500 gallons per minute in a 10-inch line, and a flow of at least 2000 gallons per minute in a 12-inch line. Where the supply will not produce the stipulated flow rate, at least the maximum flow available should be obtained by employing adequate discharge means.*

Have mains for supply to new connections been thoroughly flushed in accordance with the sprinkler rules? Yes..... No.....

How was flow obtained for flushing mains? Public water, tank or reservoir..... Fire pump.....

Through what type opening? Hydrant butt.....
Open pipe..... (Size.....inches) Other.....

Have lead-ins themselves been thoroughly flushed in accordance with the sprinkler rules? Yes..... No.....

How was flow obtained for flushing lead-ins? Public water, tank or reservoir..... Fire pump.....

Through what type opening? Y-connections to flange & spigot.....
Open pipe..... (Size.....inches) Other.....

TESTS:

Has all new sprinkler piping and underground piping been hydrostatically tested? Yes..... No.....
Pressure.....lbs. for.....hrs.

Hydrostatic test should be made at not less than 200 lbs. for 2 hours or 50 lbs. above static pressure where static pressure is in excess of 150 lbs. In systems with differential dry-pipe valves the clappers should be left open during this test to prevent damage.

Underground mains should be tested before joints are covered. Care must be taken to expel all entrapped air and have the main completely full of water. The rate of leakage should be measured by pumping at the specified test pressure from a calibrated container into the section of pipe being tested.

Leakage should not exceed the following:

Pipe Size	6 in.	8 in.	10 in.	12 in.	16 in.	20 in.
Permissible leakage, qts. per 10 joints per hour	2½	3¼	4	5	6½	9½

Pipe Size	6 in.	8 in.	10 in.	12 in.	16 in.	20 in.
Number of Joints						

Total amount of leakage measured in.....Hrs. .....Gals. .....Quarts

Dry system also tested at.....lbs. air pressure.

Air pressure loss in 24 hrs. .....lbs.

Air test should be made at 40 lbs. with loss not exceeding 1½ lbs. in 24 hrs.

Pressure tank tested at.....lbs. for.....hours.

Test should be made at normal water level and air pressure with loss not exceeding ½ lb. in 24 hrs.

BLANK TESTING GASKETS:

Number used?.....All removed? Yes..... No.....

CONTROL VALVES:

Were all valves left wide open? Yes..... No.....

System complete and placed in operation.....
(Date)

INSTRUCTIONS:

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

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

The information on this form has been examined, and the inspection and tests have been witnessed by:

Signed..... Signed.....
(Name of Sprinkler Contractor) (for Property Owner)

Signed..... Date.....
(for Contractor)

120. Maintenance.

A sprinkler system installed under these standards must be properly maintained for efficient service. The owner is responsible for the condition of his sprinkler system and must use due diligence in keeping the system in good operating condition.

The installing contractor shall provide the owner with:

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

(b) Published pamphlet on Care and Maintenance of Sprinkler Systems.*

*See Appendix for information on availability of standards.

SECTION 2. PREPARATION OF BUILDING.

201. General.

(a) 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.

(b) Necessary "stops" to check draft, necessary new partitions, closets, decks, etc., should be put in place, or provided for, so that the sprinkler equipment may conform to same.

(c) Frequently additional sprinkler equipment can be avoided by cutting down the width of decks or galleries and providing proper clearances. See paragraphs 715, 716 and 717.

Slatting of decks and walkways as a substitute for automatic sprinklers thereunder is not considered good practice.

(d) Cutting holes through partitions, either solid or slatted, to allow sprinklers on one side thereof to distribute water to the other side is not effectual.

(e) Where wood cornices on masonry buildings face an exposure they should be replaced with a parapet wall, or the projecting wood work should be cut away and metal flashing extended to cover the exposed edge of planking, or suitable sprinkler protection should be provided.

202. Floors.

(a) Flooring should preferably be made tight and waterproof.

(b) Some of the more common defects, assuming that the floor itself is tight, are cracks at side walls, openings around pipes or conduits, and small unprotected openings cut through floor for various purposes. These can be made tight by flashing, metal plates, etc. Such small openings that cannot be completely stopped off may be curbed to prevent water running through.

(c) Waterproofing of floors is highly desirable, especially if goods or machinery are of considerable value and susceptible to water damage. There are various methods of making floors reasonably water tight, depending on the type of construction.

(d) Scuppers or floor drains are also desirable in many types of buildings or occupancies. It is of importance to get any water off of floors as soon as possible after fire is extinguished and scuppers will facilitate doing this.

(e) The recommendation that floors should be made tight is important; first, to prevent easy spread of fire from one floor to another, and second, to prevent water from sprinklers or hose streams from running through floors and damaging property on floors below.

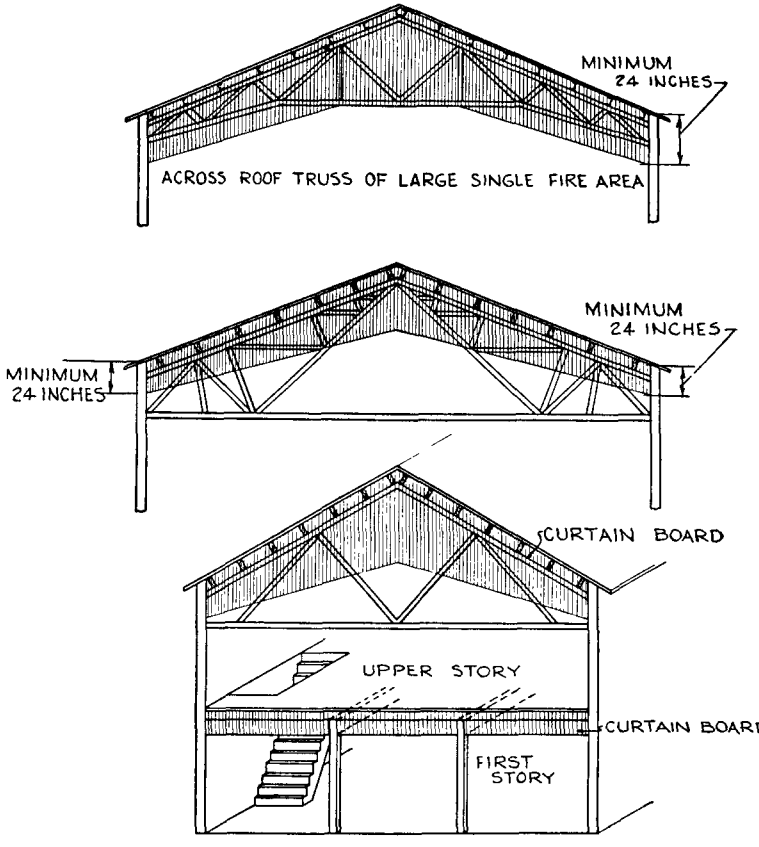


Fig. 203-1. Curtain Boards for Subdivision of Large Areas. Preferably of noncombustible material such as flat sheet or corrugated metal.

203. Vertical and Horizontal Drafts.

(a) Floor or wall openings tending to create vertical or horizontal drafts, or other structural conditions that would delay the prompt operation of automatic sprinklers by preventing the

banking up of the heated air from the fire, should be properly "stopped" in order to permit control of fire at any point by local sprinklers.

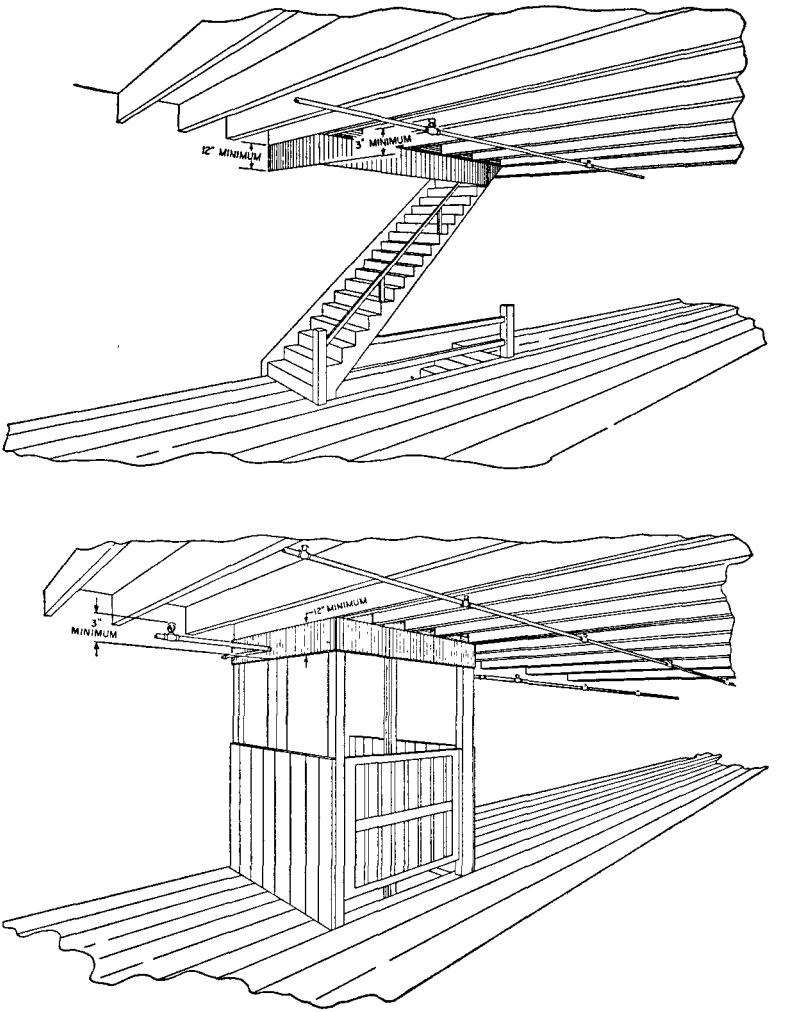


Fig. 203-2. Curtain Boards around Open Stair and Elevator Shafts. Preferably of noncombustible material such as flat sheet or corrugated metal.

Where it is impractical to do otherwise, curtain boards extending down at least 3 inches below the deflectors of adjacent automatic sprinklers but not less than 12 inches deep preferably constructed of substantial noncombustible material may be provided.

(b) Where required by the authority having jurisdiction in buildings of large single area, substantial curtains preferably of noncombustible material extending down 24 inches or more below the ceiling shall be provided to separate sprinkler systems or subdivide areas. (See Figs. 203–1 and 203–2.)

204. Separation of Sprinklered and Non-Sprinklered Areas.

Complete sprinkler protection is desirable and recommended in all cases, but where buildings or portions of buildings of combustible construction, or containing combustible contents, are not equipped with sprinklers, standard cut-offs should be provided between the sprinklered and unsprinklered buildings or areas, with all openings protected in a standard manner. (See Standards for Protection of Openings in Walls and Partitions.*)

205. Protection Against Exposure.

Exposure protection should be provided wherever conditions are such that a sprinklered building is exposed to fire from without. (See SECTION 13, Outside Sprinklers for Protection Against Exposure Fires.)

206. Clear Space Below Sprinklers.

Arrangements should be made to keep at least 18 inches clearance below sprinkler deflectors to reduce possible obstruction to the distribution of water. Increased clearance up to 36 inches should be provided over large closely-packed piles of combustible cases, bales, cartons or other closely packed combustible stock.

207. Accessory Construction.

Sprinkler equipments may require: Dry-pipe valve enclosures (see Par. 843); boxing to prevent freezing of tank risers, etc. (see Figure 460); ladders; protection of yard hydrants, sprinkler risers and post indicators against mechanical damage, etc. This work should be promptly attended to if not let with the sprinkler contract.

*See Appendix for information on availability of standards.

SECTION 3. WATER SUPPLIES AND FIRE DEPARTMENT CONNECTIONS.

301. Number and Type.

(a) Every automatic sprinkler system shall have at least one automatic water supply of adequate pressure, capacity and reliability. The necessity for a second supply will depend on various factors such as those mentioned below.

(b) The authority having jurisdiction shall be consulted in every case as to the water supplies which will be required. The water supply needed for various occupancies, including extra hazard occupancies, must be determined by a study of the conditions obtaining in each case, giving primary consideration to the number of sprinklers which may be expected to operate from any one fire plus quantities needed simultaneously for hose streams.

(c) Determination of the water supply needed for extra hazard occupancies will require special consideration of the four factors: (1) Number of sprinklers that may operate, (2) amount or rate of discharge needed from each sprinkler, (3) required time of sprinkler discharge, and (4) amount of water needed simultaneously for hose streams.

Where 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.

NOTE: Where separately published standards on various subjects contain specific provisions for water supplies, these should be consulted (See Appendix).

302. Guide to Water Supply Requirements for Sprinkler Systems.

The following guide Table 302 is given as a general guide to determine the volume of water and pressure normally required, subject to approval of the authority having jurisdiction. THE TABLE IS TO BE USED ONLY WITH EXPERIENCED JUDGMENT, and the requirements for hose streams are to be added to the quantities given.

TABLE 302.
GUIDE TO WATER SUPPLY REQUIREMENTS FOR SPRINKLER SYSTEMS

Occupancy Classification	*Minimum Residual Pressure Required Under the Roof (See Note 1)*	*Minimum Acceptable Flow at Base of Riser (See Note 2)*
LIGHT HAZARD	15 psi	500–750 gpm (See Note 3)
ORDINARY HAZARD (GROUP 1)	15 psi or higher	500–1000 gpm
ORDINARY HAZARD (GROUP 2)	15 psi or higher	500–1500 gpm
ORDINARY HAZARD (GROUP 3)	Pressure and flow requirements for sprinklers and hose streams to be determined by authority having jurisdiction.	
WOODWORKERS	Pressure and flow requirements for sprinklers and hose streams to be determined by authority having jurisdiction.	
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) shall be the residual pressure required under the roof plus the pressure required to reach this elevation.

2. The lower figure is the minimum flow ordinarily acceptable for recognition as a supply to a sprinkler system. The higher flow should normally suffice for all cases under each group unless adverse conditions are present.

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

303. Important Factors to Consider in Applying the Guide to Water Supply Requirements for Sprinkler Systems and Determination of Occupancy Classification.

(a) 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) areas shielded from proper distribution of water, (4) height of stock piles, (5) type of ceiling construction, (6) ceiling heights, (7) unprotected vertical openings, (8) undesirable draft conditions and (9) size of undivided areas.

(b) Where unfavorable features are prominently present, the water supply requirements should be increased.

(c) In these tables the occupancy referred to is the occupancy of the individual building being protected.

(d) LIGHT HAZARD: In guide Table 302, the Light Hazard class should include those properties where the amount and combustibility of the contents is low, and there is no obstruction to sprinkler distribution. This class excludes mercantiles, warehouse and manufacturing occupancies and includes only occupancies such as:

Apartments
Asylums
Churches
Clubs
Colleges and Universities
Dormitories
Dwellings
Hospitals
Hotels
Institutions
Libraries
Museums
Nursing, Convalescent and Care Homes
Office Buildings
Prisons
Public Buildings
Rooming Houses
Schools
Tenements

(e) ORDINARY HAZARD (GROUP 1). This group of the ordinary hazard class includes those properties where combustibility is low, with no flammable liquids or other quick burning materials, stock piles do not exceed 6 to 8 feet and other factors are favorable. Following are some examples of types of properties generally falling into this group:

Abrasive Works
Automobile Garages
Bakeries
Beverage Manufacturing
Bleacheries
Boiler Houses
Bottling Works
Breweries
Brick, Tile and Clay Products
Canneries
Cement Plants
Dairy Products Mfg. and Processing
Electric Generating Stations
Foundries
Fur Processing
Glass and Glass Products Factories
Ice Manufacturing
Laundries
Macaroni Factories
Millinery Manufacturing Plants
Restaurants
Slaughter Houses
Smelters
Steel Mills
Theatres and Auditoriums
Watch and Jewelry Manufacturing
Waterworks Pumping Stations
Wineries

(f) ORDINARY HAZARD (GROUP 2): This group of the ordinary hazard class includes those properties where combustibility of contents and ceiling heights are generally less favorable than those listed in Group No. 1, but there are only minor amounts of flammable liquids and essentially no obstruction. Examples of types of properties generally falling into this group are:

Cereal Mills
Chemical Works—Ordinary
Clothing Factories
*Cold Storage Warehouses
Confectionery Products Mfg.
Cotton and Woolen Mills
**Distilleries
Dye and Print Works
Grain Elevators, Tanks and Warehouses
*Leather Goods Manufacturing
*Lithographing
*Machine Shops
*Mercantiles
*Metal Working
Pharmaceutical Manufacturing
Printing and Publishing
Rope, Cordage and Twine Factories
Shoe Factories
Storage Buildings (having low factors of combustibility and obstruction)
Sugar Refining
Tanneries
Textile Knitting and Weaving Mills
Tobacco Products Manufacturing

(g) ORDINARY HAZARD (GROUP 3): This group of the ordinary hazard class includes those properties where features of combustibility of contents, ceiling heights and obstruction are unfavorable, separately or jointly. Following are some examples of the type of property falling into this group:

*Feed Mills
*Flour Mills
Paper and Pulp Mills
Paper Process Plants
Piers and Wharves
**Tire Manufacturing and Storage Warehouses (Paper, household furniture, paint, department store, etc.)
**Whisky Warehouses

(h) EXTRA HAZARD OCCUPANCIES: This class includes only those buildings or portions of buildings housing occupancies where the hazard is severe as determined by the authority having jurisdiction. These occupancies include such as:

**Aircraft Hangars
Chemical Works — Extra Hazard
Cotton Picker and Opening Operations
Explosives and Pyrotechnic Manufacturing
Linoleum and Oil Cloth Manufacturing
Linseed Oil Mills
Oil Refineries
**Pyroxylin Plastic Mfg. and Processing
Shade Cloth Manufacturing
Solvent Extracting
Varnish Works

and other occupancies involving processing, mixing, storage and dispensing of volatile flammable liquids.

(i) Where severe hazards are not otherwise adequately protected, the authority having jurisdiction should be consulted for special rulings regarding water supplies, type of equipment, supplementary systems if required, pipe sizes, types of sprinklers and sprinkler spacing.

*Under conditions favorable to the individual property, and with special permission of the authority having jurisdiction, this class may, in some cases, qualify under the immediately preceding group.

**See Appendix for listing of separately published standards relating to water supply requirements for this class.

310. Connections to Water Works Systems.

311. A connection from a reliable water works system, of adequate capacity and pressure, is preferable as a single or a primary supply.

312. Connections should be made to street mains of ample size. Street mains preferably should be not smaller than 6 inches. Connections to dead end mains should be avoided.

313. Pressure regulating valves should not be used except by special permission of the authority having jurisdiction.

314. Where meters are used they shall be of approved type.

315. To determine the value of public water as a supply for automatic sprinkler systems, it is generally necessary to make a flow test to develop how much water can be discharged at a residual pressure at grade sufficient to give the required residual pressure under the roof (with the volume flow hydraulically translated to the base of the riser) — *i.e.*, a pressure head represented by the height of the building plus the required residual pressure.

The proper method of making such test is to use two hydrants in the vicinity of the property. The static pressure should be measured on the hydrant in front of or nearest to the property and the water allowed to flow from the hydrant next nearest the property; preferably the one farthest from the source of supply if main is fed only one way. The residual pressure will be that indicated at the hydrant where water is not flowing.

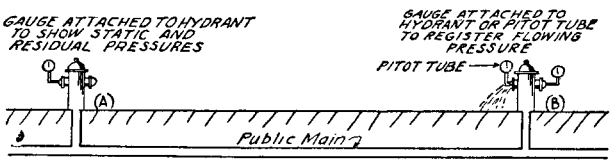


Fig. 315. Method of Conducting Flow Tests.

Referring to Fig. 315, the method of conducting the flow tests is as follows:

(1) Attach gauge to hydrant (A) and obtain static pressure.

(2) Either attach second gauge to hydrant (B) or use pitot tube at outlet. Have hydrant (B) opened wide and read pressure at both hydrants.

(3) Use the pressure at (B) to compute the gallons flowing and read the gauge on (A) to determine the residual pressure or that which will be available on the top line of sprinklers in the property.

Water pressure in pounds for a given height in feet equals height x 0.434.

In making flow tests, whether from hydrants or from nozzles attached to hose, always measure the size of the orifice. While hydrant outlets are usually 2½ in. they are sometimes smaller and occasionally larger. The Underwriters' play pipe is 1⅛ in. and 1¾ in. with tip removed, but occasionally nozzles will be 1 in. or 1¼ in. and with the tip removed the opening may be only 1½ in.

The pitot tube should be held approximately one-half the diameter of the hydrant or nozzle opening away from the opening. It should be held in the center of the stream, except that in using hydrant outlets the stream should be explored to get the average pressure.

316. In addition to flow tests, consideration should also be given to reliability of public water supply taking into account probable minimum pressure condition prevailing during such periods as at night, or during summer months when heavy draught may occur, also possibility of interruption by floods, or ice conditions in winter.

317. Where connections are made from water mains, subject to severe water hammer (especially where pressure is in excess of 100 pounds), it may be desirable to provide either a relief valve, properly connected to a drain, or an air chamber in the connection. If an air chamber is used it should be located close to where the pipe comes through wall and on the supply side of all other valves and so located as to take the full force of water hammer. Air chambers shall have a capacity of not less than 4 cubic feet, shall be controlled by an O. S. & Y. gate valve, and shall be provided with a drain at the bottom, also an air vent with control valve and plug to permit inspection.

320. Pumps.

321. A fire pump installation consisting of pump, driver and suction supply, when of adequate capacity and reliability, and properly located, makes a good secondary supply. An automatically controlled fire pump taking water from a water main of adequate volume, or taking draft under a head from a reliable storage of adequate capacity, may under certain conditions be accepted by the authority having jurisdiction as a single supply.

322. Where a centrifugal pump constitutes the sole sprinkler supply, it should be provided with supervisory service from an approved central station system or from an approved proprietary system or their substantial equivalent, which shall provide means for positive indication at the central office that the pump has operated normally. The above to be in addition to the supervision of power supply and other features that may be required by the authority having jurisdiction. These pumps should be operated at least monthly by the supervisory service representative, and at more frequent intervals where the authority having jurisdiction so requires.

NOTE: See sections dealing with sprinkler equipment supervisory and water flow alarm services in the Standards for Central Station Protective Signaling Systems or in the Standards for Proprietary, Auxiliary, Remote Station and Local Protective Signaling Systems.* See also separately published standards on Installation and Operation of Centrifugal Fire Pumps (No. 20)', and on Outside Protection (No. 24)*.

330. Gravity Tanks.

331. An elevated tank of adequate capacity and elevation makes a good primary supply, and may be acceptable as a single supply.

NOTE: See separately published Standards on Water Tanks for Private Fire Protection Service (No. 22).*

332. The size of the gravity tank should be at least large enough to supply the quantity of water required by guide Table 302 for a period of 60 minutes for Light Hazard Occupancy, and 60 to 100 minutes for Ordinary Hazard Occupancy. The elevation of the tank and arrangement of underground supply piping should be sufficient so that the required delivery rate will be available at the base of the sprinkler riser at sufficient pressure to furnish the required residual pressure under the roof. Where fire department response is such as to ensure use of the fire department connection, or in the case of buildings of limited area, the size of the tank may be reduced by special permission of the authority having jurisdiction. Where a tank serves only as a secondary supply, capacity and elevation may be reduced by permission of the authority having jurisdiction.

340. Pressure Tanks.

341. A pressure tank of adequate size makes a good primary supply when used in conjunction with an adequate secondary supply. A pressure tank supply may be acceptable in some cases as a single supply.

*See Appendix for information on availability of standards.

Where a pressure tank constitutes the sole supply for sprinklers, the tank should be provided with an approved means for automatically maintaining the required air pressure on the tank. Also, there shall be provided an approved trouble alarm to indicate low air pressure and low water level, with the trouble alarm supplied from an electrical branch circuit independent of the air compressor.

342. The size of the pressure tank required shall be determined by the authority having jurisdiction, considering all features involved, including extra capacity needed to fill dry pipe systems. Minimum requirements shall be as follows:

(a) LIGHT HAZARD OCCUPANCY. Amount of available water, not less than 2,000 gallons.

(b) 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.

(c) EXTRA HAZARD AND WOODWORKER OCCUPANCIES. Refer to authority having jurisdiction.

343. Pressure tanks should preferably be located above the top level of sprinklers, but may be located in the basement or elsewhere subject to the approval of the authority having jurisdiction.

344. (a) 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 gauge shall be maintained. When the bottom of the tank is located below the highest sprinklers served, the air pressure by the gauge 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.

(b) 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

$$P = \frac{30}{A} - 15 + \frac{0.434H}{A}$$

$A = \frac{1}{3}$ then $P = 75 + 1.30H$.
$A = \frac{1}{2}$ then $P = 45 + 0.87H$.
$A = \frac{2}{3}$ then $P = 30 + 0.65H$.

(c) 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.

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

NOTE: See separately published Standards on Water Tanks for Private Fire Protection Service (No. 22).*

350. Penstocks, Flumes, etc.

351. Water supply connections from penstocks, flumes, rivers or lakes should be arranged to avoid mud and sediment, and should be provided with approved double removable screens or approved strainers installed in an approved manner.

360. Water Supply Connections.

361. Piping from water supply to sprinkler riser should be at least as large as the riser. See Par. 413 (c).

362. 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 in. in size.

363. (a) The connection between the system steel piping and underground piping preferably should be made with a properly strapped cast iron flanged piece.

(b) Where riser is close to outside wall underground fittings of proper design and type should be used in order to avoid pipe joints being located in or under the wall. (See separately published Standards on Outside Protection, No. 24.)*

*See Appendix for information on availability of standards.

364. Connections for domestic use should not be taken from the fire protection piping; if permitted, such connections should be made on the supply side of the city check valve in the city connection near the point of entrance to the property. See section 490.

365. (a) All main water supplies should be connected with the sprinkler system at the base of riser, except that where a gravity or pressure tank or both, constitute the only automatic source of water supply, special permission may be given to connect the tank or tanks with the sprinkler system at the top of the riser.

(b) Where a gravity tank and a pressure tank are connected to a common riser approved means shall be provided to prevent residual air pressure in the pressure tank (after water has been drained from it) from holding the gravity tank check valve closed, a condition known as air lock.

Under normal conditions, air lock may be conveniently prevented in new equipment by connecting the gravity tank and pressure tank discharge pipes together 45 feet or more below the bottom of the gravity tank and placing the gravity tank check valve at the level of this connection.

370. Water Supply Test Pipes.

371. Suitable test pipes, which may also be used as drain pipes, shall be provided at such locations as will permit flowing tests to be made to ascertain whether water supplies and connections are in order. Such test pipes should be not less than 2 inches in size, and equipped with a shut-off valve. They shall be so installed that the valve may be opened wide for a sufficient time to assure a proper test without causing any water damage. The authority having jurisdiction shall be consulted as to the location and arrangement of test pipes. (See paragraphs 442 and 444.)

372. At or near each such test pipe a pressure gauge shall be installed with a connection not smaller than ¼ inch made to the main pipe. This gauge connection shall be equipped with a shut-off valve and with provision for draining. A plugged outlet ¼ inch in size should be located between each valve and gauge, for the purpose of installing the inspector's gauge.

373. GAUGES. The required pressure gauges 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 so installed as to permit of easy removal, and shall be located where they will not be subject to freezing.

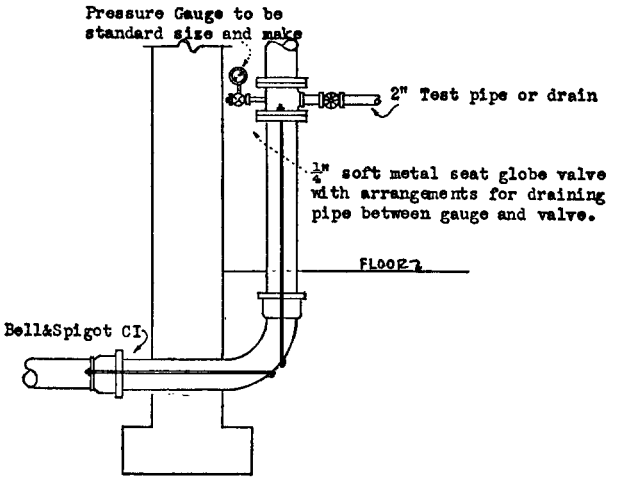


Fig. 371-1. Test Pipe on Water Supply with Outside Control. Also applicable to an interior riser.

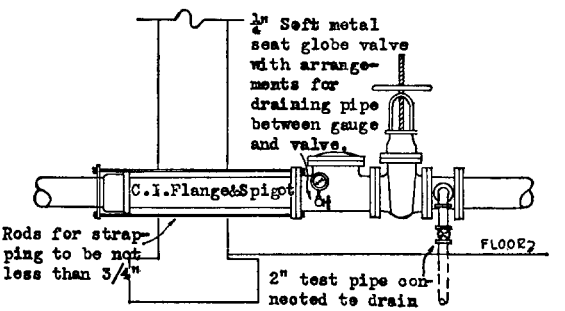


Fig. 371-2. Water Supply Connection with Test Pipe.
Located on the system side of the gate valve, one test pipe may serve for more than one city connection. It will also indicate the condition of the gate valve. Located on the supply side of the check valve, it will serve to test out check valve by closing the waterworks gate or other outside valve.

380. Fire Department Connections.

381. A connection through which a fire department can pump water into the sprinkler system makes a desirable auxiliary supply. For this purpose, one or more fire department connections shall be provided in all cases except where permission of the authority having jurisdiction is obtained for their omission.

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

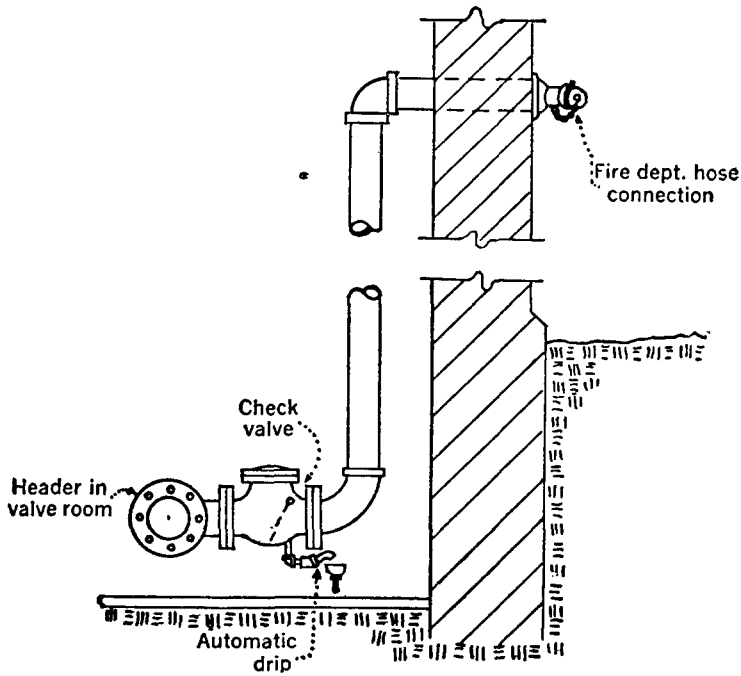


Fig. 380. Fire Department Connection.

383. ARRANGEMENT.

(a) On wet pipe systems with a single riser the connection to the system shall be made on the system side of gate, check and alarm valves in the riser.

(b) On dry pipe systems with a single riser the connection to the system shall be made between the gate valve and the dry pipe valve.

(c) On systems with two or more risers the connection to the system shall be made on the system side of all shut-off valves controlling other water supplies, but on the supply side of the riser shut-off valves so that with any one riser off the connection will feed the remaining sprinklers.

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

385. There shall be no shut-off valve in the fire department connection.

386. Fire department connections shall be properly supported.

387. DRAINAGE. The piping between the check valve and the outside hose coupling shall be equipped with an approved automatic drip arranged to discharge to a proper place.

388. HOSE CONNECTIONS.

(a) Hose connections shall be of approved type conforming to the Standards for Fire Department Hose Connections.*

(b) 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.

(c) Hose connections shall be equipped with standard caps, properly secured and arranged for easy removal by fire departments.

(d) Hose connections should be on street side of building and shall be so located as to permit prompt and easy attachment of the hose.

(e) Hose connections 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. — "AUTO-SPKR." or "OPEN SPKR."

*See Appendix for information on availability of standards.

SECTION 4. PIPING.

400. Piping Specifications.

401. Pipe used in sprinkler systems should be designed to withstand a working pressure of not less than 175 lbs. in accordance with American Standard B 36.10–1950 Wrought Steel and Wrought Iron Pipe* and any subsequent revisions thereof. These standards permit the use of "standard weight" wrought iron or mild steel pipe for water pressures up to 300 lbs.

402. Where conditions are such as to suggest the need of pipe of a type other than that which would ordinarily be used, the authority having jurisdiction shall be consulted.

403. The galvanizing of galvanized pipe shall be in accordance with Specification A 120 of the American Society for Testing Materials* and any subsequent revisions thereof.

410. Pipe Schedules.

411. (a) The vertical pipes supplying the sprinkler system are designated RISERS.

(b) Bulk mains supplying risers or cross mains are designated FEED MAINS.

(c) Pipe directly supplying the lines in which the sprinklers are placed are designated CROSS MAINS.

(d) Lines of pipe in which the sprinklers are directly placed are designated BRANCH LINES.

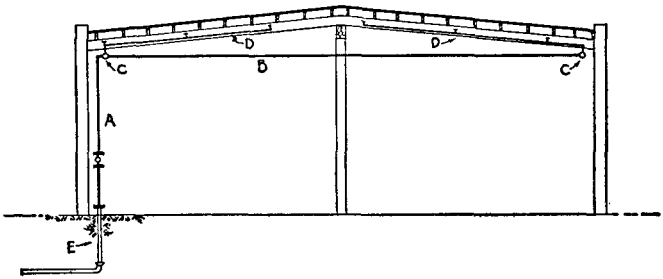


Fig. 411. Building Elevation Showing Parts of Sprinkler Piping System. A — Riser; B — Feed Main; C — Cross Main; D — Branch Line; E — Underground Supply.

412. (a) The number of automatic sprinklers on a given size pipe on one floor of one fire section should not exceed the number given in the following schedules for a given occupancy.

*See Appendix for information on availability of standards.

(b) In buildings having mezzanine floors, large platforms, or large openings between floors which cannot be closed or satisfactorily cut off, the possibility that all or most of the sprinklers might be opened by a single fire should be considered in determining the size of risers. Where occupancy and construction are exceptionally good, and where there is little likelihood of a fire spreading beyond the vicinity of its origin, the size of the feed main should be based on the total number of sprinklers in the main area plus half the number in the area not cut off.

(c) Buildings having slatted floors, or large unprotected floor openings without approved stops, should be treated as one room with reference to the pipe sizes, and the feed main or risers should be of the size required for the total number of sprinklers.

413. SCHEDULE FOR LIGHT HAZARD OCCUPANCIES.

(a) Branch lines should not exceed eight sprinklers on either side of a cross main. Pipe sizes should be as follows:

1 in. pipe.....	2 sprinklers	2½ in. pipe.....	30 sprinklers
1¼ in. pipe.....	3 sprinklers	3 in. pipe.....	60 sprinklers
1½ in. pipe.....	5 sprinklers	3½ in. pipe.....	100 sprinklers
2 in. pipe.....	10 sprinklers	4 in. pipe	No Limit — See Note

NOTE: Each large area requiring more than 100 sprinklers and without subdividing partitions should be supplied by feed mains or risers sized for ordinary hazard occupancies.

(b) Where sprinklers are installed in a space above a ceiling and such sprinklers are supplied from the same piping which supplies sprinklers under the ceiling, pipe sizes up to and including 2½ in. should be as follows:

1 in. pipe.....	2 sprinklers	2 in. pipe.....	15 sprinklers
1¼ in. pipe.....	4 sprinklers	2½ in. pipe.....	50 sprinklers
1½ in. pipe.....	7 sprinklers		

Where the total number of sprinklers above and below the ceiling exceeds 50 the pipe supplying more than 50 sprinklers shall be sized by the pipe schedule of 413 (a) for the number of sprinklers above or below the ceiling whichever is larger.

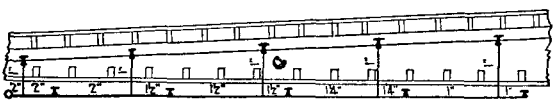


Fig. 413(b)-1. Arrangement of Branch Lines Supplying Sprinklers Above and Below a Ceiling.

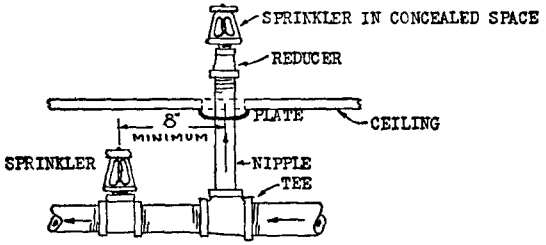
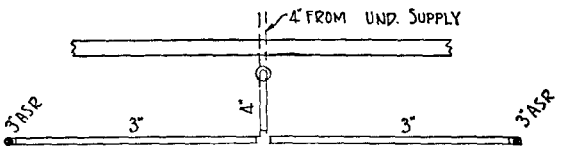
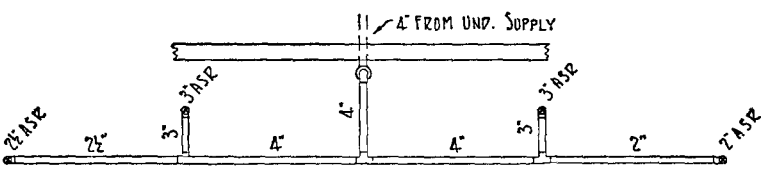


Fig. 413(b)-2. Sprinkler on Riser Nipple from Branch Line in Lower Fire Area.

(c) Connections to such systems from underground mains shall be not less than 4 inches in size.



Two 3-inch risers.



Five Risers.
Supply to last riser may be same size as riser.
Fig. 413(c). Extension of Supply to Risers in Light Hazard Occupancies.

414. Schedule for Ordinary Hazard Occupancies.

(a) Branch lines should not exceed eight sprinklers on either side of a cross main. Pipe sizes should be as follows, except as modified by 414 (b) pipe schedule.

1 in. pipe.....	2 sprinklers	3½ in. pipe.....	65 sprinklers
1¼ in. pipe.....	3 sprinklers	4 in. pipe.....	100 sprinklers
1½ in. pipe.....	5 sprinklers	5 in. pipe.....	160 sprinklers
2 in. pipe.....	10 sprinklers	6 in. pipe.....	275 sprinklers
2½ in. pipe.....	20 sprinklers	8 in. pipe.....	400 sprinklers
3 in. pipe.....	40 sprinklers		

(b) Where the distance between sprinklers on branch lines exceeds 12 ft. or the distance between branch lines exceeds 12 ft., the number of sprinklers should be as follows for given sizes of pipe.

2½ in. pipe.....	15 sprinklers
3 in. pipe.....	30 sprinklers
3½ in. pipe.....	60 sprinklers

(c) Where sprinklers are installed in a space above a ceiling and such sprinklers are supplied from the same piping which supplies sprinklers under the ceiling, pipe sizes up to and including 3 inch should be as follows:

1 in. pipe.....	2 sprinklers	2 in. pipe.....	15 sprinklers
1¼ in. pipe.....	4 sprinklers	2½ in. pipe.....	30 sprinklers
1½ in. pipe.....	7 sprinklers	3 in. pipe.....	60 sprinklers

Where the total number of sprinklers above and below the ceiling exceeds 60 the pipe supplying more than 60 sprinklers shall be sized by the pipe schedule of 414 (a) for the number of sprinklers above or below the ceiling whichever is larger.

415. SCHEDULE FOR EXTRA HAZARD OCCUPANCIES.

Branch lines should not exceed six sprinklers on either side of a cross main.

The following pipe schedule is given only as a guide for installations having no unusual features:

1 in. pipe.....	1 sprinkler	3 in. pipe.....	27 sprinklers
1¼ in. pipe.....	2 sprinklers	3½ in. pipe.....	40 sprinklers
1½ in. pipe.....	5 sprinklers	4 in. pipe.....	55 sprinklers
2 in. pipe.....	8 sprinklers	5 in. pipe.....	90 sprinklers
2½ in. pipe.....	15 sprinklers	6 in. pipe.....	150 sprinklers

For open sprinkler and deluge systems pipe schedule see paragraph 1043 (a).

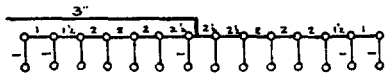
For unusually severe conditions of occupancy or area, the above pipe schedule is inadequate and it is recommended that pipe sizing be figured hydraulically on the basis of certain factors, namely:

(a) Area over which sprinklers may be expected to operate from a fire in any area or section.

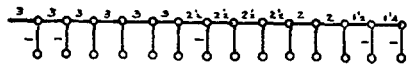
(b) Water application rate (density gal. per. min. per sq. ft.) for sprinklers expected to operate.

(c) Water supply pressure available.

Friction loss in steel pipe should be calculated using Hazen and Williams coefficient C=120 and obstruction losses due to change of direction of water through fittings shall be figured in terms of equivalent feet of pipe.



Preferable Arrangement.



Acceptable Arrangement.

Fig. 417(a). Arrangement of Two-Sprinkler Branch Lines.

417. SPECIAL CONDITIONS.

(a) Where cross mains supply more than ten branch lines of only two sprinklers each, they should usually be centrally supplied, as the conditions approach those of long single branch lines. Branch lines up to fourteen in number may be fed from one end, provided that 2½-inch pipe does not supply more than sixteen sprinklers.

(b) Not more than 14 branch lines should be allowed on either side of the riser or feed main.

(c) Where more than 8 sprinklers on a branch line are necessary, lines may be increased to 9 sprinklers by making the two end lengths 1-inch and 1¼-inch respectively and the sizes thereafter standard.

418. Where 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.

419. Where piping on wet systems is concealed, with sprinklers installed in pendent position below a ceiling, U-bends will be required when the water supply to the sprinkler system is from a raw water source, millpond, or from open top reservoirs. U-bends should be connected to the tops of branch lines in order to avoid accumulation of sediment in the drop nipples. In new systems the U-bend pipe and fittings should be 1 inch in

size. In revamping existing systems, where it is not necessary to retain sprinklers in the concealed space, ½-inch close nipples inserted in the existing sprinkler fittings may be used with 1-inch pipe and fittings for the other portions of the U-bend. Where water supply is potable, U-bends will not be required.

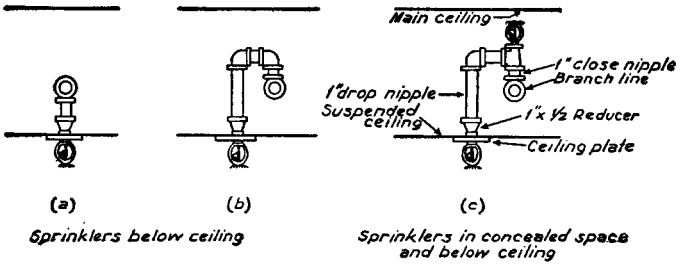


Fig. 419. Pendent Sprinklers at Suspended Ceiling.

420. Size and Location of Risers.

421. Each system riser should be of sufficient size to supply all the sprinklers on the riser on any one floor of one fire section as determined by the standard schedules of pipe sizes. There should be one or more risers in each building and in each section of the building divided by fire walls. Where the conditions warrant, the sprinklers in an adjoining building or section cut off by fire walls may be fed from a system riser in another fire section or building.

422. "Center central" or "side central" feed to sprinklers is recommended. The former is preferred especially where there are over six sprinklers on a branch line.

423. Stairs, towers or other such construction with incomplete floors, if piped on independent risers, should be treated as one area with reference to pipe sizes, *i.e.*, feed main should be of sufficient size to accommodate the total number of sprinklers.

430. Piping in Concrete.

431. Where piping is installed in cinder concrete it shall be placed in properly constructed ducts or thoroughly encased in Portland cement or its equivalent. In no case shall the piping system be installed so as to form a part of the floor arch reinforcement.

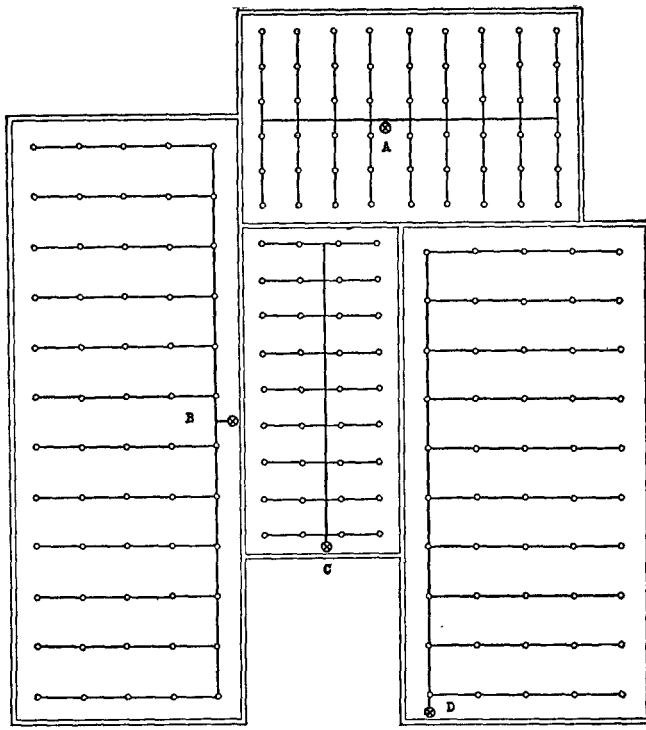


Fig. 422. Location of Risers.

A — Center Central Feed
B — Side Central Feed
C — Central End Feed
D — Side End Feed

Risers should not be located close to windows. They should be properly protected from mechanical injury or possible freezing.

432. Dry Pipe Underground. When necessary to place pipe which will be under air pressure underground, the pipe should be steel or wrought iron and protected against corrosion, (see Section 470), or it may be gasketed joint cast-iron pipe.

435. Provision for Flushing System.

Provisions should be made to facilitate flushing of system piping by providing flushing connections consisting of a capped nipple 4 inches long on the end of cross mains. All cross mains

shall terminate in 1¼ inch or larger pipe. The nipples should be the same diameter as the end pipe but not larger than 2 inches.

NOTE: Flushing connections will ordinarily not be required for concealed piping systems, but will be required on deluge systems.

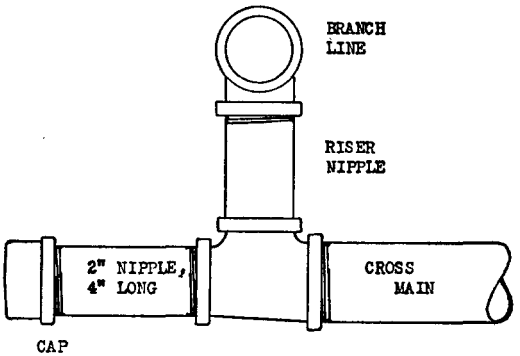


Fig. 435. Flushing Connection.

440. Drainage.

441. PITCHING OF PIPING FOR DRAINAGE.

(a) All sprinkler pipe and fittings shall be so installed that the system may be thoroughly drained. Where practicable, all piping should be arranged to drain to the main drain valve.

(b) Pipe shall be straightened before installation to prevent pockets which would interfere with proper drainage.

(c) On wet pipe systems sprinkler pipes shall be pitched not less than ¼ inch in 10 feet.

(d) 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 should 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.

(e) Where settling may occur and deprive a dry pipe system of its drainage, ends of lines should not be raised to violate section 790. The drainage should be restored by shortening the vertical piping.

442. SYSTEM OR MAIN DRAIN CONNECTIONS AND DRAIN VALVES.

(a) Provisions shall be made to properly drain all parts of the system.

(b) On all risers 4 inches or larger, 2 in. drain pipes and valves shall be provided.

(c) On risers 2½ inches to 3½ inches, drain pipes and valves not smaller than 1¼ inch shall be provided.

(d) On smaller risers, drain pipe and valves not smaller than ¾ inch shall be provided.

(e) All sectional control valves shall have a drain valve of suitable size so located as to drain that portion of the system controlled by the cut-off valve.

(f) The test valves required by paragraph 371 may be used as the main drain valves.

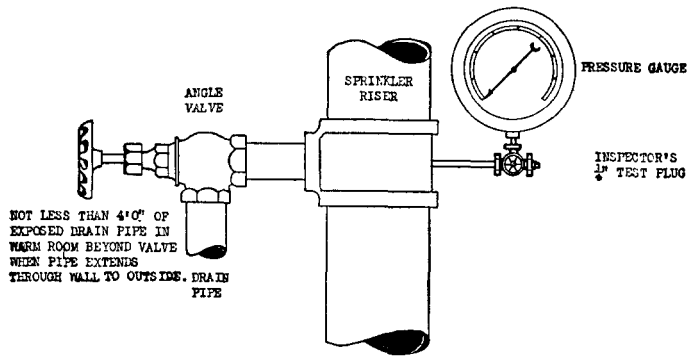


Fig. 442. Drain Connection for Sprinkler Riser.

443. AUXILIARY DRAINS.

(a) Auxiliary drains shall be provided to drain all low or trapped points of systems.

(b) Auxiliary drains on wet pipe and deluge systems shall not be smaller than as follows:

2-inch and smaller supply pipe..... ¾-inch drain
2½-inch supply pipe..... 1-inch drain
3-inch and larger supply pipe.....1¼-inch drain

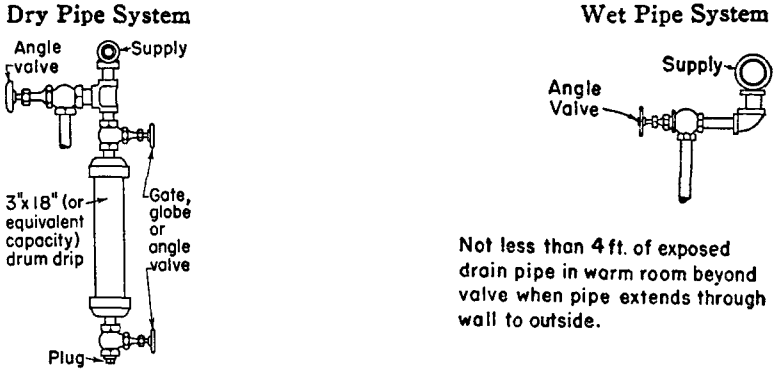


Fig. 443. Auxiliary Drains.

(c) All trapped sprinklers in excess of five shall be provided with drain valve and composition plug or nipple and cap; where in excess of twenty, sprinklers shall be provided with drain valve and drain connection. For five or less sprinklers a suitable drain plug or nipple and cap shall be provided.

(d) Auxiliary drains on dry pipe systems shall be as follows:

1. Where three or less sprinklers are trapped, a ½-inch renewable disc drain valve, plugged with a composition plug or with a nipple and cap, shall be installed.
2. Where more than three sprinklers are trapped, a two-valve drum drip should be installed, if possible in a warm location.
3. Where more than twenty sprinklers are trapped, a two-valve drum drip and a 1¼-inch draw-off valve shall be provided with drain properly piped to eliminate possibility of causing water damage.
4. Drum drip should be of approximately ½ gallon capacity and provided with either a ¾-in. gate, globe or angle valve on each side of the drum drip. Lower valve on the drum drip shall be plugged with a composition plug or with a nipple and cap.

(e) Pipe sizes for branch line tie-in drains should be one inch for twenty or less sprinklers, and 1¼ inch for more than twenty sprinklers with 1¼ inch drop to 1¼ inch or larger branch line pipe on floor below.

444. Discharge of Drain Valves.

(a) Each drain pipe should preferably discharge outside the building at a point visible from the drain valve and free from the possibility of causing water damage. Where it is not possible to

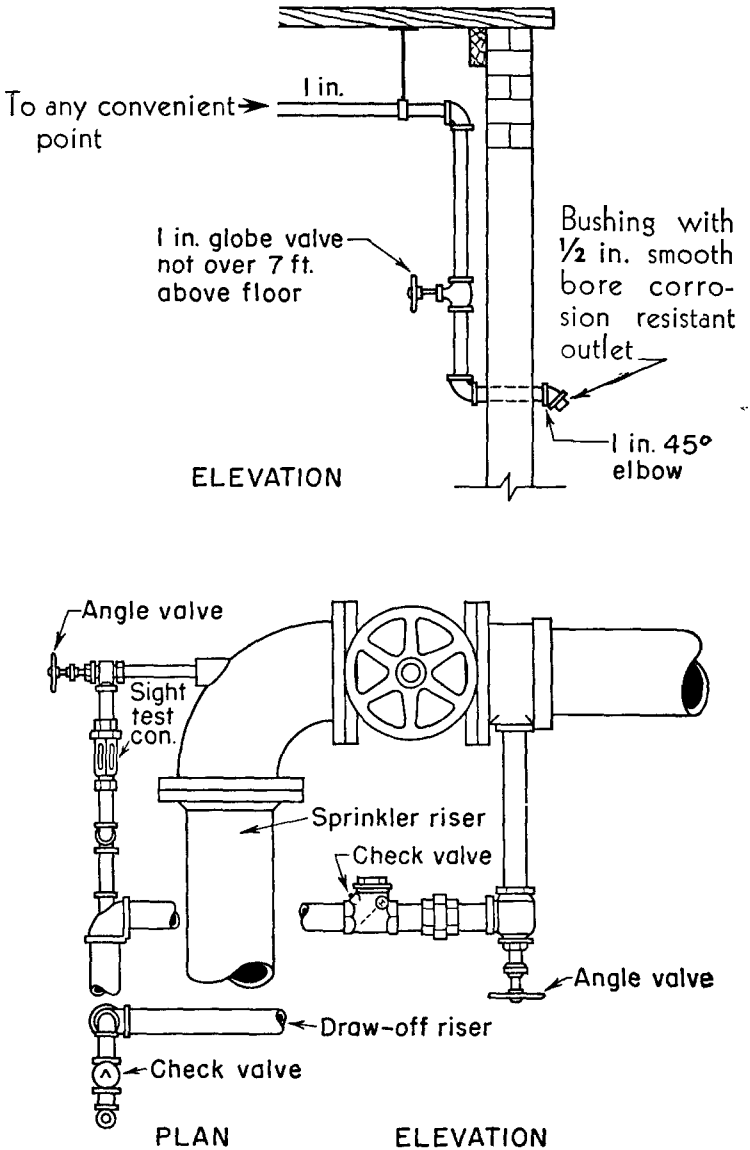


Fig. 451. One-inch System Test Pipes on Wet-Pipe Systems.
Connect to top of main riser or to sprinkler pipe in the highest part of system.

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. Direct interconnections should not be made between sewers and sprinkler drains of systems supplied with public water. The drain discharge should be in conformity with any local health or water department regulations, or sanitary code. The drain connection should be of a size to carry off water from open drains while they are discharging under normal water pressures.

(b) Where drain pipes are buried underground, either cast iron or galvanized pipe should be used.

(c) Drain pipes should not terminate in blind spaces under the building.

(d) Drain pipes when exposed should be fitted with a hood or down turned elbow to prevent obstruction.

(e) Drain pipes shall be so arranged as not to expose any part of the sprinkler system to frost. All drains should have at least 4 feet of pipe beyond the valve, in a warm room.

(f) Approved angle valves should be used on all main drains. Wherever possible drains should be located in a warm place.

450. System Test Pipes.

451. On wet systems 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. This test pipe shall be provided for each system through a pipe not less than 1 inch in diameter, in the upper story, and the connection may be at any convenient point or on cross main, branch line or top of riser. The discharge should be at a point where it can be readily observed. The test valve shall be located at an accessible point, and preferably not over seven feet above the floor.

452. The control valve on the test connection shall be located at a point not exposed to freezing.

453. On dry-pipe systems a 1-inch inspector's test with a smooth bore corrosion resistant outlet giving a flow equivalent to one sprinkler shall be installed on the end of the most distant sprinkler line in the upper story and be equipped with a 1-inch shut-off valve and composition plug.

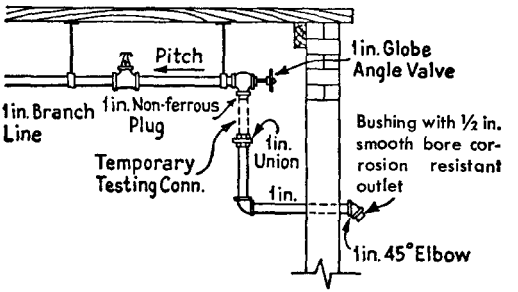


Fig. 453. One-inch System Test Pipes on Dry-Pipe Systems.

460. Protection Against Freezing.

461. Where supply pipes or risers pass through low unheated basements or open spaces under buildings, so as to be exposed to frost, they shall be properly protected, as follows:

(a) An acceptable method, especially where the space is over 18 inches high, is by an enclosure properly heated or filled with heavy earth or other suitable insulating material. The enclosure should extend below the bottom of the pipe and through the top flooring of the ground floor. In severe climates, where space is filled, the enclosure should be of sufficient size to permit of a filling of not less than four feet, all around the pipe. The en-

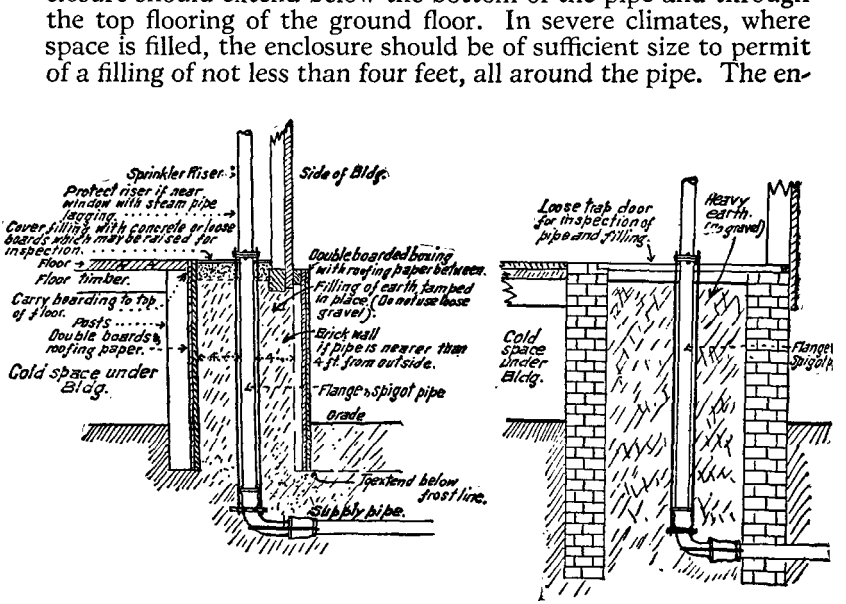


Fig. 460. Protection of Sprinkler Risers Against Freezing.

closure should preferably be of brick, but may be of wood, and if the latter, should be at least double-walled with tar paper between. If wood is used, it shall be of a kind that will endure underground or be treated with creosote or other acceptable preservative.

(b) Where the space is not more than 18 inches high, the flooring of ground floor may be cut away and the space around the pipe enclosed according to either of the above methods, except that the area may be reduced so that there will be not less than one foot clear space all around the pipe, thus exposing pipe to the heated room above. The opening at floor level should not be covered except by a metal grid.

(c) Care should be taken in laying the underground connection, to extend it sufficiently far into the building to give the required spaces called for above. The pipe may be offset, if desired, at or above the floor level.

462. Where necessary to extend feed mains of wet pipe systems through an open area or through cold rooms, passageways or other areas exposed to frost, the pipe shall be adequately protected against freezing by insulating coverings, frostproof casings, or other suitable means.

470. Protection of Pipe Against Corrosion.

(a) Where corrosive conditions exist, consideration should be given to the use of types of pipe, fittings, and hangers, designed to resist corrosion, also protective coatings, all depending on the severity of and kind of corrosive conditions. The material and protective coating to be used shall be specified and approved by the authority having jurisdiction.

(b) Galvanized pipe may be required in overhead feed mains running from one building to another where exposed to the weather, unless pipe is otherwise protected against corrosion.

(c) Where it may be necessary to use wrought iron or steel pipe underground as a connection from a system to sprinklers in a detached building, the pipe should be protected against corrosion before being buried. Galvanized pipe tarred or black pipe wrapped and tarred, are acceptable.

(d) In some places it is satisfactory to rely solely on the protective value of a paint coating, this to be maintained by repainting at intervals from one to five years, the period depending on the severity of the exposure.

(e) If corrosive conditions are not of great intensity and the degree of humidity is not abnormally high, good results can be ob-

tained by using two field coats of some high-grade paint such as sublimed blue lead in linseed oil, red lead in linseed oil or red lead in spar varnish. In locations where metal cannot be protected from attack or kept dry to receive the first field coating, a shop priming coat should be specified, this to be touched up promptly after installation and the whole to be finished with one or preferably two final coats. It is desirable under such conditions to vary colors for successive coats in order to insure adequate coverage. For instance, use red oxide inhibitive type paint for the shop or priming coat, and sublimed blue lead and/or 50 per cent red lead — 50 per cent spar varnish for finishing.

NOTE: In applying keep paint thoroughly stirred and apply only when surface is clean and dry — never in a damp or cold atmosphere.

(f) When a protective coating is applied to old piping, be sure to first remove all corrosion, scale, and grease. Otherwise, little benefit will be derived from the coating. Piping should be carefully examined at frequent intervals and if evidence of pitting, checking, blistering, or other failure is noted, the pipe should be cleaned and another coat of protective paint applied.

(g) In locations where appearance is not a factor and where temperatures do not greatly exceed 100° F., a coat of one of the inhibitive types of greases will give good protection. This type of material comes in the form of a light petrolatum and can be readily applied with a brush after installation work has been completed.

(h) When moisture conditions are extremely severe but corrosive fumes are not much of a factor, galvanized pipe, fittings, and hangers can be used successfully. When so used the threaded ends of the pipe should be sealed in with a suitable coating of asphalt base liquid and canvas. This form of protection involves painting the band of the fitting and the pipe for a distance of 4 in. to 6 in. with a heavy asphalt compound. Strips of lightweight canvas cut to a width of about 2 in. should be wrapped over the end of the fitting and on the surface of the pipe for a distance of about 4 in. from the face of the fitting. The canvas surfaces should in turn be sealed in with a follow-up coat of the asphalt compound.

(i) 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 should be employed or resort should be made to the use of some form of corrosion resisting material. This is not intended to call for protection of concealed piping installed under normal conditions.

(j) In the list of special coatings are the following:

A. A priming application of a mixture of beeswax and ozokerite dissolved in turpentine and carbon-tetrachloride, then a wrapper of lightweight canvas and finally a seal-in coating of the wax mixture.

B. Where high temperatures and rapid oxidation are not a factor a priming coat of chlorinated rubber paint, then a complete wrapping with electrician's rubber splicing tape and a follow-up seal-in coating of rubber paint.

C. Factory asphalt or bituminous coated and wrapped wrought pipe with coated fittings. The coating provided on this class of material gives excellent protection but great care must be used in thoroughly sealing-in all areas where the coating may be broken or damaged during installation.

(k) Cast iron pipe of the type which can be threaded is now available and is advantageous for use where corrosion is severe. This comes in wrought pipe sizes and with a wall thickness equal to that of extra heavy wrought material. This is made from special alloyed irons and affords good resistance to rusting and to attack by corrosive atmospheric conditions. Such material should be protected by paint, asphalt asbestos type coating, or grease to retard or prevent surface attack. The combination of iron pipe and iron fittings is effective due to the heavy thickness of the pipe wall, the similarity of the metal at the joints, and the particularly good bond which the cast pipe provides for the paint or other coatings applied to it.

(l) A silicon-bronze alloy should be used in the form of rod, strap, or castings for hangers employed wherever corrosive attack is severe and when galvanized metal is not used. This strong corrosion resisting type of bronze can be substituted for steel without increase in size or change in design of the ordinary hanger.

475. Protection of Piping Against Damage Due to Earthquakes.

(a) Breakage of sprinkler piping caused by building movement can be greatly lessened and in many cases 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 flexible couplings at critical points and allowing clearances at walls and floors. If too freely hung, however, sections of the sprinkler system will oscillate excessively or shift out of line. This action can be prevented by anchors or hangers which will damp oscillations or check movement, but not rigidly hold piping.

(b) The top and bottom of risers are critical points where the installation of approved flexible couplings is advisable. In a

multi-story building a flexible coupling may be advisable also at the floor and another at the ceiling line in an intermediate story if structural weakness or unusual flexibility is present. A pair of couplings should usually be provided on a monitor riser. A pair of approved flexible couplings with a length of pipe between, readily permits a considerable horizontal offset in any direction. Piping crossing the joint between two buildings usually needs a pair of flexible couplings as the buildings will vibrate differently unless identical in all respects. Flexible couplings may be omitted at pipes less than 3½-inch diameter.

(c) One to two-inch clearance should be provided around pipes at all floors. In one-story buildings the space at the ground floor can be filled with asphalt mastic. In multi-story buildings a sleeve should be cast in concrete floors, extending three to six inches above the top of the wearing surface and capped with a pipe collar, to prevent passage of water, smoke or fire. Tight metal collars are advisable about pipes to cover such holes through wooden floors in multi-story buildings.

(d) Riser drains, fire department connections and auxiliary piping should not be cemented into nearby walls or floors, if they can throw a strain on riser piping. Similarly, pipes which pass horizontally through walls should not be cemented solidly in them, or strains will accumulate at this point. Holes through fire walls should be packed with mineral wool or other suitable material held in place with pipe collars on each side. Pipes passing through foundation walls or pit walls in soft ground should have clearance with these walls but holes should be made watertight.

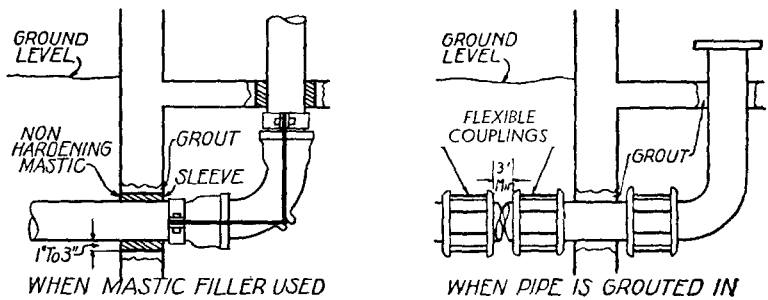


Fig. 475. Arrangement of Supply Pipe Entering Building.

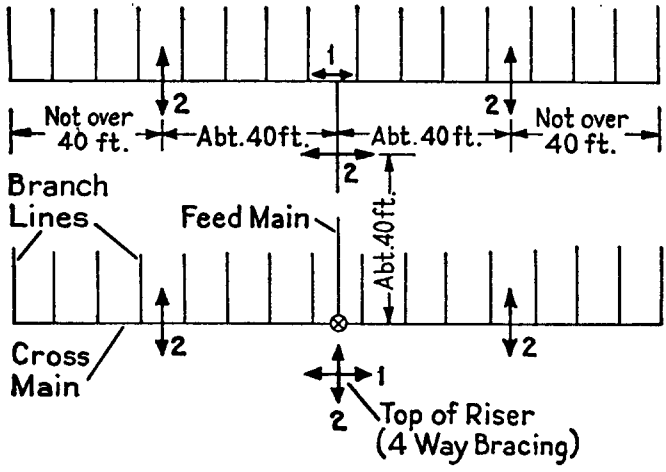
(e) Tank risers or discharge pipes should be treated the same as sprinkler risers for their portion within a building. The discharge pipe of tanks on buildings shall have a control valve above the roof line so any pipe-break within the building can be controlled.

476. SWAY BRACING.

(a) Feed and cross mains must be braced to prevent excessive oscillation. The tops of risers shall be secured against drifting in any direction. Branch lines will not require bracing.

(b) It is the intent to laterally brace the piping so that it will withstand a force equal to 50% of the weight of the piping, valve attachments and water. It is felt that if the lateral bracing is designed to withstand this force without breaking or permanently deforming, that the system will be reasonably safe from earthquake forces.

(c) All piping outside of buildings which is not buried shall be securely anchored to prevent swaying.



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 not over 40 feet from the end of the cross or feed main.

Fig. 476-1. Typical Locations of Sway Bracing Hangers.

(d) Where a system is hung with U-type hangers they may satisfy most of the requirements for sway bracing except, in general, the longitudinal hangers as numbered "1" in Fig. 476–1 will be necessary in addition. U-type hangers are better lateral braces when the legs are bent out 10°.

(e) Where a system is hung with single rods it will generally be necessary to provide all sway bracing by the installation of special hangers. (Very short rods, less than 6 inches, are fairly satisfactory.)

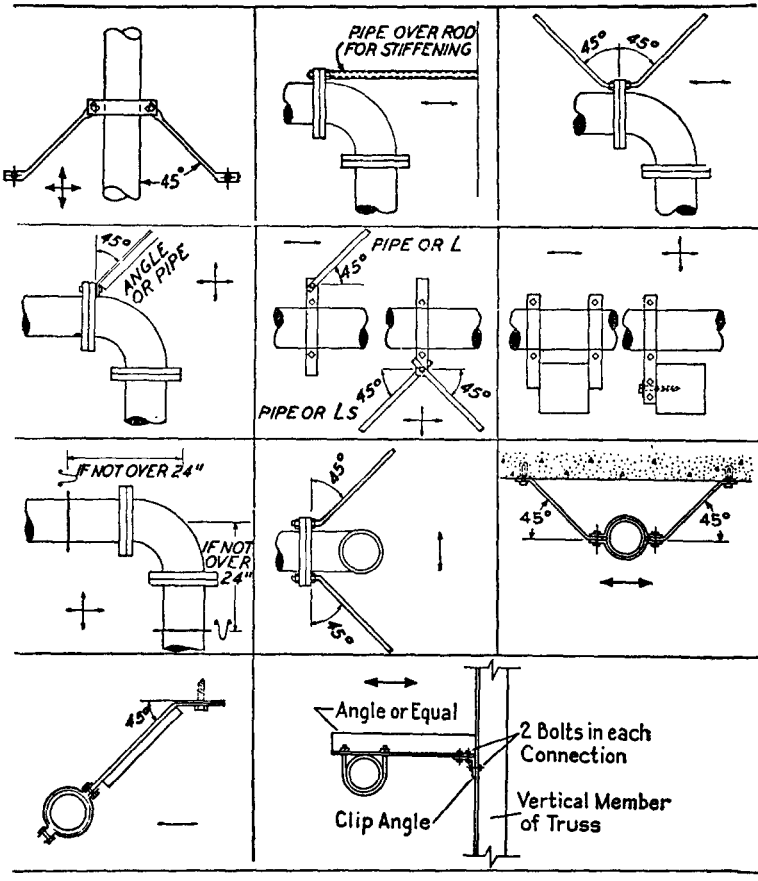


Fig. 476-2. Acceptable Types of Sway Bracing.

(f) Large piping should not be held by small branches. The piping should not be fastened to two dissimilar parts of the building such as a wall and a roof which will move differently.

(g) Transverse braces may also act as longitudinal braces if they are within 24 inches of the center line of the pipe being braced longitudinally, except that branch lines cannot hold cross mains. Earthquake braces should not be connected to a pair of companion flanges.

(h) 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. 476–2 illustrates some acceptable arrangements of sway bracing.

(i) In the design of sway braces, the slenderness ration l/r should not exceed 200 where "l" is the distance between the center lines of supports and "r" is the least radius of gyration, both in inches. For example, a flat bar 2 inches x ⅜ inch should not be over 1 foot-9 inches between fastenings. The maximum length of shapes used for sway bracing is shown in the following table:

TABLE 476.

Item	*Max. Length l/r=200*	*Item*	*Max. Length l/r=200*
ANGLES		FLATS	
1½ x 1½ x ¼ in.	4 ft. 10 in.	1½ 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.
2½ x 2 x ¼ in.	7 ft. 0 in.	2 x ⅜ in.	1 ft. 9 in.
2½ x 2½ x ¼ in.	8 ft. 2 in.	PIPE	
3 x 2½ x ¼ in.	8 ft. 10 in.	1 in.	7 ft. 0 in.
3 x 3 x ¼ in.	9 ft. 10 in.	1¼ in.	9 ft. 0 in.
RODS		1½ in.	10 ft. 4 in.
¾ in.	3 ft. 1 in.	2 in.	13 ft. 1 in.
⅞ in.	3 ft. 7 in.		

480. Sleeves for Pipe Risers.

481. Sprinkler piping passing through floors of concrete or waterproof construction should have properly designed substantial thimbles or sleeves projecting three to six inches above the floor to prevent possible floor leakage. The space between the

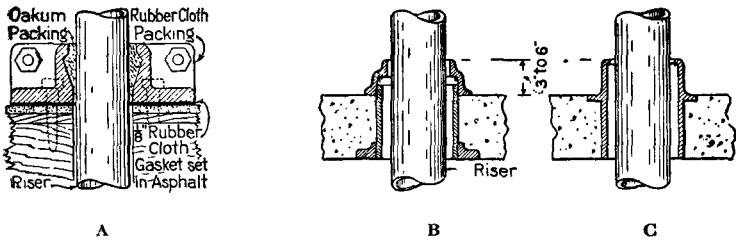


Fig. 480. Watertight Riser Sleeves.
A — For wood or concrete floors; B and C — for concrete floors.

pipe and sleeve should be caulked with oakum or equivalent material. If floors are of cinder concrete, thimbles or sleeves should extend all the way through to protect the piping against corrosion.

482. It is desirable that ordinary floors through which pipes pass should be made reasonably tight around the risers. See section 202.

490. Use of Sprinkler Piping.

491. Sprinkler piping shall not be used in any way for domestic water service. Circulation of water in sprinkler pipes is objectionable, owing to increased corrosion, deposit of sediment, and condensation drip from pipes.

492. Hand Hose Connections.

Hand hose, to be used for fire purposes only, may be attached to sprinkler pipes within a room subject to the following restrictions:

Piping and hose valve shall be 1 inch.

Hose shall be not larger than 1½ inch.

Nozzle shall not be larger than ½ inch nominal discharge capacity.

Hose should not be connected to any sprinkler pipe smaller than 2½ inch and never attached to a dry pipe system.

For details of hand hose installation, see Standards on Standpipe and Hose Systems.*

*See Appendix for information on availability of standards.

SECTION 5. VALVES, PIPE FITTINGS AND HANGERS.

511. Types of Valves to be Used.

(a) All valves on connections to water supplies and in supply pipes to sprinklers shall be approved outside screw and yoke (O. S. & Y.) or approved indicator type. Underground gate valves of approved type equipped with approved indicator post comply with this requirement.

It is recommended that such valves be supervised so that closing will result in an alarm.

(b) Drain valves and test valves shall be of approved type.

(c) Check valves shall be of approved straightway type and may be installed in a vertical or horizontal position.

512. Valves Controlling Water Supplies.

(a) Each system shall be provided with a gate valve so located as to control all sources of water supply except fire department connections when arranged as specified in paragraph 383.

(b) At least one gate valve shall be installed in each source of water supply except fire department connections.

(c) Where 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.

(d) Where there is but one water supply connection a check valve shall be installed if there is likelihood of water circulation, or if there is a fire department connection on the system.

(e) Where 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 in a vertical position immediately inside of the building; in case there is no outside control the system gate should be

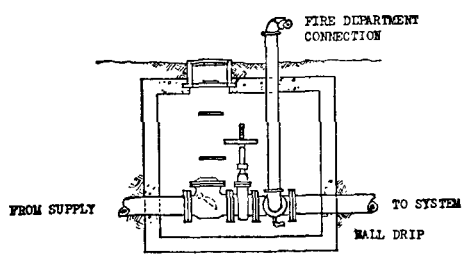


Fig. 512(d). Pit for Gate Valve. Check Valve and Fire Department Connection.

placed at the wall flanged ahead of all fittings. Such an arrangement eliminates a pit and in most cases one additional cast-iron socket quarter bend.

(f) Where either a wet or dry pipe sprinkler system is supplied by city water and a fire department connection and has more than one riser with O. S. & Y. gate valve in each, and the whole system is controlled by one outside post indicator valve, it will be satisfactory to install the main check valve in the water supply connection immediately inside building. See paragraph 383 (c).

(g) Where a wet pipe sprinkler system is supplied by city water and a fire department connection with only one riser, the alarm valve will be considered as a check valve and an additional check valve will not be required.

(h) A gate valve should be installed on each side of each check valve under conditions other than described in paragraphs (e), (f) and (g), except that in the discharge pipe from a pressure tank or a gravity tank of less than 15,000 gallons capacity no gate valve need be installed on the tank side of the check valve.

(i) Where a gravity tank is located on a tower in the yard, the gate valve on the tank side of the check valve should be of O. S. & Y. type; the other should be either an O. S. & Y. valve or an indicator post valve. Where a gravity tank is located on a building both gate valves should be of the O. S. & Y. type; and all fittings inside the building, except the drain tee and heater connections, shall be under the control of a gate valve.

(j) In a city connection serving as one source of supply the city valve in the connection may serve as one of the required gate valves. An O. S. & Y. valve or an indicator post valve should be installed on the system side of the check valve.

(k) A connection from public water system should not extend into or through a building unless such connection is under the control of an outside indicator post or O. S. & Y. gate valve or under the control of an inside O. S. & Y. gate valve located near outside wall of the building.

(l) When a pump, located in a combustible pump house or exposed to danger from fire or falling walls, or a tank, discharges into a yard main fed by another supply, either the check valve in the connection should be located in a pit or the gate should be of the indicator post type located a safe distance outside of buildings.

(m) Check valves on tank or pump connections when located underground may be placed inside of buildings and at a safe distance from the tank riser or pump, except in cases where

the building is entirely of one fire area, when it is ordinarily considered satisfactory to locate the check valve overhead in the lowest level.

(n) All gate valves controlling water supplies for sprinklers should be located where readily accessible.

Where valves are not within easy access from ground or floor level, permanent ladders, clamped treads on risers, chains and wheels, or other accepted means should be provided.

513. Sectional Valves.

In large plants the fire main system should have sectional control valves so located as to provide an acceptable degree of reliability for sprinkler equipments and water supplies.

514. Floor Control Valves.

Floor control valves may be required in special cases where area or height, or number of tenants is excessive, both in manufacturing and mercantile buildings, or where contents are more than ordinarily susceptible to damage. Floor valves should be located where they are readily accessible.

515. Indicator Posts for Gate Valves.

(a) Outside control should be provided wherever possible.

(b) Where sprinklers are supplied from a yard main, an approved outside indicator post gate valve should be placed in the connecting pipe at a safe distance from the building.

(c) Indicator post valves should be located not less than 40 feet from buildings; but where necessary to place a valve close to a building, it should be located at a blank part of the wall.

(d) When a building has no basement, and outside post indicator control cannot be furnished, short post indicator may be installed in a horizontal position in riser with handwheel projecting outside of wall.

516. Pits for Underground Valves.

Pits should be of ample size to permit of easy access to the valves for examination and repairs. (See specifications for concrete valve pits in the standards for Tanks.*)

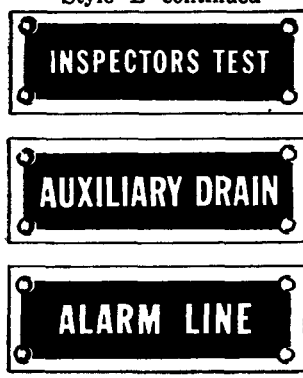
517. Securing.

All gate valves in supply pipes to automatic sprinklers,

*See Appendix for information on availability of standards.

Style "A"

Style "B" continued



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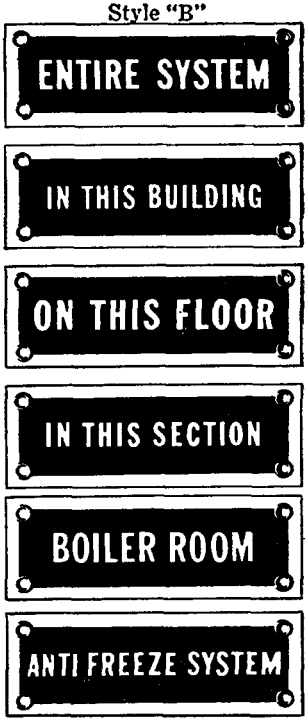

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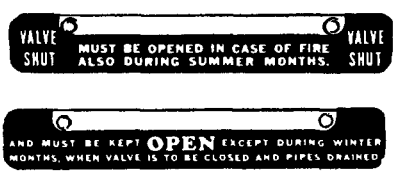


Style "D"

Fig. 518. Identification Signs.

whether or not of indicator or post pattern, should be sealed open in a satisfactory manner.

518. Identification.

All control, drain, test and alarm valves shall be provided with identification signs of the standard design adopted by the automatic sprinkler industry, or their equivalent. Such identification signs shall be of the design illustrated in Fig. 518 and designated as:

(a) To be securely affixed to Control Valves.

(b) To be securely affixed to Drain Valves, Test Valves, Air Line Valves, Filling Line Valves and Water Motor Line Valves.

(c) To be securely affixed to Sign A when the valve "must be kept open except during winter months when valve is to be closed and pipes drained." Or when "valve shut must be opened in case of fire, also during summer months."

(d) To be securely affixed to the Alarm, electrical or mechanical, or both.

521. Fittings.

(a) Fittings shall be of a type specifically approved for use in sprinkler systems.

(b) If fittings are of cast iron, extra heavy pattern shall be used in sizes larger than 2 inches where the normal pressure in the piping system exceeds one hundred and seventy-five pounds.

(c) If fittings are of malleable iron, standard weight pattern will be acceptable in sizes up to 6 inches inclusive when the normal pressure in the pipe system does not exceed three hundred pounds.

(d) 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 approval.

NOTE: Where water pressures are 175 to 300 lbs. the A.S.A. Standards permit the use of "Standard Weight" pipe and "extra heavy" valves. Until pressure ratings for valves are standardized, the manufacturers' ratings should be observed.

(e) All inside piping shall be installed by means of screwed or flanged fittings or by other approved means. Welding of joints in risers and large feed mains may be allowed in special cases. Permission for this work must be obtained from the authority having jurisdiction. Welding should preferably be done in the shop. When done in the field, the fire hazard of the process shall be suitably safeguarded. When welding is permitted it shall be

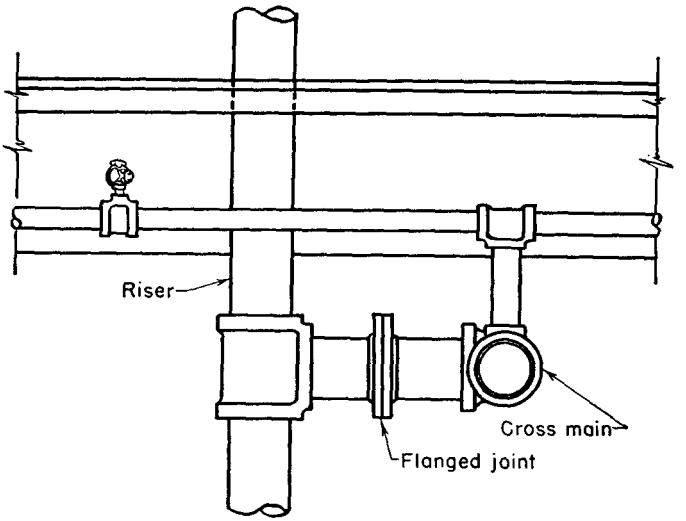


Fig. 521. One Arrangement of Flanged Joint at Sprinkler Riser.

in accordance with the American Standard Code for Pressure Piping, B 31.1–1951* and any subsequent revisions thereof.

(f) Where risers are 3 inches in size or larger, a flange joint shall be used at the riser at each floor.

522. Couplings and Unions.

Couplings should not be used except where pipe is more than 20 feet in length between fittings. Screwed unions shall not be used on pipe larger than 2 inches. Couplings of other than screwed type shall be of types approved specifically for use in sprinkler systems.

523. Reducers, Bushings.

A one-piece reducing fitting of good design should be used wherever a change is made in the size of pipe. Bushings introduce a point of weakness and should be used in reducing the size of openings of fittings only when standard fittings of the required size are not available.

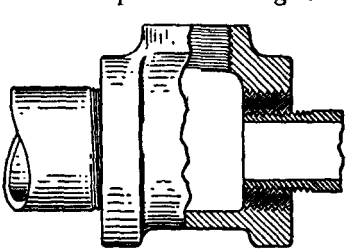


Fig. 523. Flush Bushing.

*See Appendix for information on availability of standards.

The use of bushings is subject to further provision as follows:

(a) Bushings shall be of the face or flush pattern.

(b) Bushings are not permitted in elbow fittings.

(c) Bushings are not permitted when the reduction in size of the outlet is less than ½ inch.

(d) Bushings are not permitted for more than one outlet of any tee fitting or two outlets of any cross fitting.

525. Joining of Pipe and Fittings.

(a) All fittings and pipe shall have threads cut to standard. Care should be taken that the pipe does not extend into fitting sufficiently to reduce the waterway.

(b) Pipe shall be properly reamed after cutting to remove all burrs and fins.

(c) Joint compound shall be applied to the threads of the pipe and not in the fitting.

531. Hangers.

(a) Sprinkler piping should be substantially supported from the building structure.

In all cases, sprinkler piping should be supported independently of the ceiling sheathing.

(b) Hangers shall be of approved type.

(c) Sprinkler piping should be supported by round wrought-iron U-type or approved adjustable hangers.

(d) Approved C-type hangers are acceptable for use on steel beams when provided with a strap as shown by "L" in Fig. 531 or when cup-pointed set screws with lock nuts are provided for these hangers by the manufacturer. Strap or locknut may be omitted in situations where there is no material vibration of structural members provided C-type hanger is specifically approved for use without such strap or locknut. Straps shall be not less than ⅛ by 1 inch in section.

(e) If hangers or parts of hangers are made of flat iron or steel, the thickness of the metal must be at least 3/16 in., unless protected by a suitable corrosion-resistant material and the strength of the hangers must, in any case, be comparable to that of other approved types.

(f) Pipe rings hung from coach screw hooks should be avoided. They should never be used on branch lines.

(g) Hangers which permit wide lateral motion of the pipe, particularly on branch lines, are not acceptable.

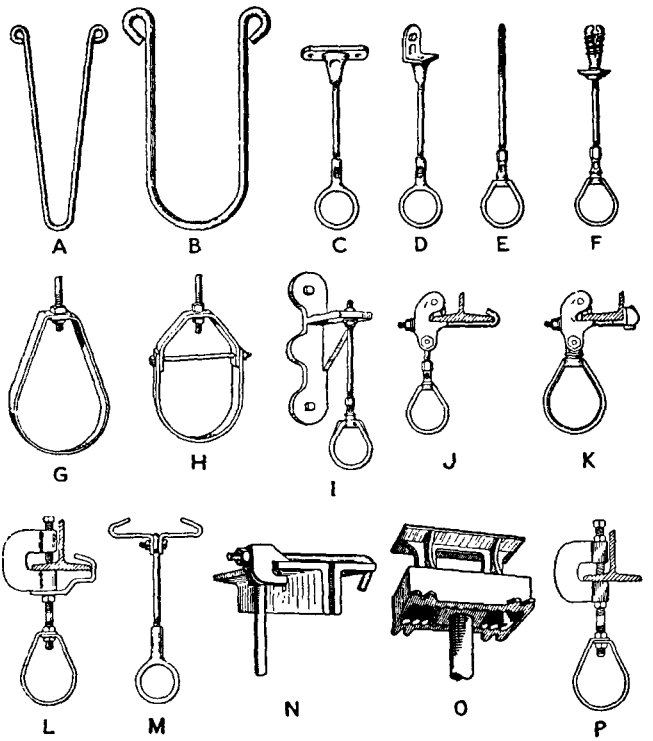


Fig. 531. Common Types of Acceptable Hangers.

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 Case.
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 — "CB-Universal" Concrete Insert.
P — C-type clamp without retaining strap but with locknut.

(h) Toggle hangers should be used only for the support of branch lines and under ceilings of hollow tile or metal lath and plaster, in buildings of fire-resistive or noncombustible construction.

(i) Under metal decking branch line hangers 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 shall be not less than $\frac{3}{8}$ inch.

(j) For trapeze hangers, the minimum size of steel angle or pipe span between purlins or joists shall be as shown in Table 531, all angles to be used with longer leg vertical. The angles shown are selected for economy and availability. Any other sizes or

TABLE 531

Trapeze Bars — One to Seven Foot Spans

PIPE SIZE →	2" OR LESS	2 ½"	3"	3 ½"	4"	5"	6"	8"
SPAN OF TRAPEZE BARS 1'-0"	1½"x1½"x3/16" 1" PIPE	1½"x1½"x3/16" 1" PIPE	1½"x1½"x3/16" 1" PIPE	1½"x1½"x3/16" 1" PIPE	1½"x1½"x3/16" 1" PIPE	1½"x1½"x3/16" 1" PIPE	2"x1½"x3/16" 1¼" PIPE	2½"x1½"x3/16" 1¼" PIPE
1'-6"	1½"x1½"x3/16" 1" PIPE	1½"x1½"x3/16" 1" PIPE	1½"x1½"x3/16" 1" PIPE	1½"x1½"x3/16" 1" PIPE	2"x1½"x3/16" 1" PIPE	2"x1½"x3/16" 1¼" PIPE	2½"x1½"x3/16" 1¼" PIPE	3"x2"x3/16" 1½" PIPE
2'-0"	1½"x1½"x3/16" 1" PIPE	1½"x1½"x3/16" 1" PIPE	2"x1½"x3/16" 1" PIPE	2"x1½"x3/16" 1" PIPE	2"x1½"x3/16" 1¼" PIPE	2½"x1½"x3/16" 1¼" PIPE	2½"x1½"x3/16" 1½" PIPE	3"x2"x3/16" 2" PIPE
2'-6"	1½"x1½"x3/16" 1" PIPE	2"x1½"x3/16" 1" PIPE	2"x1½"x3/16" 1" PIPE	2"x1½"x3/16" 1¼" PIPE	2½"x1½"x3/16" 1¼" PIPE	2½"x1½"x3/16" 1½" PIPE	3"x2"x3/16" 2" PIPE	3"x2"x¼" 2" PIPE
3'-0"	2"x1½"x3/16" 1" PIPE	2"x1½"x3/16" 1" PIPE	2"x1½"x3/16" 1¼" PIPE	2½"x1½"x3/16" 1¼" PIPE	2½"x1½"x3/16" 1¼" PIPE	3"x2"x3/16" 1½" PIPE	3"x2"x3/16" 2" PIPE	3½"x2½"x¼" 2½" PIPE
4'-0"	2"x1½"x3/16" 1¼" PIPE	2"x1½"x3/16" 1¼" PIPE	2½"x1½"x3/16" 1¼" PIPE	2½"x1½"x3/16" 1½" PIPE	3"x2"x3/16" 1½" PIPE	3"x2"x3/16" 2" PIPE	3"x2"x¼" 2" PIPE	3½"x2½"x5/16" 2½" PIPE
5'-0"	2½"x1½"x3/16" 1¼" PIPE	2½"x1½"x3/16" 1¼" PIPE	2½"x1½"x3/16" 1½" PIPE	3"x2"x3/16" 1½" PIPE	3"x2"x3/16" 2" PIPE	3"x2"x¼" 2" PIPE	3½"x2½"x¼" 2½" PIPE	4"x4"x¼" 2½" PIPE
6'-0"	2½"x1½"x5/16" 1¼" PIPE	2½"x1½"x5/16" 1½" PIPE	3"x2"x3/16" 2" PIPE	3"x2"x3/16" 2" PIPE	3"x2"x¼" 2" PIPE	3½"x2½"x¼" 2½" PIPE	4"x3"x¼" 2½" PIPE	4"x4"x5/16" 3" PIPE
7'-0"	2½"x1½"x3/16" 1½" PIPE	3"x2"x3/16" 2" PIPE	3"x2"x3/16" 2" PIPE	3"x3"x3/16" 2" PIPE	3"x2"x¼" 2½" PIPE	3½"x2½"x¼" 2½" PIPE	4"x3"x¼" 3" PIPE	4"x3"x3/8" 3" PIPE

shapes giving equal or greater section modulus will be acceptable.

For the size of hanger rods, "U" hooks, drive and lag screws for support of steel angle or pipe of the trapeze bars, see Section 535.

532. Hangers in Concrete.

(a) In concrete construction, approved inserts set in the concrete may be installed for the support of hangers. The use of wood plugs is not permitted.

(b) Hangers should be installed without regard to the support of the sleeves where pipes are run through concrete beams. Such sleeves should not normally be used for the support of pipes.

(c) Expansion shields for supporting pipes under concrete construction should preferably be used in a horizontal position in the sides of beams, but in good, sound concrete having gravel or crushed stone aggregate, they may be used in the vertical position to support pipes 4 in. or less in diameter. In all cases, the suitability of the concrete should be definitely determined before using expansion shields.

(d) For the support of pipes 4 inches and larger, expansion shields if used in the vertical position should 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 4 inches and larger may be supported entirely by expansion shields in the vertical position, but spaced not over 10 feet apart.

(e) Expansion shields should not be used in ceilings of gypsum or similar soft material. In cinder concrete, expansion shields should likewise not be used except on branch lines and even then they should alternate with through bolts or hangers attached to beams.

(f) It is important in all cases, and especially so where expansion shields are used in the vertical position, that the holes be made of the proper size and be drilled with care to provide for a uniform contact with the shield over its entire circumference. Depth of the hole should in no case be less than specified for the type of shield used.

(g) Holes for shields in the side of concrete beams should ordinarily be above the center line of the beam and always well above the bottom reinforcement.

(h) Where pipes are run through concrete beams, sleeves at least two sizes larger than the piping should be used.

533. Location of Hangers.

(a) BRANCH LINES.

On branch lines, there should ordinarily be at least one hanger for each length of pipe. Further specifications and modification of this rule are:

DISTANCE FROM SPRINKLER TO HANGER.

1. Hangers should be placed 18 inches from the sprinkler. This is the preferred distance, and should be adhered to as closely as possible.
2. If necessary, round iron hangers may be located as close as 3 inches to the sprinkler. All other type hangers require a 12-inch clearance. This keeps the hanger from interfering with the proper water distribution. This does not apply when sprinklers are installed in pendent positions.
3. If necessary, the unsupported length between the end sprinkler and the last hanger may be extended to 36 inches for 1 inch pipe, or 48 inches for 1¼ inch pipe. Where these limits are exceeded, the pipe should be extended beyond the end sprinkler for an additional hanger.

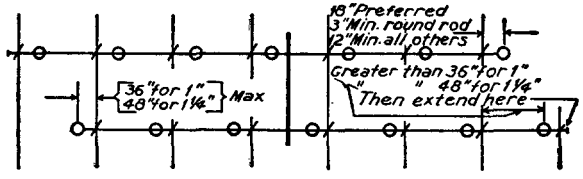


Fig. 533(a)1. Distance from Sprinkler to Hanger.

DISTANCE BETWEEN HANGERS.

4. Maximum distance between hangers should not exceed 12 feet for 1¼ inch or smaller size pipe, nor 15 feet for 1½ inch or larger size pipe.
5. Where one hanger for each length of pipe would require hangers closer than 6 feet apart, hangers may be spaced up to, but not exceeding 12 feet.

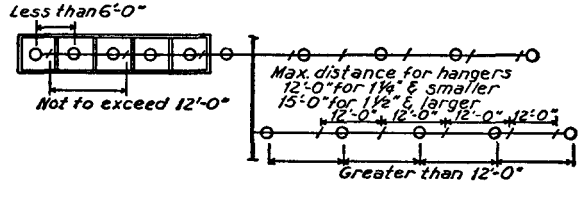


Fig 533(a)2. Distance Between Hangers.

HANGER OMISSIONS.

6. Starter lengths less than 6 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.

7. 1-inch arms, not over 12 inches long, from branch lines or cross mains do not require hangers.

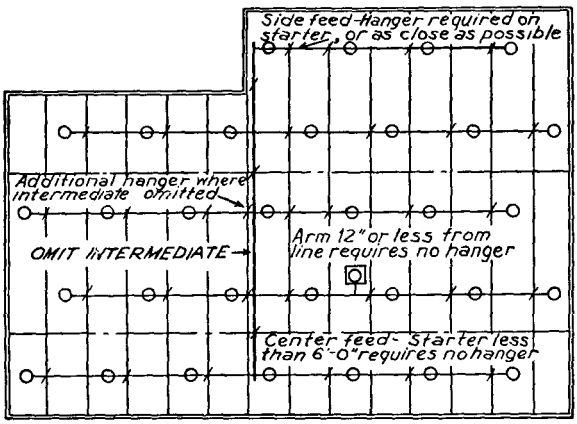


Fig. 533(a)3. Hanger Omissions.

SPECIAL.

In special cases it may be necessary to make provisions to take care of the thrust of branch lines in a steeply pitched roof especially where there is a long nipple between the cross main and the branch. This may be done by installing a clamp on the pipe just above the lower hanger.

(b) CROSS MAINS.

On cross mains there should ordinarily be one hanger between each two branch lines.

1. Where cross mains are supported from roof or floor framing members, and intermediate hanging may require a trapeze type hanger, this hanger may be omitted and each branch line should have a hanger attached to the purlins as near to the cross main as purlin location permits.

2. When the end length of cross main may require the use of a trapeze type hanger, this hanger may be omitted and the cross main extended to the next framing member where an ordinary hanger may

be used. When this trapeze hanger is omitted, each branch line must have a hanger attached to the purlins as near to the cross main as purlin location permits.

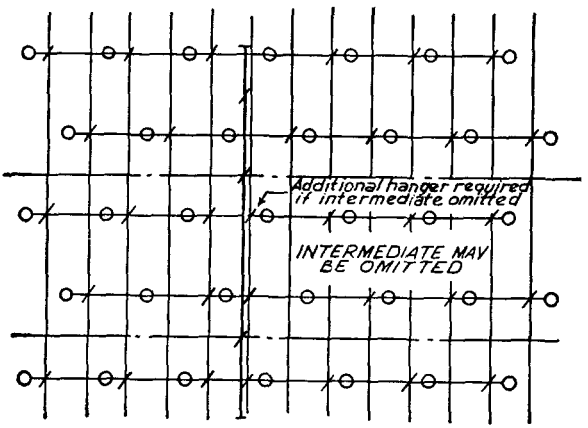


Fig. 533(b)1. Hangers on Cross Main.

3. In bays requiring three branch lines supported from roof or floor framing members, intermediate hangers on cross mains may be omitted as outlined below.

Side Feed System: One intermediate hanger may be omitted, provided additional branch line hangers are located on purlins as near to the cross main as purlin location permits.

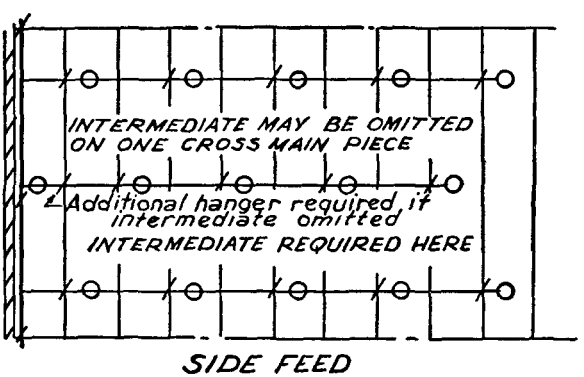


Fig. 533(b)2. Hanger Omissions on Side Feed System.

Center Feed System: All intermediate hangers may be omitted provided additional branch line hangers are located on purlins on both sides of the cross main, and located as near to the cross main as purlin location permits.

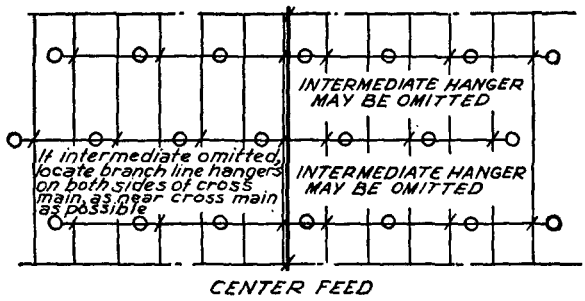


Fig. 533(b)3. Hangers on Cross Main — Center Feed System.

(c) Feed Mains.

On feed mains there should be at least one hanger for each 15 ft. of pipe.

534. Support of Risers.

(a) Risers shall be adequately supported by attachments direct to the riser or by hangers located on the horizontal connections close to the riser.

(b) Where risers are supported at the ground and are without offsets additional support at every fourth floor above will ordinarily be ample. Where risers do not rise from the ground, direct support should be provided, preferably at every floor.

(c) In buildings of heavy construction and ten stories in height no support is required above the fifth floor.

(d) In buildings of heavy construction and more than ten stories, supports are required at the ground (first) level, 5th and 9th levels, and every fourth story above.

(e) In buildings of light construction additional supports are required.

(f) Sprinkler and tank risers in vertical shafts should be supported equivalent to the above.

(g) Clamps supporting pipe by means of set screws shall not be used.

535. Ceiling Flanges, Rods and "U" Hooks.

(a) Ceiling Flanges. For pipe sizes up to 2 in., ceiling flanges shall have at least two supporting screw holes; for sizes 2½ in. to 8 in., not less than three holes, preferably so located that no two holes are in the same line as the grain in the planking.

(b) Rods. The size of rods for hangers shall not be less than that given in the following table. Such sizes are nominal diameters associated with machined threads. For rolled threads the rod size shall be not less than the root diameter of the thread.

Pipe Size	*Dia. of Rod*	*Pipe Size*	*Dia. of Rod*
Up to 2 in.	⅜ in.	4 in., 5 in.	⅝ in.
2½ in., 3 in., 3½ in.	½ in.	6 in.	¾ in.
8 in.	⅞ in.		

(c) "U" Hooks. The size of the rod material of "U" hooks shall be not less than that given in the following table:

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.

(d) Screws. For ceiling flanges and "U" hooks screw dimensions shall be not less than those given in the following table:

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.

(e) Drive Screws shall be used only in a horizontal position as in the side of a beam. Wood screws shall not be driven.

(f) Nails are not acceptable for fastening hangers.

(g) Screws in the side of a timber or joist should be not less than 2½ in. from the lower edge when supporting branch lines, and not less than 3 in. when supporting main lines. This shall not apply to 2 in. or thicker nailing strips resting on top of steel beams.

(h) 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:

Diameter of Rod	*Nominal Plank Thickness*	*Nominal Width of Beam Face*
Up to ⅜ in.	3 in.	2 in.
½ in.	4 in.	2 in.
⅝ in.	4 in.	3 in.
¾ in.	4 in.	4 in.

Lag screw rods should not be used for support of pipes larger than 6 in. All holes for lag screw rods should be predrilled ⅛ in. less in diameter than the root diameter of the lag screw thread.

(i) When the thickness of planking and thickness of flange does not permit the use of screws 2 in. long, screws 1¾ in. long may be permitted.

536. Powder Driven Studs and Welding Studs.

(a) Powder driven studs and welding studs shall not be used unless the studs and the tools for attaching powder driven studs are listed by a nationally recognized testing laboratory for use in hanging sprinkler piping.

(b) Powder driven studs should not be used in steel less than 3/16 in. total thickness. The size of sprinkler pipe supported by powder driven studs in steel shall not exceed 5 inches.

(c) Powder driven studs should be used in concrete only where the authority having jurisdiction approves such use on the basis of a test of the acceptability of the studs made in the actual concrete on the job. The ability of concrete to hold the studs varies widely according to type of aggregate and quality of concrete, and it should be established in each case by testing to determine that the studs will hold a minimum load of 750 lbs. for 2 inch or smaller pipe and 1000 lbs. for 3 or 3½ inch pipe, and will not work loose by jiggling the stud or by vibration. The size of sprinkler pipe supported by powder driven studs in concrete shall not exceed 3½ inches.

(d) Studs or other hanger parts should not be attached by welding to steel less than 3/16 inch in thickness.

SECTION 6. SPRINKLERS.

601. (a) Sprinklers shall be of approved makes and types.

(b) Automatic sprinklers with nominal ½-in. discharge orifice and of the ordinary degree temperature ratings will usually be required.

(c) The authority having jurisdiction shall be consulted in every case involving special use of sprinklers as contemplated by this section of the standards.

602. DISCHARGE CAPACITIES. (a) The following table shows the discharge capacities of approved sprinklers having ½-in. orifice or its equivalent in discharge, at various pressures up to 100 lbs.

TABLE 602.

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

(b) Automatic sprinklers of capacities less than that of standard ½-in. sprinklers should be of nominal ⅜-inch or ¼-inch size with capacities one-half and one-quarter that of the standard ½-inch sprinkler respectively.

(c) ⅜- and ¼-inch sprinklers should have a pintle extending above deflector for identification purposes.

(d) Large orifice sprinklers should have a capacity of 140 per cent of a nominal ½-inch sprinkler and should have a ¾-inch pipe thread.

610. TEMPERATURE RATINGS. The standard temperature ratings of automatic sprinklers are as follows. (The frame arms only are colored to show temperature rating.)

TABLE 610

Rating	*Operating Temp. °F*	*Color*	*Max. Ceiling Temp. °F*
Ordinary	135°–150°–160°–165°	Uncolored*	100°F
Intermediate	175°–212°	White*	150°F
High	250°–280°–286°	Blue	225°F
Extra High	325°–340°–360°	Red	300°F
Very Extra High	400°–415°	Green	375°F
	450°	Orange	425°F
	500°	Orange	475°F

* The 135° sprinklers of some manufacturers are half black and half uncolored. The 175° sprinklers of the same manufacturers are yellow.

TABLE 611(b) 1.

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. 611) 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. 611)	—	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 611(b) 2.

RATINGS OF SPRINKLERS IN SPECIFIED LOCATIONS

Location	*Ordinary Degree Rating*	*Intermediate Degree Rating*	*High Degree Rating*
SKYLIGHTS	—	Glass	—
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: The above tables are to be considered a guide only. A check of job condition by means of thermometers may be necessary.

Where higher temperature sprinklers are necessary to meet extraordinary conditions special sprinklers as high as 600° are obtainable.

611. USE OF HIGH TEMPERATURE SPRINKLERS. (a) Sprinklers of ratings higher than ordinary shall be used only when necessary. The use of high temperature sprinklers should be in accordance with maximum ceiling temperatures as given in table 610.

(b) Information regarding the highest temperature that may be encountered in any location in a particular installation should 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.

(c) The following general practices should be observed when installing high temperature sprinklers, unless special rulings have been made based on temperature readings.

(1) Sprinklers near unit heaters.

Where steam pressure is not more than 15 lbs., sprinklers in the Heater Zone should be 250° to 286°, and sprinklers in the Danger Zone 175° to 212°. Where steam pressure exceeds 15 lbs., or for unit heaters having gas or

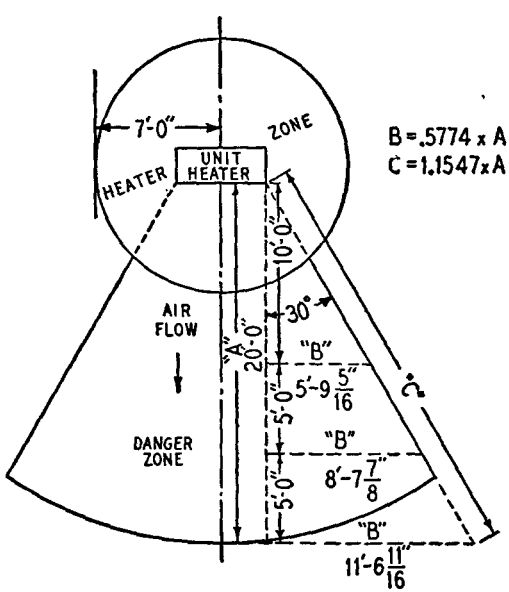


Fig. 611. Heater and Danger Zones at Unit Heaters.

electric heating elements, the temperature should be examined with a registering thermometer to determine the proper ratings for sprinklers to be used.

Where hot water is the heating element, the temperatures should be examined with a registering thermometer to determine if it would be possible to put in a lower temperature rating sprinkler than those given in the diagram.

(2) Sprinklers located within 12 in. to one side or 30 in. above an uncovered steam main, heating coil or radiator, should be 175° to 212°.

(3) Sprinklers within 7 ft. of a low pressure blow-off valve which discharges free in a large room, should be 250° to 286°.

(4) Sprinklers under glass skylights exposed to the direct rays of the sun should be 175° to 212°.

(5) Sprinklers in an unventilated concealed space under an uninsulated wood or metal roof, or in an unventilated attic, or in a building having an unventilated peak roof of thin boards or metal, should be 175° to 212°.

(6) Sprinklers in unventilated show windows having high-powered electric lights near the ceiling should be 175° to 212°.

(7) At intervals some occupancies employ high temperature fumigation processes requiring consideration in the selection of sprinkler temperature ratings.

(8) Where a locomotive enters a building, sprinklers should be located not nearer than 5 ft. from the center line of the track.

612. In case of change of occupancy involving temperature changes, the sprinklers should be changed accordingly.

620. Special Types.

Sprinklers used for the special purposes and locations described in paragraphs 621 to 625 inclusive shall be of types specifically approved for such use.

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

622. (a) Approved 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, foundries, forge shops, 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.

(b) Special care shall be taken in the handling and installation of wax coated or similar sprinklers to avoid damaging the coating.

(c) Corrosion resistant coatings shall not be applied to the 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 the installation has been completed. Otherwise, corrosion will attack the exposed metal and will in time creep under the wax coating.

623. For small enclosures and other special locations or conditions not requiring as much water as is discharged by a nominal ½-in. orifice sprinkler, sprinklers having smaller discharge orifices may be used.

624. 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.

NOTE: Sprinklers having special discharge characteristics may be required where either a fine spray or directional discharge of water is needed.

625. SIDEWALL SPRINKLERS. (a) Sidewall sprinklers are special purpose sprinklers and the authority having jurisdiction should be consulted where sidewall sprinklers are to be used.

(b) Where a standard sprinkler system can be installed, without interfering with the decorative scheme, sidewall sprinklers should not be used.

(c) Where, to preserve appearance, concealed sprinkler piping and standard sprinklers can be installed, sidewall sprinklers should not be used.

(d) Generally the use of sidewall sprinklers should be confined to light hazard occupancies, such as hotels, clubs, schools, hospitals and churches.

(e) In both light hazard and ordinary hazard occupancies, sidewall sprinklers may be used in show windows, halls and private offices.

(f) Consideration of the use of sidewall sprinklers may be given where preservation of limited headroom under low decks and ceilings is necessary; or where special types of apparatus or occupancy conditions such as coal conveyors, rug racks, etc., require directional water flow.

630. Stock of Extra Sprinklers.

631. There shall be maintained on the premises a supply of extra sprinklers (never less than six) so that any sprinklers that

have operated or been injured 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 should be kept in a cabinet located where the temperature to which they are subjected will at no time exceed 100° F. Cabinets are furnished in standard sizes of 6 and 12 sprinkler capacities.

632. A special sprinkler wrench should also be provided and kept in the cabinet, to be used in the removal and installation of sprinklers.

633. The number of sprinklers carried for replacement purposes should be governed by:

(a) Size of system.
(b) Location of protected property to source of sprinkler supply.
(c) Number of sprinklers likely to be opened by extraordinary conditions such as flash fire.

Ordinarily, under average conditions, the stock of emergency sprinklers should be as follows:

For equipments not over 300 sprinklers .. 6 sprinklers
For equipments 300 to 1,000 sprinklers...12 sprinklers
For equipments above 1,000 sprinklers...24 sprinklers

Stock of emergency sprinklers should include all types and ratings installed.

For equipments aboard vessels or in isolated locations, a greater number of sprinklers should be carried, to permit equipment to be put back into service promptly after a fire.

640. Guards and Shields.

641. 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.

642. Sprinklers under the gridiron of theatres should be provided with metal shields.

643. Heat collectors over automatic sprinklers under steel grating floors should not be less than 18 inches in least dimension. The deflector should be located not more than 4 inches below the collector.

650. Painting.

651. (a) When the sprinkler piping is given any kind of a coating, such as whitewash or paint, care must be exercised to see that no portion of the automatic sprinklers is covered.

(b) Painting sprinklers after installation interferes with the free movement of parts and may render the sprinkler inoperative. Sprinklers so painted should be replaced with new clean sprinklers. When painting sprinkler piping or in areas near sprinklers they may be fully protected by covering with a paper bag to be removed immediately after painting is finished.

652. The use of painted or enamelled sprinklers is undesirable. Where sprinklers with ornamental finish are desired only those specifically approved as such shall be used. In those cases where approved lacquered sprinklers are allowed they should not be refinished.

SECTION 7. LOCATION AND SPACING OF SPRINKLERS.

701. The authority having jurisdiction shall be consulted in every case as to location and spacing of sprinklers for the protection of buildings and contents.

705. Partial Installations.

(a) Installation of sprinklers throughout the premises is necessary for complete protection to life and property. However, 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 limited protection to property or to provide opportunity for safe exit from the building.

(b) Where such partial sprinkler installations are installed, the standards of this pamphlet should be used in so far as they are applicable. The authority having jurisdiction should be consulted in each case.

(c) 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.

706. Basic Fundamentals.

(a) The basic fundamentals for providing proper protection are namely: (1) Definite maximum protection area per sprinkler. (2) Minimum interference to discharge pattern by beams,

bracing, girders, trusses, piping, lighting fixtures and air conditioning ducts. (3) Correct location of automatic sprinklers with respect to ceilings, or beams and wood joists to obtain suitable sensitivity.

(b) The installation requirements are specific for the usual arrangement of structural members. There will be arrangements of structural members not specifically detailed by the requirements. By applying the basic fundamentals, layouts for such construction can vary from specific illustrations provided the maxima specified for the Spacing of Sprinklers (Sections 720–786) and Position of Sprinklers (Section 790) are not exceeded.

710. Where Installed.

711. Sprinklers should be installed throughout the premises, including basements, lofts and all of the locations herein specified.

712. (a) Sprinklers should be installed under stairs, inside elevator wells, in belt, cable, pipe, gear and pulley boxes, in cold

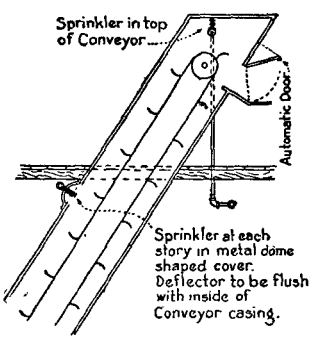


Fig. 712(a). Sprinklers in Conveyor Enclosure.

storage rooms and coolers in other occupancies, inside small enclosures, such as drying and heating boxes, tenter and drying room enclosures, chutes, combustible air ducts, conveyor trunks, bucket elevator enclosures and in all bins, hoppers, lockers, cupboards and closets unless they have tops entirely open and are so located that sprinklers can properly spray therein.

(b) ENCLOSURES with cloth, paper or other similar flammable ceiling should be sprinklered. Sprinklers above unsprinklered enclosures will ordinarily restrict a fire to the enclosure and immediate vicinity but should not be considered as protection for the enclosure and its contents. Many sprinklers may open in such a fire involving water damage over a large area.

(c) STAIRWAYS should be sprinklered underneath whether risers are open or not.

(d) 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.

(e) CONVEYOR ENCLOSURES, DRYERS, ETC. The general rules for the spacing of sprinklers will, in most cases, suggest the proper arrangement for boxed machines, dryer enclosures, large beltways, and similar locations. Special treatment is, however, necessary for picker trunks, or small belt and conveyor enclosures where there is not room inside the enclosure for pipes or sprinklers.

For small beltways and conveyor enclosures pipes may be run outside the enclosures and sprinklers installed in dome-shaped covers about 10 inches in diameter. Where sprinklers can be nippled into the boxing without forming an obstruction, this should be done and dome-shaped covers omitted.

(f) Sprinklers in picker trunks should be not over 7 ft. apart, except in wide trunks, requiring more than one line, where sprinklers may be spaced 8 ft. apart.

(g) Sprinkler piping may be run above hoods over paper machines, dry cans, and similar equipment where dripping of condensation from sprinkler piping must be avoided, and the sprinklers nippled through. The lower sprinklers under the hoods should be located just outside of the line of the cylinders or rolls. If hoods are noncombustible, a line of sprinklers over the bearings at each side will give satisfactory protection.

(h) Automatic sprinkler protection is needed in certain types of economizers such as used in paper mills. Where economizers are subject to freezing temperatures special types of sprinkler protection should be provided.

(i) Special instructions should be obtained relative to placing sprinklers inside show windows, telephone booths, boxed machines, metal air ducts, ventilators and concealed spaces, and under large shelves, benches, tables, overhead storage racks, platforms and similar water sheds, and over electrical generating and transforming apparatus and switchboards.

(j) GENERATOR AND TRANSFORMER ROOMS. Sprinkler protection should ordinarily be provided in generator and transformer rooms. Hoods or shields to protect generators, switch-

boards and other important electrical equipment shall be noncombustible and should be arranged to minimize interference with sprinkler protection. Where walls, floor and ceiling are of fire-resistive construction, sprinklers may be omitted.

(k) Where overhead doors form an obstruction to water distribution from sprinklers above, additional sprinkler protection may be required. Properly located sidewall sprinklers may be used to advantage.

713. BLIND SPACES.

(a) Sprinklers should be installed in all blind spaces enclosed wholly or partly by combustible construction, as in walls, floors and ceilings, except as modified by paragraph (b) below. In spaces formed by studs or joists, sprinkler protection should be provided where there is 6-inches or more clearance between the inside or near edges of the studs or joists, which form the opposite sides of the space. In bar joist construction, sprinklers should be installed wherever the total depth of the space exceeds 6 inches between roof or floor deck and ceiling; the spacing of sprinklers in that case may be on the basis of light hazard classification.

(b) Permission may be given to omit sprinklers from combustible blind spaces where the following conditions prevail:

1. Where the ceiling is attached directly to the under side of the supporting beams of a combustible roof or floor deck or otherwise installed to make the installation of sprinklers impracticable.
2. Where 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.
3. Where a concealed space exceeds 6 inches between structural members but is very limited in area and does not extend to another fire area provided fire or draft stops are installed to subdivide the areas. Such fire or draft stops should be provided at each floor level for vertical and at approximately 50 foot intervals for horizontal divisions or at closer intervals if required by authority having jurisdiction.
4. Where there are small concealed spaces over closets, bathrooms and the like.

714. SPACES UNDER GROUND FLOORS. Sprinklers should be installed in all spaces below combustible ground floors, except that by special permission sprinklers may be omitted where 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 used on the floor above.

715. (a) DECKS. Sprinklers should be installed under decks and galleries unless they do not exceed 4 feet in width, with at least 6 inches clearance from the wall or partition and with arrangements to keep all stock a similar distance from the wall or partition. See Section 201.

(b) DUCTS. Sprinklers should be installed under ducts which are over 4 feet wide, and under ducts of less width if distribution from ceiling sprinklers is obstructed.

716. FIXTURES. Sprinklers should be installed in all stock fixtures which exceed 5 feet in width, also in those which are less than 5 feet but more than 2½ feet in width unless bulkheaded with tight partitions. Sprinklers should be installed in any compartments which are larger than 5 feet deep, 8 feet long and 3 feet high.

717. TABLES. (a) Sprinklers should be installed under cutting, pressing, sewing machine and other work tables wider than 5½ feet, also under tables less than 5½ feet but wider than 4 feet unless provided underneath with tight vertical partitions of galvanized iron or other noncombustible material not over 10 feet apart.

(b) Partitions should be full width of table, extend from underside of table to floor and from front edge to back edge of table, should be substantially fastened to the underside of table and to floor; and should be reinforced with angle or channel iron uprights.

(c) The outer edges of each partition should be smoothly finished (rounded if of metal) so as to prevent injury to employees.

(d) Special instructions should be obtained relative to the installation of "stops" under tables of unusual construction.

718. EXTERIOR DOCKS AND PLATFORMS. (a) Sprinklers should be installed under awnings or roofs over outside platforms except where construction is noncombustible and the platform is not used for storage.

(b) Sprinklers should be installed under exterior docks and platforms of combustible construction unless such space is closed off and protected against accumulation of wind-borne debris.

719. PERMISSIBLE OMISSIONS. (a) Subject to the approval of the authority having jurisdiction, sprinklers may be omitted in rooms or areas where sprinklers are considered undesirable because of the nature of the contents, or in rooms or areas of noncombustible construction with wholly noncombustible contents and which are not exposed by other areas. Sprinklers should not be omitted from any room merely because it is damp or of fire-resistive construction.

(b) It is not advisable to install sprinklers where the application of water or flame-and-water to the contents may constitute a serious life or fire hazard, as in the manufacture or storage of quantities of aluminum powder, calcium carbide, calcium phosphide, metallic sodium and potassium, quicklime, magnesium powder, and sodium peroxide. The manufacture and storage of such materials should be confined to specially cut-off, unsprinklered rooms or buildings of fire-resistive construction.

(c) SAFE DEPOSIT OR OTHER VAULTS of fire-resistive construction will not ordinarily require sprinkler protection when used for the storage of records, files and other documents, when stored in metal cabinets or on metal shelving.

720. Spacing of Sprinklers Under Smooth Ceiling Construction.

721. The term "smooth ceiling" construction as used in this section includes, namely:

(a) Mushroom, flat-slab, pan-type or joisted type reinforced concrete.

(b) Continuous smooth bays formed by wood, concrete or steel beams spaced more than 7½ ft. 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 ft. on centers.

(d) Smooth monolithic ceilings of at least ¾ inches of cement plaster, fibered gypsum plaster, perlite or vermiculite plaster on metal lath or equivalent or other materials or combination of materials of equivalent fire-resistance rating attached to the underside of wood or bar joists.

In b, c, and d the roof and floor decks may be noncombustible or combustible. Item b, would include standard mill construction.

(e) Roof and floor decks consisting of poured gypsum, or concrete on combustible form board supported on steel supports shall be considered noncombustible.

722. LIGHT HAZARD OCCUPANCY. With construction as described in 721 a, b, c, and d the protection area allotted per sprinkler shall not exceed 200 sq. ft. The maximum allowable distance between lines and between sprinklers on lines is 15 ft. Sprinklers need not be staggered.

723. ORDINARY HAZARD OCCUPANCY. (a) With construction as described in 721 a, b, and c, the protection area allotted per sprinkler shall not exceed 130 sq. ft. of noncombustible ceiling and shall not exceed 120 sq. ft. of combustible ceiling. Under metal lath and plaster ceiling 721 d. the protection area allotted per sprinkler shall not exceed 130 sq. ft. of ceiling attached to bar joists supporting a noncombustible roof or floor deck and shall not exceed 120 sq. ft. of ceiling attached to wood joists or bar joists supporting a combustible roof or floor deck.

(b) The protection area allotted per sprinkler under a metal roof deck with noncombustible vapor seal shall not exceed 130 sq. ft. The protection area allotted per sprinkler under a metal roof deck with combustible vapor seal shall not exceed 120 sq. ft.

(c) The maximum allowable distance between lines and between sprinklers on lines is 15 ft. Sprinklers on alternate lines shall be staggered if the distance between lines or the distance between sprinklers on lines exceeds 12 ft. In offices, reception rooms, display rooms and the like of limited area, where appearance is a prime factor, sprinklers may be installed without stagger.

(d) In buildings used for storage where ceiling heights will allow solid closely packed piles of materials in cartons, bales and cases piled over 15 ft. high, or materials on pallets or in racks piled over 12 ft. high, the protection area allotted per sprinkler shall in no case exceed 100 sq. ft. per sprinkler, and the maximum distance between lines and between sprinklers on lines shall in no case exceed 12 ft.

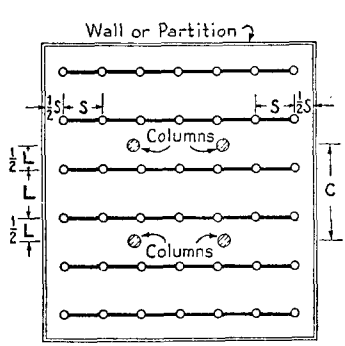
724. EXTRA HAZARD OCCUPANCY. With construction as described in 721 a,b,c, and d, the protection area allotted per sprinkler should not exceed 90 sq. ft. of noncombustible ceiling and should not exceed 80 sq. ft. of combustible ceiling. The maximum allowable distance between lines and between sprin-

klers on lines is 12 ft. Sprinklers on alternate lines shall be staggered if the distance between sprinklers on lines exceeds 8 ft.

725. (a) Under mushroom flat-slab and pan-type reinforced concrete (paragraph 721a) and smooth metal lath and plastered ceilings (paragraph 721d), branch lines may be run in either direction. It is usually desirable to treat each space between columns as a unit; that is installing the same number of lines in each space. Layout of sprinklers under mushroom and pan-type reinforced concrete is shown in Fig. 725a.

Mushroom and Pan Type Reinforced Concrete

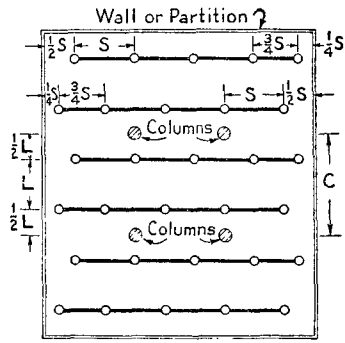
Maximum Spacing: 130 Square Feet Per Sprinkler
L × S = 130 or less



Sprinklers on Alternate Lines Not Staggered
L not over 12 ft.
S not over 12 ft.

EXAMPLES

C	L	S (Max.)
24 ft.	12 ft.	10 ft. 10 in.
22 ft.	11 ft.	11 ft. 10 in.



Sprinklers on Alternate Lines Staggered
When either L or S is 12 ft. 1 in. to 15 ft.

EXAMPLES

C	L	S (Max.)
18 ft.	9 ft.	14 ft. 5 in.
26 ft.	13 ft.	10 ft. 0 in.

Fig. 725a. Layout of Sprinklers Under Smooth Ceiling Construction — Ordinary Hazard. (For Key to symbols see Fig. 725c.)

(b) Under joisted type reinforced concrete ceilings branch lines should be run at right angles to or across the joists. Branch lines should usually be placed midway between the girders in each bay or should be uniformly spaced between girders if the distance between girders is great enough to require more than one line of sprinklers.

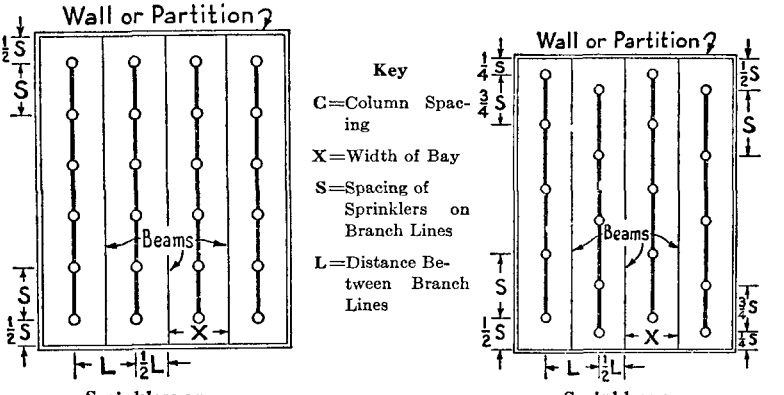
(c) In continuous smooth bays formed by wood or steel beams spaced more than 7½ ft. on centers and supported by columns (paragraph 721b), branch lines should usually be placed midway between the beams in each bay as shown in Fig. 725 (c) or should be uniformly spaced between beams if the distance be-

tween beams is great enough to require more than one line per bay. Branch lines may be placed across the beams and sprinklers may be spaced without regard to the location of beams provided the maximum allowable distance from the ceiling to the deflector will not be exceeded (see Section 793) and provided the location of sprinkler deflectors, if above the bottoms of beams, will be at sufficient distance from the beams to avoid obstructions to distribution, as specified in Section 792.

Continuous Smooth Bays with Beams Supported on Columns

Maximum Spacing: Noncombustible Construction, 130 Sq. Ft. Per Sprinkler
$L \times S = 130$ or less

Maximum Spacing: Combustible Construction, 120 Sq. Ft. Per Sprinkler
$L \times S = 120$ or less



Sprinklers on Alternate Lines Not Staggered
L not over 12 ft.
S not over 12 ft.

EXAMPLES

Construction	X	L	S (Max.)
Noncomb.	12 ft.	12 ft.	10 ft. 10 in.
Comb.	10 ft.	10 ft.	12 ft.

Sprinklers on Alternate Lines Staggered
When either L or S is 12 ft. 1 in. to 15 ft.

EXAMPLES

Construction	X	L	S (Max.)
Noncomb.	9 ft.	9 ft.	14 ft. 5 in.
Comb.	13 ft.	13 ft.	9 ft. 3 in.

Fig. 725c. Layout of Sprinklers Under Smooth Ceiling Construction — Ordinary Hazard.

(d) In continuous smooth bays formed by wood, concrete or steel beams spaced more than 7½ ft. on centers and supported on girders or trusses (721b), branch lines may be placed across the beams and sprinklers may be spaced without regard to the location of beams provided the maximum allowable distance from the ceiling to the deflector will not be exceeded (see section 793) and provided the location of sprinkler deflectors, if above the bottoms of beams, will be at sufficient distances from the beams to avoid obstructions to distribution, as specified in section 792.

In no case should branch lines be closer than 3 ft. 9 in. to girders or trusses. The branch line piping may also be run in the continuous smooth bays but sprinklers should be at least 3 ft. 9 in. from girders or trusses in order to avoid obstructions to the spray distribution by the structural members.

Sprinklers may be located directly above girders or trusses no more than 8 inches wide providing the deflector is at least 6 inches above the top of the girder or truss.

(e) Under smooth ceilings supported directly on girders or trusses (721c), branch lines should usually be placed midway between the girders or trusses in each bay or should be uniformly spaced between girders or trusses if the distance between girders or trusses is great enough to require more than one line per bay. The branch line piping may also be run through the trusses.

726. The distance from the wall to the end sprinklers should not exceed one-half the allowable distance between sprinklers on the branch line. The distance from the wall to the end branch line should not exceed one-half the allowable distance between branch lines.

727. 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. See Table 792 showing Maximum Allowable Distance Deflector Above Bottom of Beam.

730. Spacing of Sprinklers Under Beam and Girder Construction.

731. The term "beam and girder construction" as used in this section includes noncombustible and combustible roof and floor decks supported by, namely:

(a) Wood beams of 4 inches or greater nominal thickness or concrete or steel beams spaced 3 to 7½ ft. 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.)

(b) Bar joists or light steel trusses spaced 3 to 7½ ft. on centers.

(c) Roof and floor decks consisting of poured gypsum or concrete on combustible form board supported on top of steel

beams, steel trusses or bar joists shall be considered noncombustible.

NOTE: See 723(b) for metal roof decks with combustible or noncombustible vapor seal.

732. LIGHT HAZARD OCCUPANCY. With construction as described in 731 (a) and (b) the protection area allotted per sprinkler should not exceed 200 sq. ft. of either noncombustible or combustible roof or floor deck. The maximum allowable distance between lines and between sprinklers on lines is 15 ft. Sprinklers on alternate lines should be staggered.

733. ORDINARY HAZARD OCCUPANCY. (a) With construction as described in 731 (a) and (b) the protection area allotted per sprinkler should not exceed 130 sq. ft. for noncombustible and not to exceed 120 sq. ft. for combustible roof or floor deck. The maximum allowable distance between lines and between sprinklers on lines is 15 ft. Sprinklers on alternate lines should be staggered.

(b) In buildings used for storage where ceiling heights will allow solid closely packed piles of materials in cartons, bales and cases piled over 15 ft. high, or materials on pallets or in racks piled over 12 ft. high, the protection area allotted per sprinkler shall in no case exceed 100 sq. ft. per sprinkler, and the maximum distance between lines and between sprinklers on lines shall in no case exceed 12 ft.

734. EXTRA HAZARD OCCUPANCY. With construction as described in 731 (a) and (b) the protection area allotted per sprinkler should not exceed 90 sq. ft. for noncombustible, and not to exceed 80 sq. ft. for combustible roof or floor deck. The maximum allowable distance between lines and between sprinklers on lines is 12 ft. Sprinklers on alternate lines should be staggered.

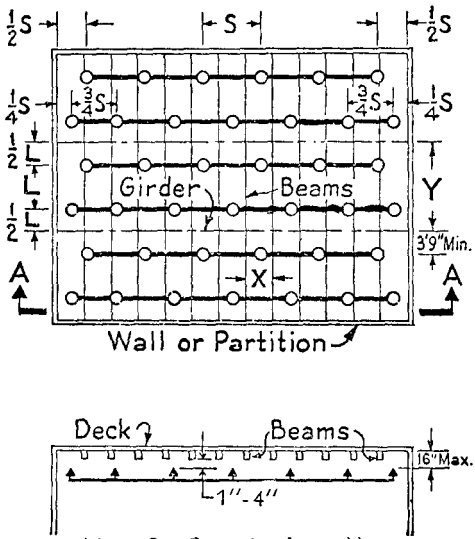
735. With framing described in 731(a) branch lines should usually be run at right angles to the beams and supported from them. Branch lines should be placed midway between girders in each bay or should be uniformly spaced between girders if the distance between girders is great enough to require more than one line per bay. In no case shall branch lines be closer than 3 ft. 9 in. to girders or trusses. (See Fig. 735)

736. With framing as described in 731(a), sprinklers may be spaced alternate beam, alternate bay, or without regard to

Wood or Steel Beams Spaced Less than 5 Ft. Apart and Either Supported On or Framed Into Girders

Maximum Spacing: Noncombustible Construction, 130 Sq. Ft. Per Sprinkler
$L \times S = 130$ or less

Maximum Spacing: Combustible Construction, 120 Sq. Ft. Per Sprinkler
$L \times S = 120$ or less



Note: See Fig. 792 if sprinkler deflector is above bottom of beam

Section A-A

L not over 15 ft.

S not over 15 ft.

X 3 ft. to 4 ft. 11 in.

Key

X=Width of Bay

Y=Maximum Distance between Girders

S=Spacing of Sprinklers on Branch Lines

L=Distance Between Branch Lines

Examples Noncombustible Construction			Examples Combustible Construction		
Y	L	S (Max.)	Y	L	S (Max.)
30 ft.	15 ft.	8 ft. 8 in.	30 ft.	15 ft.	8 ft. 0 in.
24 ft.	12 ft.	10 ft. 10 in.	24 ft.	12 ft.	10 ft. 0 in.
18 ft.	9 ft.	14 ft. 5 in.	18 ft.	9 ft.	13 ft. 4 in.

Fig. 735. Layout of Sprinklers Under Beam and Girder Construction — Ordinary Hazard.

location of beams provided the maximum allowable distance from roof or floor decks to deflector of sprinklers (Section 794) is not exceeded and provided the location of deflectors, if above the bottom of beams will be at sufficient distance from sides of beams to avoid obstruction to the discharge pattern as specified in Section 792 (c) and Table 792. In order to utilize the heat baffling action of the girders, the deflectors of sprinklers in the bays should be located not lower than the bottom of girders.

NOTE: Beam and girder construction by definition is limited to bays not over 7½ feet wide. For the purposes of this paragraph, bays in panel construction may be wider if the panel does not exceed 300 square feet in area.

737. With framing as described in 731(b) branch lines should usually be run at right angles to the bar joists and either beneath them or through them so that the maximum allowable distance from roof or floor deck to sprinkler deflector (Section 794) will not be exceeded. Branch lines should be uniformly spaced between girders. Sprinklers may be located without reference to the bar joists but should be staggered on alternate lines.

738. The distance from the wall to the end sprinklers should not exceed one-half the allowable distance between sprinklers on the branch lines. The distance from the wall to the end branch line should not exceed one-half the allowable distance between branch lines.

739. Girders and trusses forming narrow pockets of combustible construction along walls when of a depth which will obstruct the spray discharge pattern may require additional sprinklers. See Table 792 showing Maximum Allowable Distance Deflector Above Bottom of Beam.

740. Spacing of Sprinklers Under Open Wood Joist Construction.

741. The term "wood joist construction" refers to wood boards or planks on wooden beams spaced less than 3 ft. on centers. Wooden beams less than 4 inches nominal thickness spaced more than 3 ft. on centers are also considered as joist construction.

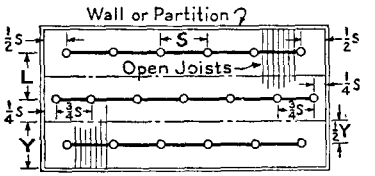
742. LIGHT AND ORDINARY HAZARD OCCUPANCY: (a) Under open finish joist construction without fire stops the protection area allotted per sprinkler should not exceed 90 sq. ft., and not exceed 100 sq. ft. if joist channels are fire stopped at not over 40 ft. intervals. The maximum allowable distance between lines and between sprinklers on lines is 12 ft. Sprinklers shall

Joists Above Girders or Framed into Girders; Branch Lines Uniformly Spaced between Girders

Maximum Spacing

90 Sq. Ft. Per Sprinkler if Joist Channels are Without Fire Stops
$L \times S = 90$ or less

100 Sq. Ft. Per Sprinkler if Joists are Framed into Girders or Joist Channels are firestopped at not over 40 ft. intervals. $L \times S = 100$ or less

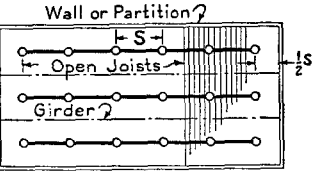


Sprinklers on Alternate Lines Staggered
S=8 ft. 1 in. to 12 ft.
L not over 12 ft.

EXAMPLES
(MAXIMUM 90 SQ. FT. NO FIRE STOPS)

Y	L	S (Max.)
11 ft.	11 ft.	8 ft. 2 in.
16 ft.	8 ft.*	11 ft. 3 in.

*Two lines per bay.



Sprinklers on Alternate Lines Unstaggered
S=8 ft. or less
L not over 12 ft.

EXAMPLES
(MAXIMUM 90 SQ. FT. NO FIRE STOPS)

Y	L	S (Max.)
12 ft.	12 ft.	7 ft. 6 in.
24 ft.	12 ft.*	7 ft. 6 in.

*Two lines per bay.

Fig. 742a. Layout of Sprinklers Under Open Joist Construction — Light and Ordinary Hazard Occupancy. (For Key to symbols see Fig. 744b.)

be staggered across the joists if the distance between the sprinklers across the joists exceeds 8 ft.; otherwise sprinklers need not be staggered. (See Figure 742 a)

(b) Bays 12 ft. 1 in. to 14 ft. 6 in. in width require two lines of sprinklers except where numerous bays of this width prevail, in which case two and one lines may be installed in adjoining bays with two lines in bays next to side or end walls. With this arrangement neither the maximum allowable distance between sprinklers on lines nor the maximum allowable protection area per sprinkler (within each bay) should be exceeded. In the bays containing two branch lines, the lines should be located at the quarter point and not closer than 3 ft. to the girders. (See Figure 742 b)

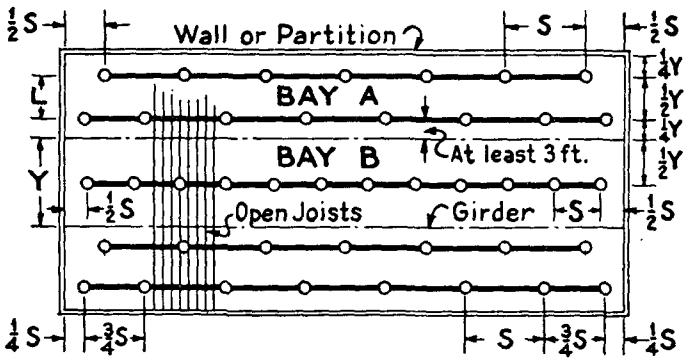
743. EXTRA HAZARD OCCUPANCY: Under open finish joist construction, without fire stops the protection area allotted per sprinkler should not exceed 70 sq. ft., and not exceed 80 sq. ft. if joist channels are fire stopped at not over 40 ft. intervals. The maximum allowable distance between lines and between sprinklers on lines is 10 ft. Sprinklers on alternate lines shall be staggered across the joists.

Joists Above Girders or Framed Into Girders
Two and One Branch Lines Installed Alternately in Bays 12 ft. 1 in. to 14 ft. 6 in. Wide

Maximum Spacing: 90 sq. ft. per sprinkler if joist channels are without firestops. Bay A: L×S=90 or less; Bay B: Y×S=90 or less.

Maximum Spacing: 100 sq. ft. per sprinkler if joists are framed into girders or joist channels are fire stopped at not over 40 ft. intervals.

Bay A: L×S=100 or less; Bay B: Y×S=100 or less.



Bay A: L=6 ft. to 7 ft. 3 in.; S=not over 12 ft. Sprinklers on alternate lines staggered.
Bay B: Y=12 ft. 1 in. to 14 ft. 6 in.; S=7 ft. 6 in. to 6 ft. 3 in. (90 sq. ft. max.)
S=8 ft. 3 in. to 6 ft. 11 in. (100 sq. ft. max.)

EXAMPLE:
Maximum 90 sq. ft. per sprinkler

	Y	L	S (Max.)
Bay A	14 ft.	7 ft.	12 ft.
Bay B	14 ft.	—	6 ft. 5 in.

EXAMPLE:
Maximum 100 sq. ft. per sprinkler

	Y	L	S (Max.)
Bay A	14 ft.	7 ft.	12 ft.
Bay B	14 ft.	—	7 ft. 2 in.

Y=Maximum Distance between Girders
W=Width of Building
S=Spacing of Sprinklers on Branch Lines
L=Distance between Branch Lines

Fig. 742b. Layout of Sprinklers Under Open Joist Construction — Light and Ordinary Hazard Occupancy.

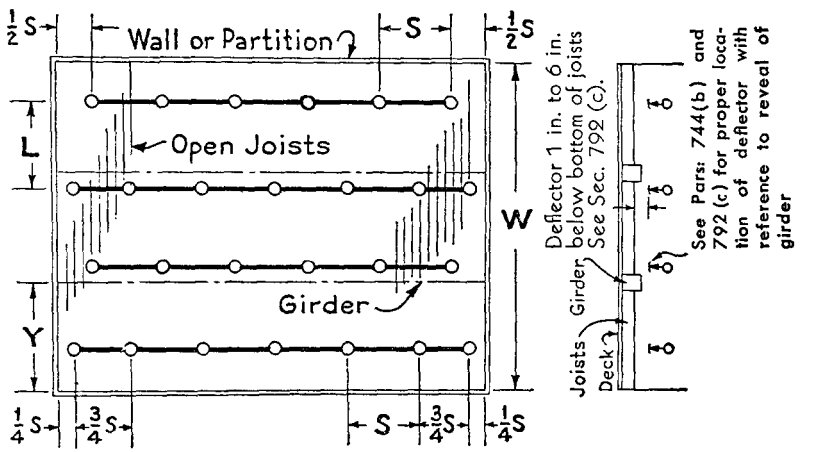
744. (a) Branch lines should be run at right angles to, or across, the joists. Branch lines should usually be placed midway between girders in each bay or should usually be uniformly spaced between girders if the distance between girders is great enough to require more than one line per bay (See Figure 742a).

(b) Where the joists are framed into supporting girders, the girders may be disregarded in the spacing of the branch

lines providing sprinkler deflectors are at such elevation that the girders offer no obstruction to the spray discharge pattern.

Joists Framed Into Girders; Branch Lines Not Uniformly Spaced Between Girders

Use when branch lines can be located so that reveal of girder offers no obstruction to discharge pattern. Maximum Spacing: 100 Sq. Ft. Per Sprinkler
L × S = 100 or less



Sprinklers on Alternate Lines Staggered

S=8 ft. 1 in. to 12 ft.
L not over 12 ft.
Number of Lines = $\frac{W}{L}$

EXAMPLES	
L	S (Maximum)
12 ft.	8 ft. 4 in. (staggered)
8 ft. 4 in.	12 ft. (staggered)

Y=Maximum Distance between Girders
W=Width of Building

S=Spacing of Sprinklers on Branch Lines
L=Distance between Branch Lines

Fig. 744b. Layout of Sprinklers Under Open Joisted Construction — Light and Ordinary Hazard Occupancy.

745. The distance from the wall to the end sprinklers should not exceed one-half the allowable distance between sprinklers on the branch lines.

746. Where there are two sets of joists under a roof or ceiling and there is no flooring over the lower set, sprinklers should be installed above and below the lower set of joists where there is a clearance of from 6 in. to 12 in. between the top of the lower joist and bottom of the upper joist.

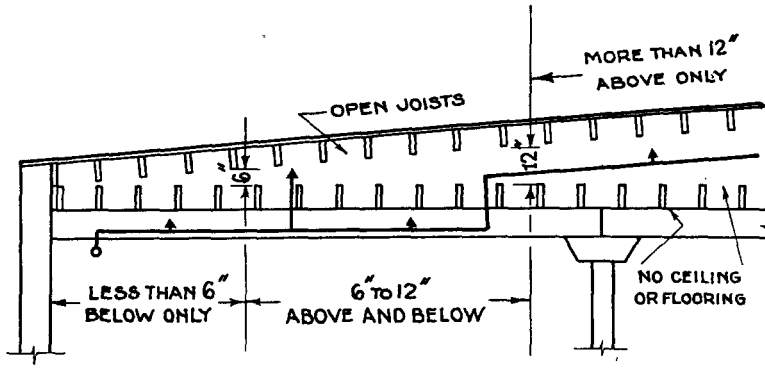


Fig. 746. Arrangement of Sprinklers under Two Sets of Open Joists — no sheathing on lower joists.

750. Spacing of Sprinklers Under Wood Joist Construction with Sheathed or Suspended Ceiling.

751. For wood joist construction sheathed with metal lath and plaster or other ceiling described in 721(d), the spacing requirements under section 720 apply.

752. LIGHT HAZARD OCCUPANCY. Where wood joist construction is sheathed with plaster board, metal, wood lath and plaster, wood, fiberboard or other combustible sheathing, the protection area allotted per sprinkler shall not exceed 168 sq. ft. The maximum allowable distance between lines and between sprinklers on lines is 14 ft. Sprinklers need not be staggered.

753. ORDINARY HAZARD OCCUPANCY. (a) Where wood joist construction is sheathed with plaster board, metal, wood lath and plaster, the protection area allotted per sprinkler shall not exceed 100 sq. ft. The maximum allowable distance between lines and between sprinklers on lines is 12 ft. Sprinklers need not be staggered.

(b) Where wood joist construction is sheathed with wood, fiberboard or other combustible sheathing, the protection area allotted per sprinkler shall be as for open wood joist construction. See section 742(a). Sprinklers shall be staggered across the joists if the distance between the sprinklers across the joists exceeds 8 feet; otherwise sprinklers need not be staggered.

(c) A protection area of 130 sq. ft. per sprinkler may be allotted for sprinklers under a noncombustible suspended ceiling and 120 sq. ft. per sprinkler under a combustible suspended ceil-

ing as described in 713(a) provided there is a full complement of sprinklers in the space immediately above such ceilings and the space is unfloored and unoccupied. The maximum allowable distance between lines and between sprinklers on lines is 15 ft. Sprinklers on alternate lines shall be staggered if the distance between lines or between sprinklers on lines exceeds 12 ft.

(d) In buildings used for storage where ceiling heights will allow solid closely packed piles of materials in cartons, bales and cases piled over 15 ft. high, or materials on pallets or in racks piled over 12 ft. high, the protection area allotted per sprinkler shall in no case exceed 100 sq. ft. per sprinkler, and the maximum distance between lines and between sprinklers on lines shall in no case exceed 12 ft.

754. EXTRA HAZARD OCCUPANCY. Where wood joist construction is sheathed with sheathing other than described in 721(d), the protection area allotted per sprinkler shall not exceed 80 sq. ft. The maximum allowable distance between lines and between sprinklers on lines is 12 ft. Sprinklers on alternate lines shall be staggered.

755. Spacing of Sprinklers Under Bar Joist, Beam and Girder or Smooth Ceiling Construction with Sheathed or Suspended Ceiling.

756. For bar joist construction sheathed with metal lath and plaster or other ceiling described in 721(d), the spacing requirements under section 720 apply.

757. LIGHT HAZARD OCCUPANCY. Where bar joist, beam and girder or smooth ceiling construction is sheathed with plaster board, metal, wood lath and plaster, wood, fiberboard or other combustible sheathing, the protection area allotted per sprinkler shall not exceed 168 sq. ft. The maximum allowable distance between lines and between sprinklers on lines is 14 ft. Sprinklers need not be staggered.

758. ORDINARY HAZARD OCCUPANCY. (a) Where bar joist, beam and girder or smooth ceiling construction is sheathed with plaster board, metal, wood lath and plaster, the protection area allotted per sprinkler shall not exceed 120 sq. ft. The maximum allowable distance between lines and between sprinklers on lines is 12 ft. Sprinklers need not be staggered.

(b) Where bar joist, beam and girder or smooth ceiling construction is sheathed with wood, fiberboard or other combustible sheathing, the protection area allotted per sprinkler shall

not exceed 110 sq. ft. The maximum allowable distance between lines and between sprinklers on lines is 12 ft. Sprinklers shall be staggered across the joists if distance between sprinklers measured in this direction exceeds 8 ft., otherwise sprinklers need not be staggered.

(c) A protection area of 130 sq. ft. per sprinkler may be allotted for sprinklers under a noncombustible suspended ceiling and 120 sq. ft. per sprinkler under a combustible suspended ceiling as described in 713(a) provided there is a full complement of sprinklers in the space immediately above such ceilings and the space is unfloored and unoccupied. The maximum allowable distance between lines and between sprinklers on lines is 15 ft. Sprinklers on alternate lines shall be staggered if the distance between lines or between sprinklers on lines exceeds 12 ft.

(d) In buildings used for storage where ceiling heights will allow solid closely packed piles of materials in cartons, bales and cases piled over 15 ft. high, or materials on pallets or in racks piled over 12 ft. high, the protection area allotted per sprinkler shall in no case exceed 100 sq. ft. per sprinkler, and the maximum distance between lines and between sprinklers on lines shall in no case exceed 12 ft.

759. EXTRA HAZARD OCCUPANCY. Where bar joist, beam and girder or smooth ceiling construction is sheathed with sheathing other than described in 721(d), the protection area allotted per sprinkler shall not exceed 80 sq. ft. The maximum allowable distance between lines and between sprinklers on lines is 12 ft. Sprinklers on alternate lines shall be staggered.

760. Spacing of Sprinklers Under Open Bar Joist Construction.

761. The term "bar joist construction" refers to construction employing joists consisting of steel truss-shaped members formed of rods or small steel shapes.

762. This section includes noncombustible and combustible roof and floor decks supported on bar joists or light steel trusses spaced less than 3 ft. on centers. For sprinkler spacing under similar construction with bar joists or light steel trusses spaced 3 to 7½ ft. on centers see Section 730.

Roof and floor decks consisting of poured gypsum or concrete on combustible form board supported on top of steel bar joists or long span steel beams shall be considered noncombustible.

NOTE: See 723(b) for metal roof decks with combustible or noncombustible vapor seal.

763. LIGHT HAZARD OCCUPANCY. With construction as described in 762 the protection area allotted per sprinkler should not exceed 168 sq. ft. of noncombustible or combustible roof or floor deck. The maximum allowable distance between lines and between sprinklers on lines is 15 ft.

764. ORDINARY HAZARD OCCUPANCY. (a) With construction as described in 762 the protection area allotted per sprinkler should not exceed 120 sq. ft. for noncombustible, and not exceed 110 sq. ft. for combustible roof or floor deck. The maximum allowable distance between lines and between sprinklers on lines is 15 ft.

(b) In buildings used for storage where ceiling heights will allow solid closely packed piles of materials in cartons, bales and cases piled over 15 ft. high, or materials on pallets or in racks piled over 12 ft. high, the protection area allotted per sprinkler shall in no case exceed 100 sq. ft. per sprinkler, and the maximum distance between lines and between sprinklers on lines shall in no case exceed 12 ft.

765. EXTRA HAZARD OCCUPANCY. With construction as described in 762 the protection area allotted per sprinkler should not exceed 90 sq. ft. for noncombustible and not exceed 80 sq. ft. for combustible roof or floor deck. The maximum allowable distance between lines and between sprinklers on lines is 12 ft.

766. Sprinklers may be located without reference to the bar joists but should be staggered on alternate lines and consideration given to obstruction formed by joist members. See 775.

767. Branch lines should usually be run at right angles to the bar joists and either beneath them or through them so that the maximum allowable distance from ceiling to sprinkler deflector will not be exceeded (see Section 796). Branch lines should be uniformly spaced between girders.

768. The distance from the wall to the end sprinklers should not exceed one-half the allowable distance between sprinklers on the branch lines. The distance from the wall to the end branch line should not exceed one-half the allowable distance between branch lines.

770. Spacing of Sprinklers Under Pitched Roofs.

(a) Under pitched roofs having a pitch in excess of 1 foot in 3 and where branch lines are run parallel to the peak, one line of sprinklers should be located in the peak of the roof or a line of sprinklers should be located on each side down from the

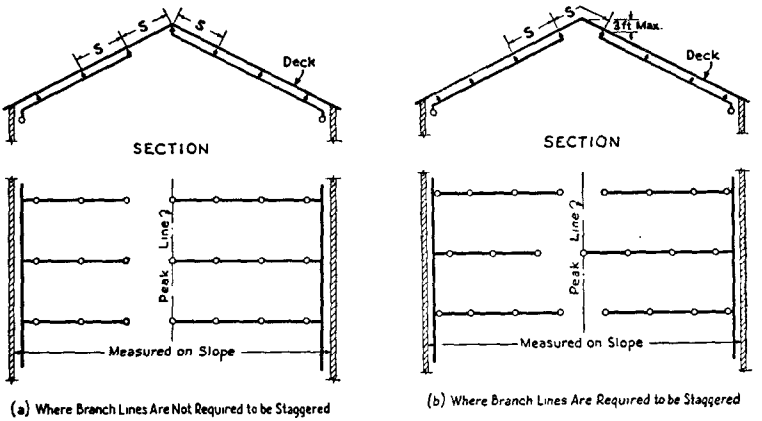


Fig. 770. Sprinklers at Pitched Roofs. Branch Lines Run Up the Slope.

S = spacing of sprinklers on branch lines

peak a distance not greater than one-half the distance between branch lines. Where branch lines are run up the slopes, the end sprinklers on branch lines on one slope should be located in the peak or end sprinklers on branch lines on both slopes should be located down from the peak a distance not greater then one-half the allowable distance between sprinklers on the branch lines. In any case the deflectors of the highest sprinklers should be not more than 3 ft. vertically below the peak. (See Section 797.)

(b) The spacing of sprinklers should be in accordance with the type of construction as outlined in sections 720 to 760 inclusive. The distances between sprinklers on branch lines should be measured on a line parallel with the roof.

(c) In sawtooth roofs the end sprinklers on the branch lines should usually be not over 3 feet from the peak of the sawtooth.

771. Spacing of Sprinklers Under Curved Roofs — Quonset Type Buildings:

(a) Under curved roofs, sprinklers should be spaced in accordance with the foregoing requirements for the closest comparable type of ceiling construction. Where 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.

(b) Under curved roof of steel with ribs 6 inches deep spaced 4 feet on centers the protection area allotted per sprinkler for light and ordinary hazard occupancy should not exceed 120 ft. of the ceiling area. The maximum allowable distance between lines and between sprinklers on lines is 12 feet, with the sprinklers staggered on alternate lines.

(c) Where curved roofs of steel are sheathed with a combustible sheathing see Section 755 for spacing of sprinklers.

(d) Deflectors of sprinklers should be parallel with the curve of the roof or tilted slightly toward the peak of the roof. The distance of deflectors of sprinklers from ceiling shall be as specified in Section 798.

772. Where extra hazard occupancy spacing of sprinklers is used under pitched or 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 exta hazard occupancies, but in no case shall the spacing on the roof or ceiling be wider than required for ordinary hazard occupancies.

773. Prefabricated Type Metal Buildings. Spacing of sprinklers under prefabricated type metal buildings should not exceed a protection area of 120 sq. ft. per sprinkler. The maximum allowable distance between lines and between sprinklers on lines is 12 ft., with the sprinklers staggered on alternate lines.

774. Distance from Walls. The distance from wall or partition to first sprinkler shall not exceed one-half the allowable distance between sprinklers in the same direction. Additional sprinklers may be required in narrow combustible pockets formed by bay timbers or beams with walls or partitions. (See Table 792.)

775. Obstructions. Timbers, uprights, hangers, piping, lighting fixtures, ducts etc., are likely to interfere with the proper distribution of water from sprinklers. Therefore, sprinklers should be so located or spaced that any interference is held to a minimum. This will ordinarily mean a distance of at least 12 inches from such members, except for lighting fixtures and ducts — See Section 792(c).

776. Lighting Fixtures. (a) Lighting fixtures of the pendent or surface mounted type may offer obstruction to discharge from sprinklers unless the clearances specified in Table 792 are provided.

(b) Branch sprinkler lines should be run parallel to and between lines of fixtures and should be sufficient in number to provide proper floor and ceiling coverage. Pendent fixtures located below the level of the sprinkler deflectors and also surface mounted fixtures may necessitate additional branch lines.

777. Open Grid Ceilings. The installation of open grid egg crate, louver or honeycomb ceilings beneath sprinklers restricts the sidewise travel of the sprinkler discharge and may change the character of discharge.

The following rules are applicable to open grid ceilings in which the openings are ¼ inch or larger in least dimension and such openings constitute a large percentage of the area of the ceiling material. Other types of open grid ceilings should not be installed beneath sprinklers unless they are listed by a nationally recognized testing laboratory and are installed in accordance with their listing.

NOTE: Ceilings made of highly flammable material may spread fire faster than sprinklers can control.

(a) In light hazard occupancies where spacing of sprinklers of either standard or old type is not wider than 10 by 10 ft., a minimum clearance of at least 18 inches should be provided between the sprinkler deflectors and the upper surface of the open grid ceiling. Where spacing is wider than 10 by 10 ft. but not wider than 10 by 12 ft., a clearance of at least 24 inches should be provided from standard sprinklers and at least 36 inches from old type sprinklers. Where spacing is wider than 10 by 12 ft., a clearance of at least 48 inches should be provided from standard sprinklers; any old type sprinklers should be replaced with standard sprinklers.

(b) In ordinary hazard occupancies open grid ceilings should be installed beneath sprinklers only where such use is approved by the authority having jurisdiction, and should be installed beneath standard sprinklers only. Where sprinkler spacing is not wider than 10 by 10 ft., a minimum clearance of at least 24 inches should be provided between the sprinkler deflectors and the upper surface of the open grid ceiling. Where spacing is wider than 10 by 10 ft., a clearance of at least 36 inches should be provided.

778. Protection of Vertical Shafts:

(a) Within vertical shafts having combustible sides, sprinklers shall be provided for each 200 sq. ft. of combustible surface, in addition to sprinklers at tops of shafts. Such sprinklers

should be installed at each floor when practicable, and always when shaft is trapped. In vertical shafts with noncombustible sides there should be at least one sprinkler near the bottom.

(b) Where practicable, sprinklers shall be "staggered" at the alternate floor levels, particularly when only one sprinkler is installed at each floor level.

(c) Where vertical openings are not protected by standard enclosures, sprinklers should be so placed as to fully cover them. This necessitates placing sprinklers close to such openings at each floor level.

779. Protection of Fur Vaults:

(a) Sprinklers in fur storage vaults should be located centrally over the aisles between racks and should be spaced not over 5 feet apart along the aisles.

(b) Where sprinklers are spaced 5 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

(c) Sprinklers shall be of approved old type 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 separately published standard on Fur Storage (No. 81).* For tests of sprinkler performance in fur vaults see Report on Automatic Sprinkler Protection for Fur Storage Vaults of Underwriters' Laboratories, Inc.

780. Sidewall Sprinklers. (See Section 625.)

781. Sidewall sprinklers should be located not more than 10 ft. apart on walls for ordinary hazard occupancies and not more than 14 ft. apart for light hazard occupancies. Ordinarily, deflectors should be at a distance from walls and ceiling not exceeding 6 inches and never less than 4 inches. The installation of sidewall sprinklers other than beneath smooth ceilings will require special rulings.

782. Rooms having widths in excess of 15 ft. up to 30 ft. shall have sprinklers on two opposite walls with spacing as above required and sprinklers regularly staggered. Where rooms are over 20 ft. in width special consideration should be given to addi-

*See Appendix for information on availability of standards.

tional sprinkler protection required to supplement the protection given by the sprinklers along the sidewalls.

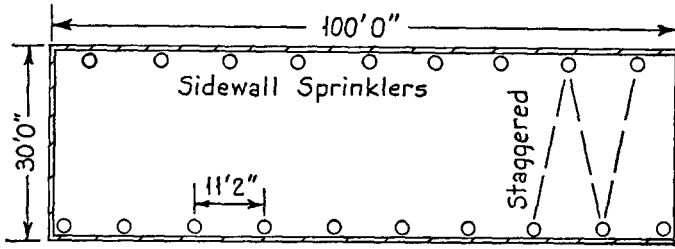


Fig. 782. Spacing of Sidewall Sprinklers under Smooth Ceilings, with Light Hazard Occupancy. Water pressure, construction and occupancy may necessitate additional branch lines of sprinklers in rooms over 20 ft. in width.

783. Special consideration should be given to placing sidewall sprinklers so that they will be favored to the greatest possible extent in receiving the heat from a fire and at the same time most effectively distribute the water discharged by them. This is likely to be particularly important where heavy decorative molding is encountered near the junction of walls and ceilings.

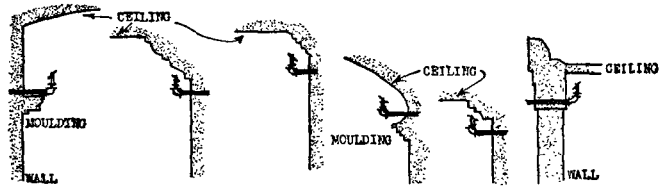


Fig. 783. Suggested Arrangements for Sidewall Sprinklers — placed to receive early heat waves and provide effective distribution.

784. Where the ceiling above and the wall to the rear of sidewall sprinklers are smooth and at right angles to each other good results are obtainable with the sprinklers placed vertical.

785. Where the ceiling contour is sloping or there is other reason for greater than ordinary ceiling protection due to construction, occupancy, etc., increased ceiling coverage is obtainable by tilting the sprinklers to conform with the ceiling slope.

786. Spacing of side wall sprinklers should be as follows:

(a) LIGHT HAZARD OCCUPANCY.

1–With noncombustible smooth ceiling the protection area allotted per sprinkler shall not exceed 196 sq. ft. with the distance between sprinklers on lines not in excess of 14 feet.

2–With combustible smooth ceiling sheathed with plasterboard, metal, or wood lath and plaster the protection area allotted per sprinkler shall not exceed 168 sq. ft. with the distance between sprinklers on lines not in excess of 14 feet. Where sheathing is combustible such as wood, fibreboard or other combustible material the protection area allotted per sprinkler shall not exceed 120 sq. ft. with the distance between sprinklers on lines not in excess of 14 feet.

(b) ORDINARY HAZARD OCCUPANCY.

1–With noncombustible smooth ceiling the protection area allotted per sprinkler shall not exceed 100 sq. ft. with the distance between sprinklers on lines not in excess of 10 feet.

2–With combustible smooth ceiling sheathed with plasterboard, metal, wood lath and plaster, wood, fibreboard or other combustible material the protection area per sprinkler shall not exceed 80 sq. ft. per sprinkler with the distance between sprinklers on lines not in excess of 10 feet.

(c) EXTRA HAZARD OCCUPANCY.

Installation of sidewall sprinklers in extra hazard occupancy will require special permission and recommendations by the authority having jurisdiction.

790. Position of Sprinklers.

791. UPRIGHT OR PENDENT. 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. Sprinklers should be installed with the frame parallel to the branch line pipe to reduce to minimum the obstruction of the discharge pattern.

792. POSITION OF DEFLECTORS.

(a) 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.

(b) Where branch lines run across the beams, the deflectors of sprinklers located in the bays, should preferably be located above the bottom of the beam and in no case more than 4 inches below the bottom level of the beams.

(c) It is essential that if deflectors of sprinklers in the bays are above the bottom of beams, they be at sufficient distances from the beams, as shown in the table below, and in Fig. 792 to avoid obstructions to the discharge pattern.

TABLE 792

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.

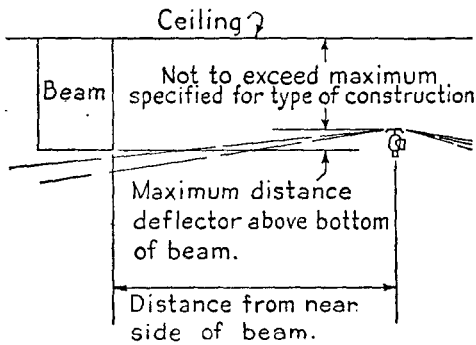


Fig. 792. Position of Deflector When Located Above Bottom of Beam.

793. SMOOTH CEILING CONSTRUCTION. (As defined in Section 720.)

(a) Deflectors of sprinklers in bays should be located not less than 3 inches below ceilings, and not more than 10 inches below combustible ceilings or 12 inches below noncombustible ceilings.

(b) Deflectors of sprinklers under beams should 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.

(c) When sprinklers approved for pendent use are installed in the pendent position under smooth ceilings the deflectors should be not less than 2½ inches from ceiling. Special approved

type pendent sprinklers (flush type, ceiling type) may have deflectors nearer the ceiling.

794. BEAM AND GIRDER CONSTRUCTION. (As defined in Section 730.)

(a) Deflectors of sprinklers in bays formed by beams spaced less than 5 feet on centers and supported on girders should be located not less than 3 inches below and not more than 16 inches below combustible or noncombustible roof or floor decks.

(b) Deflectors of sprinklers under beams spaced less than 5 ft. on centers and supported on girders should be 1 inch to 4 inches below beams and not more than 16 inches below combustible or not more than 18 inches below noncombustible roof or floor decks.

(c) Deflectors of sprinklers in bays formed by beams spaced 5 feet to 7½ feet on centers and supported on girders should be located not less than 3 inches below and not more than 12 inches below combustible or not more than 14 inches below noncombustible roof or floor decks.

(d) Deflectors of sprinklers under beams spaced 5 feet to 7½ feet on centers and supported on girders should be located 1 inch to 4 inches below beams and not more than 16 inches below combustible or not more than 18 inches below noncombustible roof or floor decks.

(e) Deflectors of sprinklers in bays formed by beams framed into girders resulting in panels up to 200 square feet should be located not less than 3 inches below, and not more than 16 inches below combustible or not more than 20 inches below noncombustible roof and floor decks.

(f) Deflectors of sprinklers in bays formed by beams framed into girders resulting in panels 201 to 300 square feet should be located not less than 3 inches below, and not more than 12 inches below combustible or not more than 18 inches below noncombustible roof and floor decks.

(g) Deflectors of sprinklers under beams framed into girders forming panels up to 200 square feet should be located 1 inch to 4 inches below beams, and not more than 22 inches below combustible and noncombustible roof and floor decks.

(h) Deflectors of sprinklers under beams framed into girders forming panels 201 to 300 square feet should be located 1 inch to 4 inches below beams, and not more than 18 inches below combustible, or not more than 20 inches below noncombustible roof and floor decks.

NOTE: Nailing strips to 2 inches nominal thickness on beams only will not prevent the use of the panel area credit.

(i) Where bar joists or light steel trusses are spaced 3 feet to 7½ feet on centers, sprinklers should be located with deflectors not less than 3 inches, and not more than 10 inches below combustible, or not more than 12 inches below noncombustible roof or floor decks.

795. JOIST CONSTRUCTION (As defined in Section 740). In open joist construction sprinklers should be located with deflectors 1 inch to not more than 6 inches below the bottom of the joists. Under joist construction with sheathed or plastered ceilings, sprinklers should be located with deflectors 3 inches to 10 inches below the ceilings.

796. BAR JOIST CONSTRUCTION (As defined in Section 760). Deflectors of sprinklers should be located not less than 3 inches below and not more than 10 inches below combustible or not more than 12 inches below noncombustible roof or floor decks.

797. PITCHED ROOF CONSTRUCTION. Interference with the discharge pattern may result where sprinklers are located in peaks of a steeply pitched roof. To minimize this interference the distance from peak to deflectors may be increased over that specified in Section 770. It is desirable to maintain a horizontal clearance of not less than 2 feet. (See Figures 797, 770.)

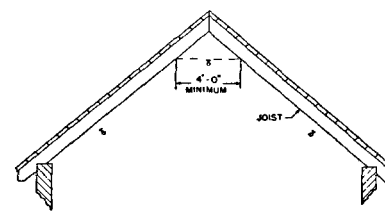


Fig. 797. Desirable Horizontal Clearance for Sprinklers at Peak of Pitched Roof.

798. CURVED ROOFS (Quonset Type Buildings). Deflectors of sprinklers should be located as described for beam and girder construction or for the closest comparable type of ceiling construction.

799. BAFFLES. Baffles should be installed wherever sprinklers are less than 6 ft. apart to prevent the sprinkler first opening from wetting adjoining sprinklers, thus delaying their operation. Baffles should be located midway between sprinklers and arranged to baffle the actuating elements. Baffles may be of sheet metal, about 8 inches wide and 6 inches high. When placed on branch line piping, the top of baffles should extend 2 to 3 inches above the deflectors.

SECTION 8. DRY-PIPE SYSTEMS.

801. Dry-pipe systems shall comply with all other rules except as modified by this section.

802. A dry-pipe system should be installed only where a wet-pipe system is impracticable, as in rooms or buildings which cannot be properly heated. The use of an approved dry-pipe system is, however, far preferable to entirely shutting off the water supply during cold weather.

803. Where it is necessary to have but 25 per cent or less of the total number of sprinklers on a dry-pipe system, only such sprinklers should be thus piped; the remainder should be placed on wet system. This may require small dry-pipe systems or preaction systems for show windows, blind attics or other minor portions exposed to freezing. No sprinklers should be shut off in cold weather without the consent of the authority having jurisdiction, and in no case should the number of sprinklers so shut off exceed ten.

804. Sprinklers should be installed in the upright position. Sprinklers installed in the pendent position shall be of the approved dry pendent type.

810. Subdivision of Systems.

811. Where two or more dry-pipe valves are used, systems should preferably be divided horizontally.

812. Where required by the authority having jurisdiction in buildings of large single area such as piers, storage sheds, foundries, car shops, large attics, etc., substantial curtains preferably of noncombustible material extending down 24 inches or more below the ceiling shall be provided to separate sprinkler systems or subdivide areas. (See Figs. 203–1 and 203–2.)

820. Size of Systems.

821. Not more than 600 sprinklers or 750 gallons system capacity should be controlled by one dry-pipe valve.

822. The capacities of the various sizes of pipe given in the following table are for convenience in calculating the air capacity of a system.

TABLE 822.

CAPACITY OF 1 FOOT OF PIPE.
(Based on actual internal diameter)

Diameter	*Gallons*	*Diameter*	*Gallons*
¾ in.	.028	3 in.	.383
1 in.	.045	3½ in.	.513
1¼ in.	.078	4 in.	.660
1½ in.	.106	5 in.	1.040
2 in.	.174	6 in.	1.501
2½ in.	.248	8 in.	2.66

SPRINKLER EQUIVALENTS FOR EACH FOOT LENGTH OF FEED MAIN PIPE.

Pipe Size	*Sprinklers per Ft.*	*Pipe Size*	*Sprinklers per Ft.*
2 in.	0.130	4 in.	0.522
2½ in.	0.204	5 in.	0.816
3 in.	0.293	6 in.	1.175
3½ in.	0.399	8 in.	2.01

823. Where an 8-inch riser is employed in connection with a dry-pipe system, a 6-inch dry-pipe valve and a 6-inch gate valve between taper reducers may be used.

830. Quick-Opening Devices.

831. Each standard dry-pipe valve controlling more than 400 sprinklers or having system capacity of more than 500 gallons shall be provided with an approved quick-opening device.

832. The quick-opening device shall be located as close as possible to the dry-pipe valve. Protection of the restriction orifice and other operating parts of the quick-opening device against submergence necessitates that the connection to the riser shall be at a point above which water (priming water and back drainage) is not to be expected when the dry-pipe valve and quick-opening device are set, except where design features of particular quick-opening devices make these requirements unnecessary.

NOTE: In the case of dry-pipe valves having relatively small priming chambers and in which the normal quantity of priming water fills, or nearly fills, the entire priming chamber, the object contemplated by this rule will be met by requiring connection of the quick-opening device at a point on the riser above the dry-pipe valve, which will provide a capacity measure between the normal priming level of the air chamber and the connection of 1½, 2 and 3 gallons for 4-, 5- and 6-inch risers, respectively. Making the connection 24 inches above the normal priming water level will ordinarily provide this capacity.

833. 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.

834. A globe or gate valve shall also be installed in the connection between the quick-opening device and the intermediate chamber of the dry-pipe valve whenever necessary to prevent the escape of water if the dry-pipe valve should trip with the quick-opening device disconnected. A check valve may be used instead of a gate valve whenever it will serve the same purpose.

840. Location and Protection of Dry-Pipe Valve.

841. (a) The dry-pipe valve should be located in an accessible place and as near as practicable to the sprinkler system it controls. It should be properly protected against freezing and mechanical injury.

(b) To protect supply pipe from frost, avoid low space under floor.

(c) Where exposed to cold the dry-pipe valve should preferably be located in an approved valve room or enclosure and, where this is not possible, in an underground pit acceptable to the authority having jurisdiction. Room should be of sufficient size to give at least 2½ feet of free space at the sides and in front of, also above and below the dry-pipe valve or valves, and this room, if feasible, should not be built until the valve is in position.

(d) Size of enclosures should be governed by the number and arrangement of dry-pipe valves, so as to give ready access to these devices.

(e) Valve room should be well lighted, preferably by electric light, and properly heated by steam, electric heater (installation to comply with the National Electrical Code*), gas or lard oil lantern. If fire heat is used, some ventilation will be necessary to supply the air for combustion.

(f) Latches for doors should be arranged to hold door tight to frame. Latches similar to those used on refrigerators are recommended.

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

843. Sketches of Dry-Pipe Valve Enclosures.

The enclosures shown on pages 13–116, 13–117, 13–118, and 13–119 are intended to serve as illustrations of those already in successful use, rather than as standards, from which to select or modify the design most suitable for local needs, in consideration of the varying climatic conditions. The sketches are not drawn to scale.

*See Appendix for information on availability of standards.

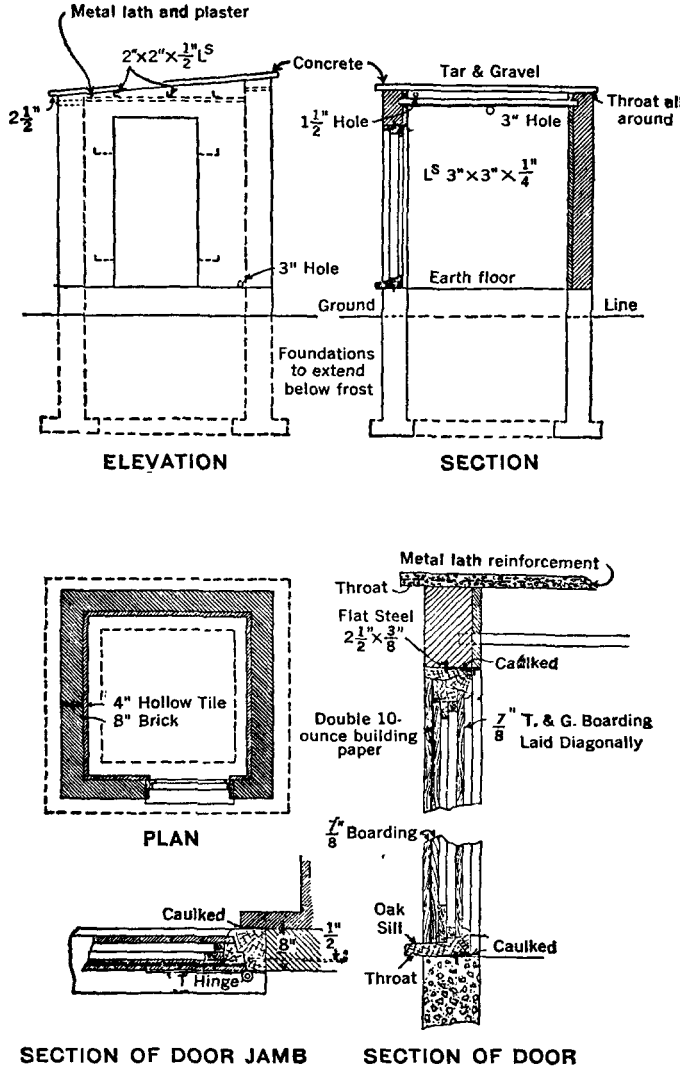
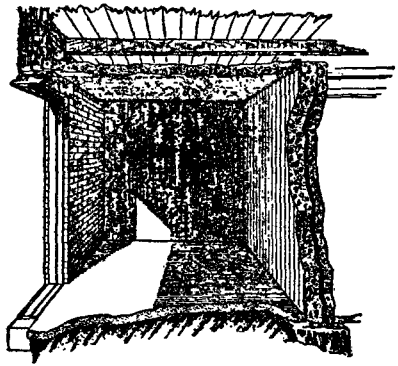


Fig. 843-1. Dry-Pipe Valve Enclosures — Fire-Resistive Construction, Located Outside of Building with no Direct Communication to Building.



SECTIONAL VIEW

Outer and inner walls should be bonded to provide greater stability and insure even settlement but not so as to interfere with circulation of air. Corners should be protected by angle iron or other suitable means, where subject to mechanical injury. Provision should be made in the erection by metal sleeves or otherwise for the needed openings for the piping.

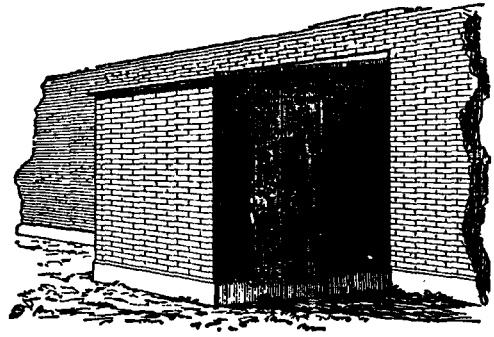
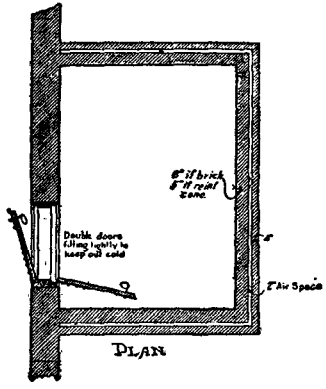
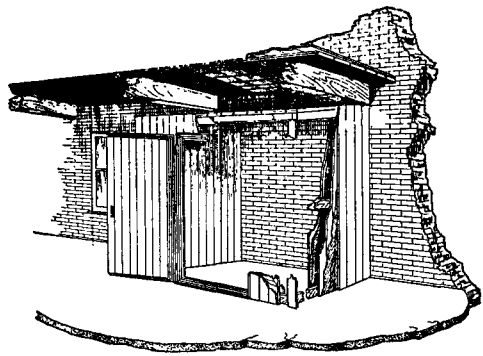


Fig. 843-3. Dry-Pipe Valve Enclosures — Fire-Resistive Construction, Located Outside of Building with no Direct Communication to Building.



PLAN

Fig. 843-2. Dry-Pipe Valve Enclosure — Fire-Resistive Construction, Located in Building but with Entrance from Outside Only. Walls and roof may be either of brick or concrete. Where fire heat is used to warm enclosure ventilation should be provided.



SECTIONAL VIEW

Fig. 843-4. Dry-Pipe Valve Enclosure — Combustible Construction, Located Inside Building.

Air space may be increased and filled with insulating material. Where exposed to frost, floor should be double and filled with insulating material. With this type, any heating should preferably be steam, or at least electric. If gas, the inside should be protected and ventilation provided. With fire heat, a better enclosure would be one of expanded metal and cement. Walls should be double, each side at least two inches thick with two inches air space between, floor should be concrete. Ventilation should be provided and door should be of metal or standard tin clad.

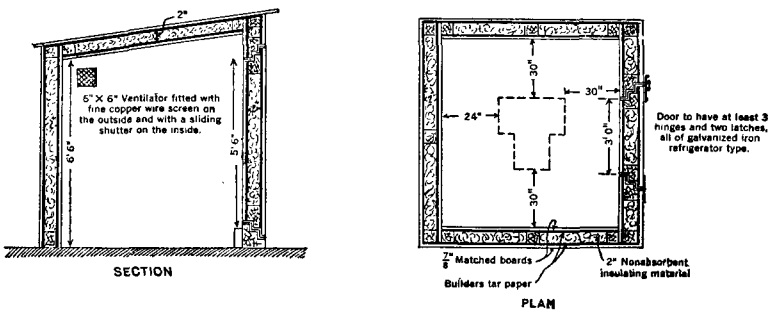
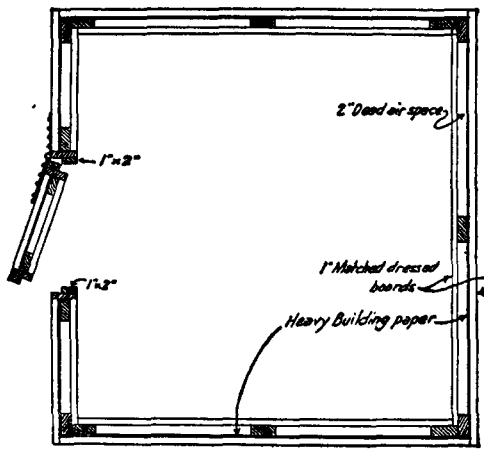
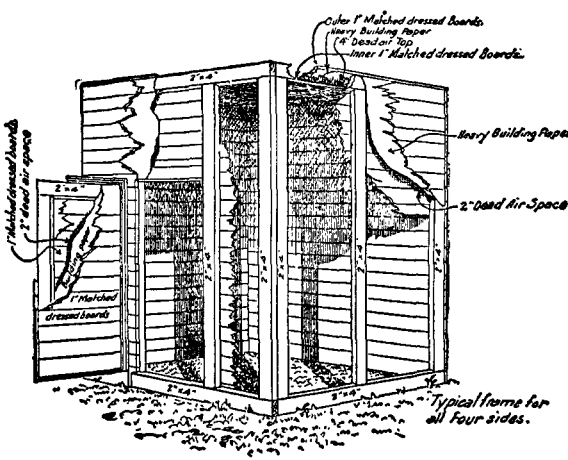


Fig. 843-5. Dry-Pipe Valve Enclosure — Combustible Construction.

This enclosure is for use where dry valves are subject to freezing. It should be provided with an electric light where possible and should be heated either by steam or by electricity. Where the enclosure is located as on a pier, or other exposed place, the floor must be constructed similarly to the walls. The outside part of wall must be protected by sheet iron and the corners by 2-in. angle iron. Not suitable for outside use in severe climates as no provision is made to carry foundations below frost line. The dimensions are the minimum ones to permit of easy access to the valve.



PLAN



SECTIONAL VIEW

Fig. 843-6. Dry-Pipe Valve Enclosure — For Mild Climates, and Location Inside Building.

850. Cold Storage Rooms.

851. Careful installation and maintenance, and some special arrangements of piping and devices as outlined in this section are needed to avoid the formation of ice and frost inside piping in cold storage rooms which will be maintained at or below 32° F. Conditions are particularly favorable to condensation where pipes enter cold rooms from rooms having temperatures above freezing. Periodic examinations of piping are needed to detect these formations.

852. Fittings for this purpose should be provided at the following locations:

a. Wherever 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. 852–1. Such fittings in conjunction with the flushing connections specified in section 435 would permit examination of the entire lengths of the cross mains. Branch lines may be examined by backing the pipe out of fittings.

b. Wherever feed mains change direction. Facilities are needed for direct observation of every length of feed main within the refrigerated area. This may be accomplished by means of 2-inch capped nipples or blind flanges on fittings.

c. Wherever 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. 852–2.

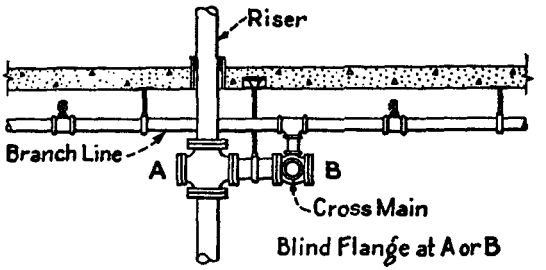
853. Whenever the opportunity offers, fittings such as specified above and illustrated in Figs. 852–1 and 852–2, as well as flushing connections specified in section 435, should be provided in existing systems.

854. Risers should be located in stair towers or other locations outside of refrigerated areas, where possible. This would reduce the probabilities of ice or frost formation within the riser (supply) pipe.

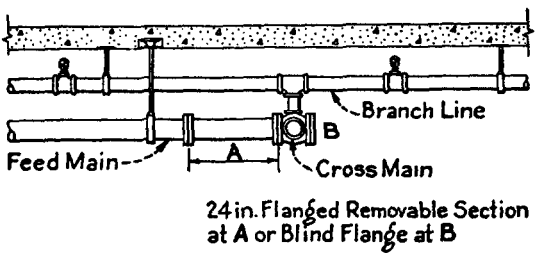
855. Cross mains should be connected to risers or feed mains with flanges. In general, flanged fittings should be installed at points which would allow easy dismantling of the system. Split ring or other easily removable types of hangers will facilitate the dismantling.

856. A low air-pressure alarm is desirable on sprinkler systems supplying freezer sections.

857. Piping in cold storage rooms should be installed with ample pitch, as outlined in paragraph 441.



(a) Elevation at Riser and Cross Main



(b) Elevation at Feed Main and Cross Main

Fig. 852-1. Fittings to Facilitate Examination of Feed Mains, Risers, and Cross Mains in Freezing Areas.

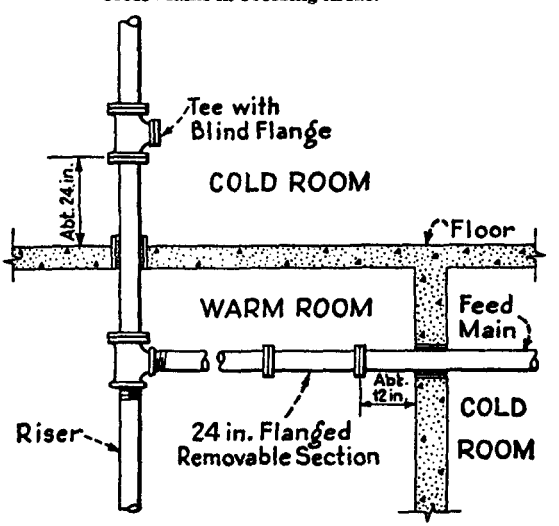


Fig. 852-2. Fittings in Feed Main or Riser Passing Through Wall or Floor from Warm Room to Cold Room.

858. (a) The air supply for dry-pipe systems in cold storage plants should be taken from the freezers of lowest temperature or through a chemical dehydrator.

(b) Compressed nitrogen gas in cylinders can be used in place of air in dry-pipe systems to eliminate introducing moisture. Cylinder pressure should be reduced to somewhat less than maximum allowable system pressure, and regulated by the usual cylinder regulator. Propylene glycol or other suitable material may be used as a substitute for priming water, to prevent evaporation of the priming fluid, and thus reduce ice formation within the system.

860. Air Pressure and Supply.

861. MAINTENANCE OF AIR PRESSURE. Air pressure shall be maintained on dry-pipe systems throughout the year.

862. AIR SUPPLY. (a) The compressed air supply shall be from a reliable source available at all times and having a capacity of restoring normal air pressure in the system within a period of thirty minutes. The compressor should draw its air supply from a place where the air is dry and not too warm. Moist air may cause trouble from condensation in the system.

(b) The air compressor, when the only supply and non-automatic, shall be driven independently of all plant shafting.

863. INDEPENDENT AIR FILLING CONNECTION. (a) The connection pipe from the air compressor should not be less than ¾-inch and enter the system above the priming water level of the dry-pipe valve. In this air line there shall be installed a check valve and on the supply side of this check valve a shut-off valve of renewable-disc type.

(b) An approved relief valve shall be provided between compressor and controlling valve and set to relieve at a pressure five pounds in excess of maximum air pressure which should be carried in the system.

(c) Where the air supply is taken from a shop system having a normal pressure greater than that required for dry-pipe systems, the relief valve shall be installed between two control valves in the air line and a small air cock, which is normally left open, installed in fitting below relief valve.

(d) Where 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

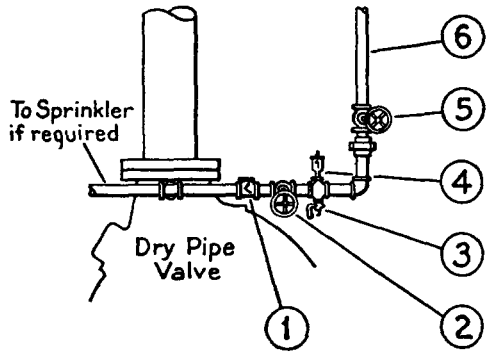


Fig. 863. Air Supply from Shop System.

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

the required air pressure on the dry-pipe system. More than one dry-pipe system should not be connected to a single automatic air maintenance device where the air supply piping to the systems is subdivided only by check valves. Otherwise when one dry-pipe valve operates leakage past check valves could water column other dry-pipe valves.

864. AIR PRESSURE TO BE CARRIED. High air pressure in dry-pipe systems is undesirable. The pressure to be carried will depend upon the normal tripping pressure of the dry-pipe valve. The instruction chart furnished with dry-pipe valves should be consulted to determine the air pressure to be carried. The maximum air pressure needed has been found in most cases to be 15 to 20 lb. in excess of the normal tripping pressure of the dry-pipe valve. The permitted rate of air leakage shall be as specified in paragraph 114(b). The design of some dry-pipe valves includes an excess pressure relieving device which is intended to automatically limit the air pressure.

865. PRESSURE GAUGES. Approved pressure gauges conforming to paragraph 373 shall be connected as follows:

(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.

SECTION 9. ANTI-FREEZE SOLUTIONS.

901. WHERE USED.

Anti-freeze solutions may be used for maintaining automatic sprinkler protection in small unheated areas which would otherwise be shut off and drained during freezing weather. Anti-freeze solutions are recommended only for systems not exceeding 20 sprinklers. The cost of refilling the system or even of replenishing small leaks makes it more advisable to use small dry valves where more than 20 sprinklers are to be supplied.

902. RECOMMENDED ANTI-FREEZE SOLUTIONS.

(a) Where sprinkler systems are supplied by public water connections the use of anti-freeze solutions other than water solutions of pure glycerine (C.P. or U.S.P. 96.5% Grade) or propylene glycol are undesirable from a public health standpoint. The use of anti-freeze solutions MUST be in conformity with any state or local health regulations which may apply. Suitable glycerine-water and propylene glycol-water mixtures are shown in Table 902–1.

NOTE: Beyond certain limits, increased proportion of Anti-Freeze does not lower the freezing point of solution. (See Fig. 902.)

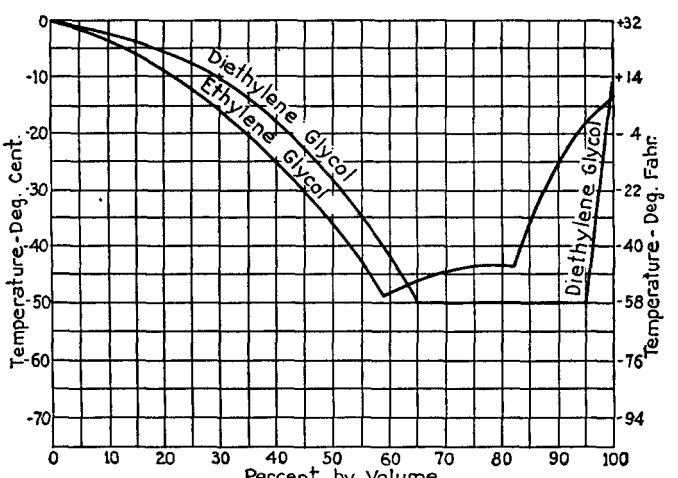


Fig. 902. Freezing Points of Water Solutions of Ethylene Glycol and Diethylene Glycol.

TABLE 902–1.

ANTI-FREEZE 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 902–2.

ANTI-FREEZE 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 902–1.		
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 902–1.		
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.

(b) If public water is not connected to sprinklers, the commercially available materials indicated in Table 902–2 are suitable for use in anti-freeze solutions.

(c) An anti-freeze solution should be prepared with a freezing point a few degrees below the expected minimum temperature for the locality. The specific gravity of the prepared solution should be checked by a hydrometer with suitable scale.

(d) Glycerine, diethylene glycol, ethylene glycol and propylene glycol should never be used without mixing with water in proper proportions because these materials tend to thicken near 32° F.

903. ARRANGEMENT OF SUPPLY PIPING AND VALVES.

All anti-freeze solutions are heavier than water. At the point of contact (interface) the heavier liquid must be below the lighter liquid in order to prevent diffusion of water into the unheated areas. In most cases, this makes necessary the use of a 5 ft. drop pipe or U-loop as illustrated in Fig. 903. The preferred arrangement is to have the sprinklers below the interface between the water and the anti-freeze solution. If sprinklers are above the interface, a check valve with 1/32 in. hole in the clapper should be provided in the U-loop. A water control valve and two small solution test valves should be provided as illustrated in Fig. 903. An acceptable arrangement of filling cup is also shown. To avoid leakage, the materials and workmanship must be excellent, the threads clean and sharp, and the joints tight. Use only metal-faced valves.

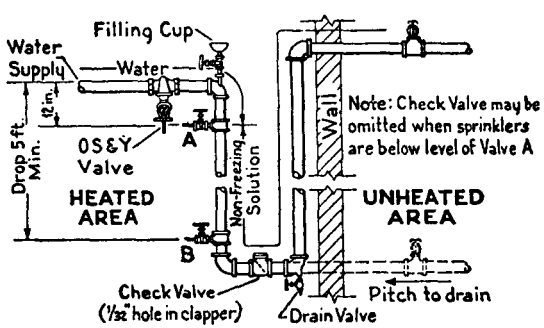


Fig. 903. Arrangement of Supply Piping and Valves.

904. FILLING. With water supply valve closed and the system drained, fill the piping through the filling cup, using a suitable anti-freeze solution of the proper concentration. Vent the air at the end sprinklers. Back out all sprinklers slightly until the liquid appears so that the piping will be completely filled and all air expelled. If the filling cup is not above the highest sprinklers, the piping may be filled through valve B by means of a small pump or through a filling cup installed at the highest branch sprinkler line. If the last named method is used, the drop pipe should be filled through the filling cup shown in diagram. Then tighten the sprinkler heads and open valve A until the 12-inch section of pipe above this valve is empty and the level of the anti-freeze solution in the drop pipe is at valve A. Close valve A. Close the filling connection valve and slowly open the supply valve wide.

905. TESTING. Before freezing weather each year, the solution in the entire system should be emptied into convenient containers and brought to the proper specific gravity by adding concentrated liquid as needed. The resulting solution should be used to refill the system.

Tests should be made by drawing a sample of the solution from valve B two or three times during the freezing season, especially if it has been necessary to drain the building sprinkler system for repairs, changes, etc. A small hydrometer should be used so that a small sample will be sufficient. When water appears at valve B or when the test sample indicates that the solution has become weakened, empty the entire system and recharge as previously described.

NOTE: The $\frac{1}{32}$ in. 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.

SECTION 10. PRE-ACTION AND DELUGE SYSTEMS.

1000. Description.

1001. 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 heat-responsive devices and provided with manual means for operation which are independent of the sprinklers. See section 102.

1002. Systems may have equipment of the following types: (See paragraphs 1032 and 1042.)

(a) Automatic sprinklers with both sprinkler piping and heat-responsive devices automatically supervised.

(b) Automatic sprinklers with sprinkler piping and heat-responsive devices not automatically supervised.

(c) Open sprinklers with only heat-responsive devices automatically supervised.

(d) Open sprinklers with heat-responsive devices not automatically supervised.

(e) Combination of open and automatic sprinklers with heat-responsive devices automatically supervised.

(f) Combination of open and automatic sprinklers with heat-responsive devices not automatically supervised.

(g) Open head systems operated by both heat-responsive devices of the rate of temperature rise and fixed temperature types in combination, in which case the heat-responsive devices should be automatically supervised.

(h) Outside sprinklers for protection against exposure fire; the heat-responsive devices should be automatically supervised if more than 20 sprinklers on the system.

1010. General.

1011. Where required by the authority having jurisdiction, sprinkler systems shall be of the pre-action or deluge type.

1012. Pre-action and deluge systems shall comply with all other rules except as modified by this section.

1013. Conditions of occupancy or special hazards may require quick application of large quantities of water and in such cases deluge systems are likely to be needed.

1014. Care should be exercised to select heat-responsive devices having an adjustment to assure proper operation and to

guard against premature operation of the system from normally fluctuating temperatures.

1015. In locations where temperatures, at ceilings, are likely to be high from sources of heat other than fire conditions, such as manufacturing processes, boiler rooms and dry kilns, it is necessary to give special consideration to the selection of heat-responsive devices operating normally at higher than ordinary temperatures and which are capable of withstanding the normal high temperatures for long periods of time.

1016. Where corrosive conditions exist that may affect the heat-responsive devices or systems, consideration should be given to the use of types of materials or protective coatings designed to resist corrosion.

1017. Stock of extra fusible elements of heat-responsive devices, not less than two of each temperature, shall be maintained on the premises for replacement purposes.

1020. Location and Spacing of Heat-Responsive Devices.

1021. Spacing of heat-responsive devices shall be in accordance with their listing by nationally recognized testing laboratories, unless conditions indicate the need for a closer spacing.

1022. DISTANCE BETWEEN DEVICES AND WALLS. (a) Where ceilings are level, one-half the distance allowed between rows of heat-responsive devices.

(b) With sloping ceilings, slope more than 1½ inches per foot, lowest row of heat-responsive devices two-thirds the distance allowed between rows of heat-responsive devices. Distance may be measured horizontally for both level and sloping ceilings.

(c) In areas requiring only a single row of heat-responsive devices the distance between the end device and the end wall shall be one-third the allowable distance between heat-responsive devices.

1023. CEILING HEIGHTS. Where ceiling heights exceed 35 feet the heat-responsive devices should be so spaced that the area covered by each device will not exceed 75 per cent of the area normally covered.

1024. SPECIAL HAZARDS. In occupancies involving unusual hazards where it is necessary to discharge water through open sprinklers on the fire instantaneously, special arrangement of heat-responsive devices should be made in accordance with recognized good practice for such hazards.

1025. Two or More Systems. Where there are two or more systems in one area controlled by separate systems of heat-responsive devices, the heat-responsive devices on each system shall be spaced up to the dividing line between systems as to a wall or partition or draft stop.

1026. Monitors. Flat or sloping surfaces between monitors do not require heat-responsive devices, except when their width is such that the distance between rows of heat-responsive devices in adjoining monitors or between wall and rows of heat-responsive devices in adjoining monitors exceed the allowable distance, in which case install heat-responsive devices under the flat or sloping sections in accordance with the rules governing the shape of ceiling and type of construction.

1027. Decks Inside Buildings. Decks, not enclosed and not more than 10 feet in width, should not ordinarily require the installation of heat-responsive devices.

1028. Stair Towers, Elevator Shafts and Other Enclosures. Where sprinklers are installed in stair towers, elevator shafts and other enclosures, heat-responsive devices shall be installed in each such enclosure.

1030. Pre-Action Systems.

1031. Not more than 1000 closed sprinklers shall be controlled by any one pre-action valve.

1032. Where there are over 20 sprinklers or where required by the authority having jurisdiction, both sprinkler piping and heat-responsive devices shall be automatically supervised.

Note: See Section 410 for Pipe Schedules.

1033. Automatic sprinklers installed in the pendent position shall be of the approved dry pendent type.

1040. Deluge Systems.

1041. The number of open head sprinklers controlled by any one deluge valve should be as follows:

1½ in. valve	5 sprinklers
2 in. valve	10 sprinklers
2½ in. valve	27 sprinklers
3 in. valve	40 sprinklers
4 in. valve	75 sprinklers
6 in. valve	150 sprinklers

1042. Where there are over 20 sprinklers or where required by the authority having jurisdiction, the heat-responsive devices or systems shall be automatically supervised.

1043. PIPE SCHEDULE FOR DELUGE SYSTEMS.

(a) The following pipe schedule is given only as a guide for installations having no unusual features:

The pipe schedule for deluge systems (½-inch orifice sprinklers or equivalent discharge) is as follows:

1 in. pipe	1 sprinkler
1¼ in. pipe	2 sprinklers
1½ in. pipe	5 sprinklers
2 in. pipe	8 sprinklers
2½ in. pipe	15 sprinklers
3 in. pipe	27 sprinklers
3½ in. pipe	40 sprinklers
4 in. pipe	55 sprinklers
5 in. pipe	90 sprinklers
6 in. pipe	150 sprinklers

(b) Deluge systems are usually applied to severe conditions of occupancy. In designing the piping system the water supply should be based on not less than an average discharge of 15 gallons per minute per sprinkler. Adjustment in pipe sizes to provide uniform sprinkler discharge should be based on a maximum variation of 15% from the assumed average discharge per sprinkler. Where practical to obtain the required degree of uniformity of discharge by sizing of piping this should be done rather than by using sprinklers having orifices smaller than ½ inch.

(c) Pipe sizes should be adjusted according to detailed friction loss calculations. These calculations should show the relation between the water supply and demand. These calculations shall be submitted to the authority having jurisdiction.

(d) Friction loss in steel pipe of deluge systems should be calculated using Hazen & Williams coefficient C=120 and obstruction losses due to change of direction of water through fittings shall be figured in terms of equivalent feet of pipe.

(e) Where change is made in pipe sizes this should not be effected by means of reducing flanges.

(f) Where 8-inch piping is employed to reduce friction losses in a system operated by heat responsive devices a 6-inch

pre-action or deluge valve and 6-inch gate valve between taper reducers may be used.

1050. Gate Valves.

1051. There shall be a separate gate valve installed to control the water supply to each pre-action or deluge valve.

1052. In hazardous locations the gate valve and manual means for operation of pre-action or deluge valve shall be installed a safe distance away from the pre-action and deluge valve and where access to the control valves is not likely to be prevented under fire emergency conditions.

1053. In case of deluge systems the deluge valve shall be located as close as possible to the hazard protected, consistent with safety, preferably in an enclosure outside any fire or explosion hazard area.

1060. Hydrostatic Test.

1061. All new pre-action or deluge systems shall be tested hydrostatically as specified in section 113. In testing deluge systems plugs shall be installed in fittings and replaced with open sprinklers after the test is completed, or automatic sprinklers should be installed and the links, etc., knocked out after test is completed.

1070. Devices for Test Purposes and Testing Apparatus.

1071. When heat-responsive devices installed in circuits are located where not readily accessible, an additional heat-responsive 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.

1072. Suitable testing apparatus capable of producing the heat necessary to operate any normal heat-responsive 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 safe method of testing shall be used.

1073. PRESSURE GAUGES. Approved pressure gauges conforming to paragraph 373 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.

SECTION 11. COMBINED DRY-PIPE AND PRE-ACTION SYSTEMS.

1101. Combined dry pipe and pre-action systems shall comply with all other rules except as modified by this section. (See 102 e.)

1102. Combined dry pipe and pre-action systems may be installed where wet pipe systems are impractical. They are intended for use but not limited to structures where a number of dry pipe valves would be required if a dry pipe system were installed.

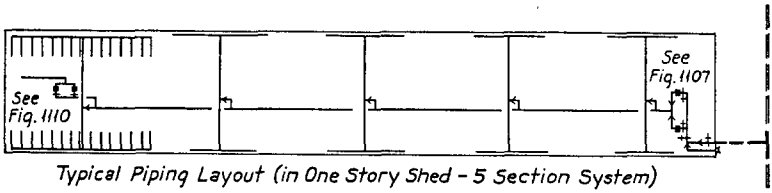


Fig. 1100. Typical Piping Layout for Combined Dry Pipe and Pre-Action Sprinkler System.

1104. Combined automatic dry pipe and pre-action systems shall be so constructed that failure of the heat responsive system shall not prevent the system from properly functioning as a conventional automatic dry pipe system.

1105. 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 heat responsive system from properly functioning as an automatic fire alarm system.

1106. Provision shall be made for the manual operation of the heat responsive system at locations requiring not more than 200 feet of travel.

1107. 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. 1107.)

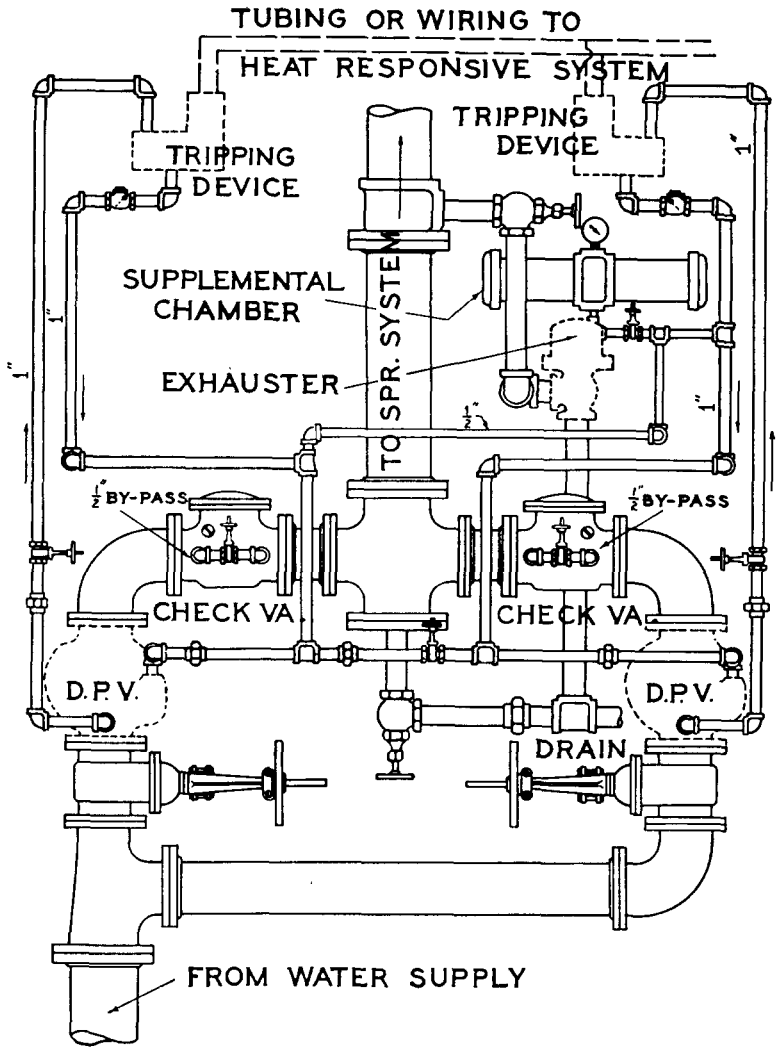


Fig. 1107. Header for Combined Dry Pipe and Pre-Action Sprinkler System. Standard Trimmings Not Shown