Standards for the Installation of SPRINKLER SYSTEMS

MAY

1953

*Fifty Cents**

NATIONAL FIRE PROTECTION ASSOCIATION
International
60 Batterymarch St., Boston 10, Mass.

*Discount for quantities

4M-6-53-FP

Printed in U.S.A.

NATIONAL FIRE PROTECTION ASSOCIATION

International

Executive Office: 60 Batterymarch St., Boston 10, Mass.

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 over a hundred and eighty national and regional societies and associations and fifteen thousand individuals, corporations, and organizations. Membership in the National Fire Protection Association is open to any society, corporation, firm or individual interested in the protection of life or property against loss by fire.

This pamphlet is one of a large number of publications on fire safety issued by the Association. All interests concerned have opportunity through the National Fire Protection Association to participate in the development of the standards and to secure impartial consideration of matters affecting them.

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Standards for the Installation of SPRINKLER SYSTEMS.

These National Fire Protection Association Standards for the Installation of Sprinkler Systems were first printed under the direction of the Committee on Automatic Sprinklers in 1896. They have since been revised at frequent intervals to keep them up to date, and new material has been added from time to time. All changes have been made through the established NFPA procedure, with revisions prepared by the Committee on Automatic Sprinklers, published and circulated for comment, and adopted by Annual Meetings of the Association. Official records of NFPA action will be found in the NFPA proceedings from 1896 to date.

The present text, adopted May 22, 1953 by the National Fire Protection Association on recommendation of the Committee on Automatic Sprinklers, supersedes the edition of 1951. For prior history of these standards dating back to 1896, see National Fire Codes, Vol. IV, Extinguishing and Alarm Equipment.

Prior editions of this standard have been adopted and published by the National Board of Fire Underwriters with identical text (except for cover and introductory matter). It is anticipated that the present edition will be similarly published.

The 1951 edition of these standards was similarly adopted and published by the Dominion Board of Insurance Underwriters as DBIU Pamphlet No. 13, likewise with identical text except for cover and introductory material pertaining to application in Canada.

Detail of the changes made in the 1951 edition will be found in the NFPA Advance Reports and Proceedings, 1953. The changes include, among others, the following:

A more detailed classification of occupancies of various degrees of hazard has been incorporated.

A new type of system known as the combined dry pipe and preaction system has been included in the definitions and detailed provisions made for installations.

An entirely new SECTION No. 14 has been included on automatic spray sprinkler systems.

The former SECTION 11, Sprinkler Alarms, has been renumbered as SECTION 12, and the former SECTION 12, Outside Sprinklers, has been renumbered as SECTION 13.

These Standards are subject to amendment at any Annual Meeting of the National Fire Protection Association. Anyone may propose amendments; communications proposing amendments may be filed with the Committee on Automatic Sprinklers or with the Executive Office of the Association. All proposals will be considered by the Committee, and any resulting recommendations for amendment of the Standards will be reported in due course to the National Fire Protection Association for action. Submitters of proposals for amendments should be advised that any communications received too late for effective Committee consideration prior to an Annual Meeting may be deferred until the following year.

Standards for the Installation of Sprinkler Systems

CONTENTS.

DEFINITION OF TERMS

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 measurement 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 equipment. The standards are prepared, as far as practicable, in terms of required performance, avoiding specification 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.

STANDARDS FOR THE INSTALLATION OF SPRINKLER SYSTEMS.

SECTION 1. GENERAL INFORMATION.

100. Foreword.

These standards are in general the minimum requirements 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 or requirements are amendatory of these standards for Extra Hazard Occupancies as covered by separate standards.

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.

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.

(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.

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. The authority having jurisdiction may however recognize the degree of protection afforded by special types of sprinkler systems when installed and maintained in accordance with the requirements of the listing thereof by a nationally-recognized testing laboratory.

104. Classification of Occupancies.

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

Apartments	Institutions
Asylums	Libraries
Churches	Museums
Clubs	Office Buildings
Colleges and Universities	Prisons
Dormitories	Public Buildings
Dwellings	Rooming Houses
Hospitals	Schools
Hotels	Tenaments

(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.

(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

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.

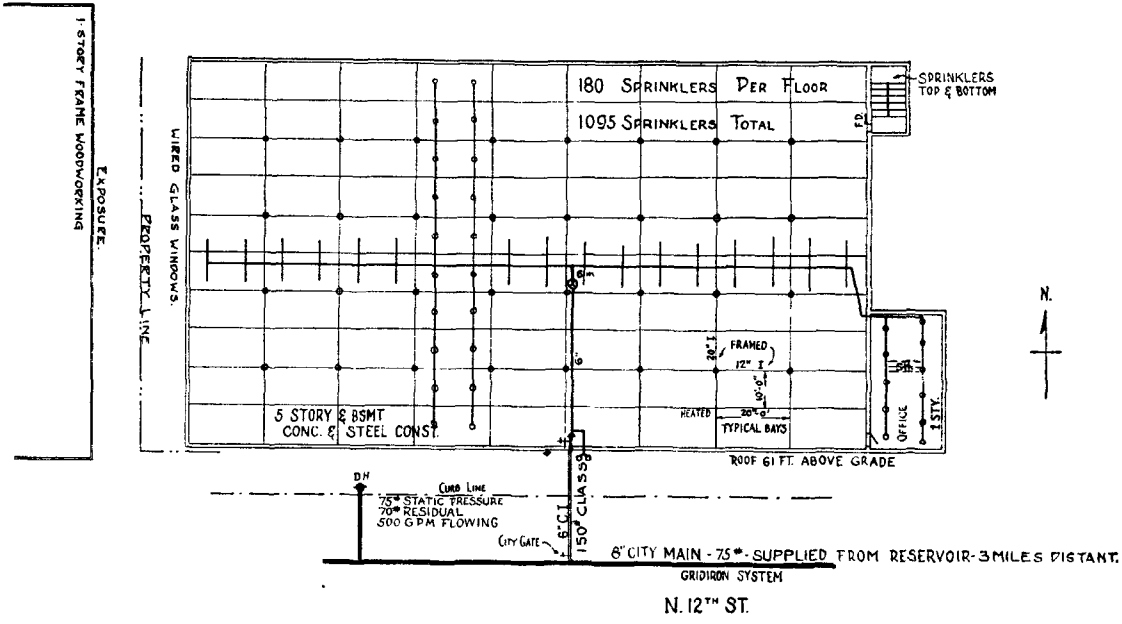


Fig. 107. Typical Preliminary Layout.

(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
Linseed Oil Mills
Linoleum & Oil Cloth Manufacturing
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 tables 822a and b. 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:

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.

(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.

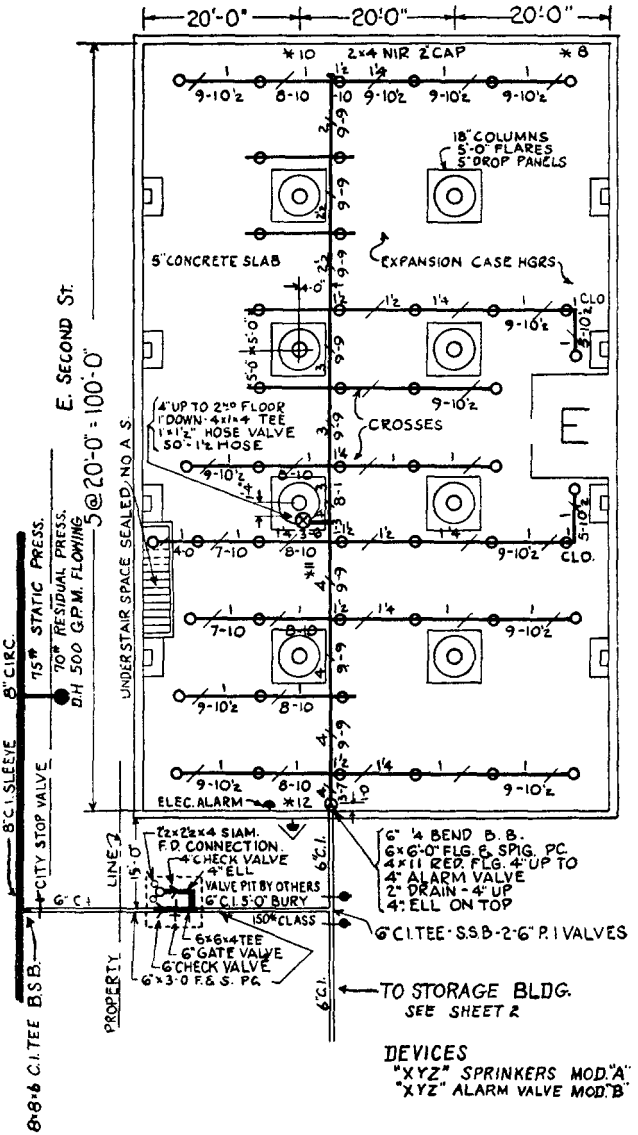
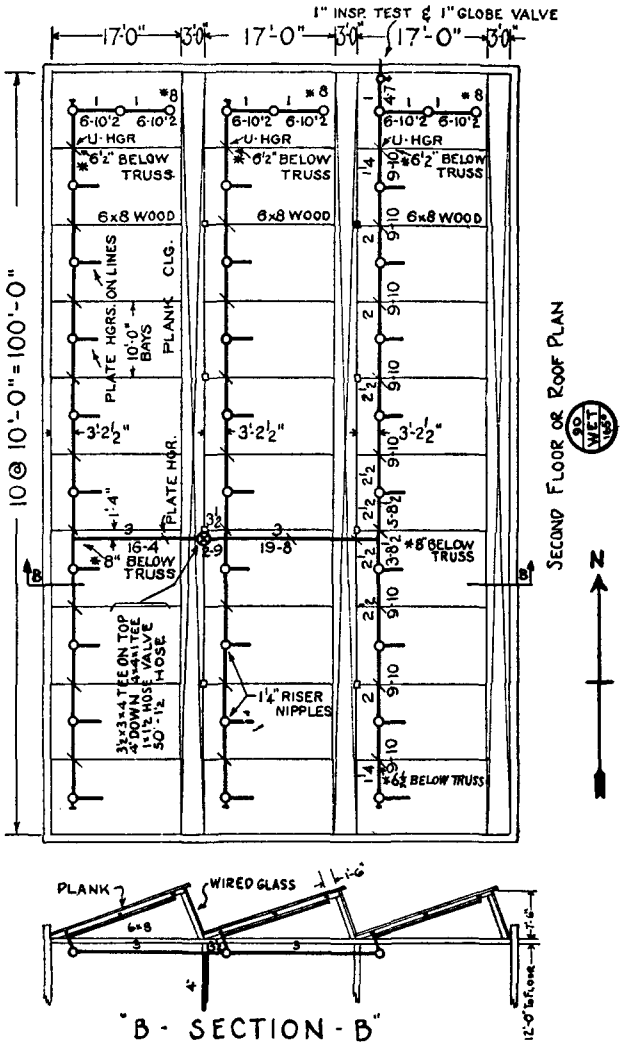


Fig. 108-1. Typical Working Plan.



"B - SECTION - B"

GENERAL NOTES -
GRADE TO HIGHEST SPRINKER-30 FT.
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: 0000 = 1 FT.
No OF SPRINKLERS	151				SHEET No 1 OF 2
"XYZ" SPRINKLER CO. NEWARK, O.					

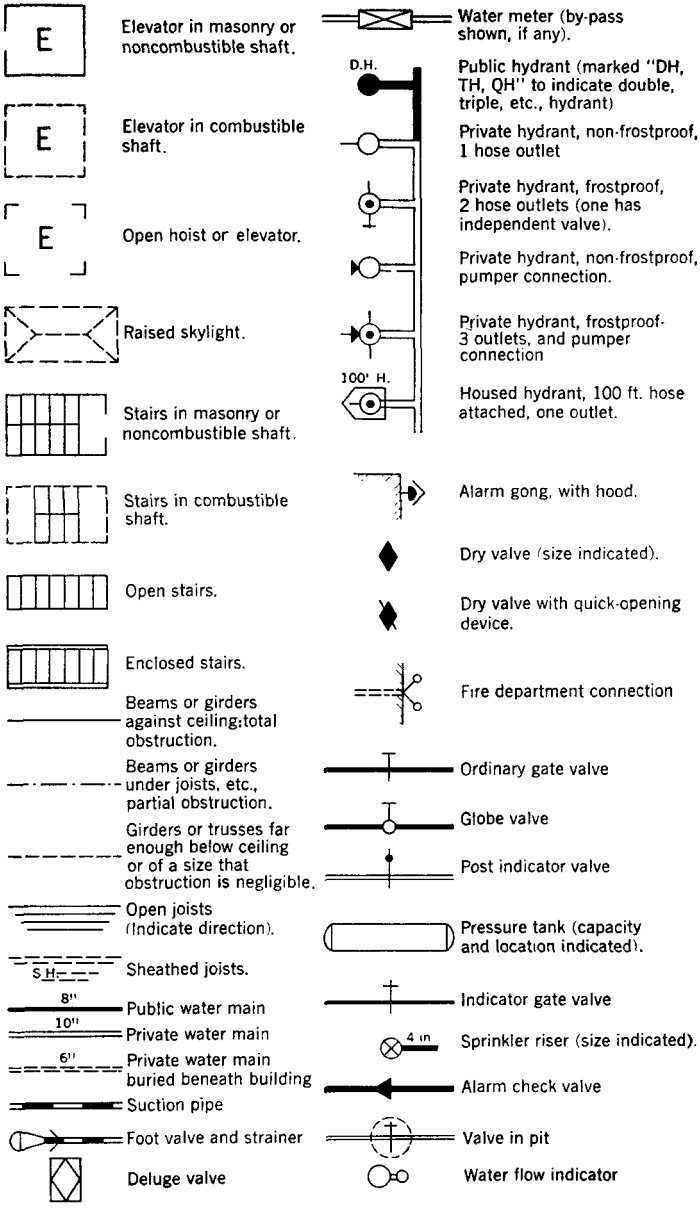


Fig. 108-2. Standard Plan Symbols.

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.

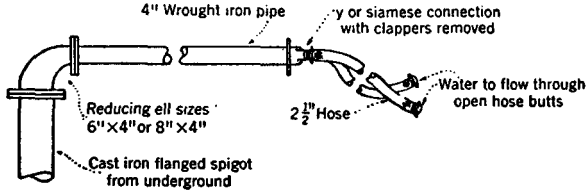
(c) When changes involve shutting off water from any considerable number of sprinklers for more than a few hours, temporary connections should be made to sprinkler systems so that reasonable protection can be maintained. In adding to old systems or revamping them, protection should be restored each night 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.

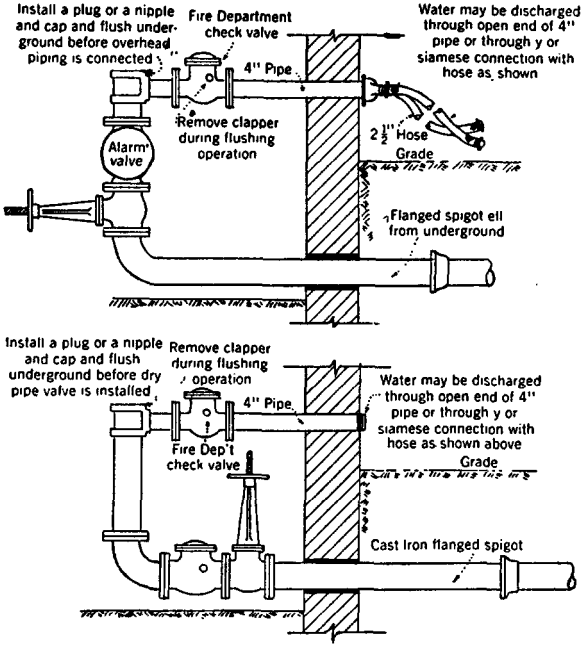
Where sprinklers are installed in buildings subject to recurring floods, special attention shall be given (1) to the arrangement of piping and location of valves so that valves will be accessible during high water, (2) to the location of alarm devices and equipment so as to keep as much of the equipment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

112. Flushing of Underground Connections.

Branches from 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. To establish these velocities the following flows in gallons per minute will be needed: 6-inch pipe, 500 gallons per minute; 8-inch pipe, 1000 gallons per minute; 10-inch pipe, 1500 gallons per minute; 12-inch pipe, 2000 gals. per min.



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.

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 should be made, if possible, 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)

(NOTE. This form properly executed, should be submitted to the authority having jurisdiction when requesting inspection and approval of the completed system. 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?.....

No. 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?.....

No. installed.....Make and Model.....

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

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

Give maximum time to trip dry-pipe valve through 1-inch system test valve. With quick-opening device: .....Min. .....Sec. Without quick-opening device: .....Min. .....Sec.

Deluge system supervised? Yes..... No.....
Operation: Pneumatic..... 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 stations? Yes..... No.....

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

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

REMARKS:.....

.....

UNDERGROUND PIPE AND FITTINGS:

Type and class of 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:

Have mains for supply to new connections and lead-ins been thoroughly flushed in accordance with Standards for the Installation of Sprinkler Systems (No. 13)? Yes..... No.....

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.

How was flow obtained for flushing?.....

.....

CONNECTIONS. Branches from existing or new underground mains to inside sprinklers shall be flushed out thoroughly before connecting the sprinkler riser. A flow of at least 500 gallons per minute should be established in 6-inch lines and smaller, 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. (See section 112.)

TESTS:

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

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.
Permissible leakage, qts. per 10 joints per hour	2½	3¼	4	5	6½

Was leakage measured? Yes..... No.....
Was leakage less than the above limits? Yes..... No.....
Dry system also tested at.....lbs. air pressure.
Air pressure loss in 24 hours:..... .....lbs.
(Air test should be made at 40 lbs. with loss not exceeding 1½ lbs. in 24 hours.)
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 hours.)

BLANK TESTING GASKETS:

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

CONTROL VALVES:

Were all valves left wide open? Yes..... No.....
System completed and placed in operation on.....
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 copy of instruction and maintenance chart been left at the plant? Yes..... No.....

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

..... 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 (No. 13A).

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) In buildings of combustible construction narrow pockets 6 in. or less in width, formed by bay timbers, beams, partitions, etc., and wall, may be sealed in lieu of additional sprinklers.

(f) 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.

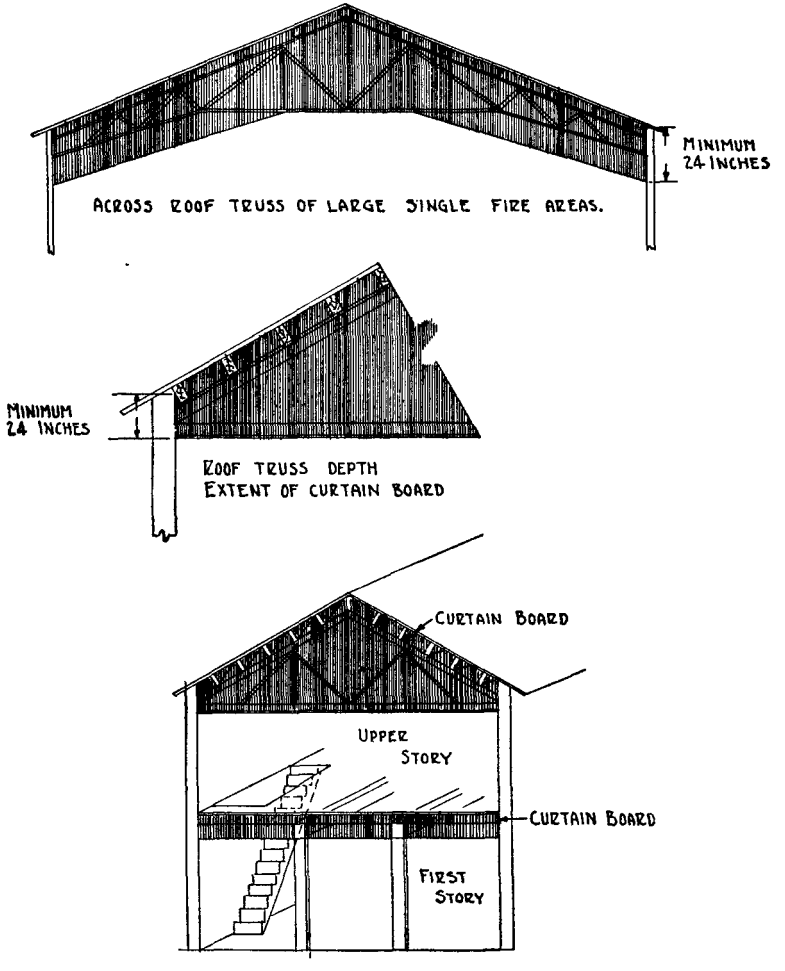


Fig. 203-1. Curtain Boards for Subdivision of Large Areas. Preferably of noncombustible material such as flat sheet or corrugated metal.

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

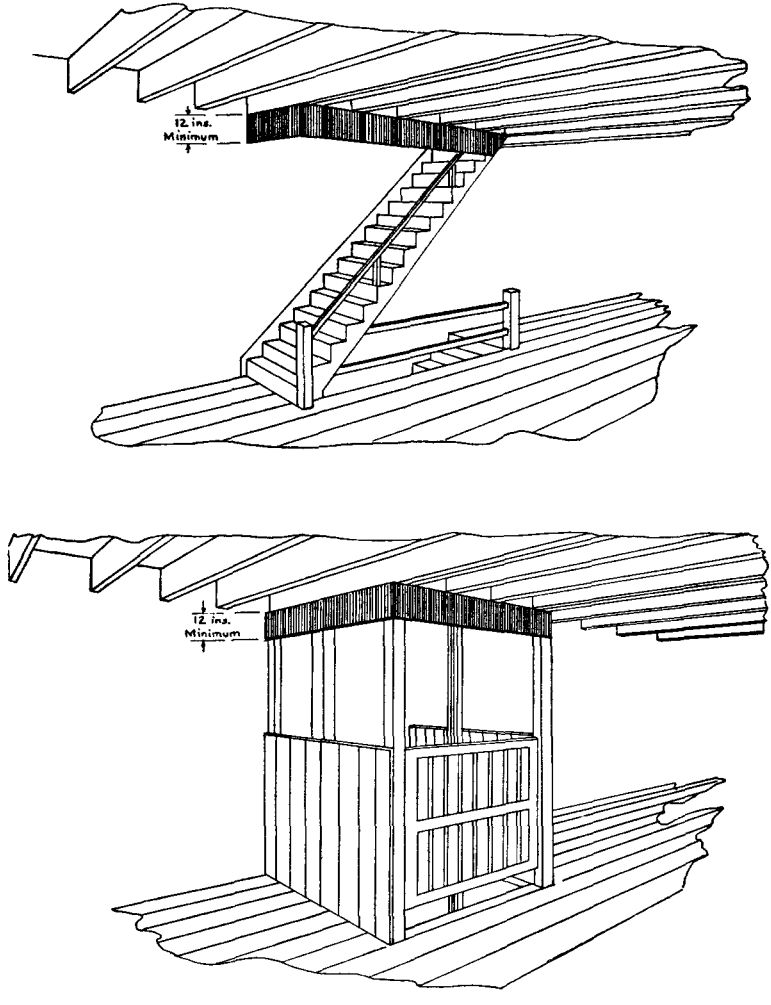


Fig. 203-2. Curtain Boards around Open Stair and Elevator Shafts. Preferably of noncombustible material such as flat sheet or corrugated metal.

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.

Where it is impractical to do otherwise, curtain boards at least 12 inches deep or other horizontal draft stops 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 shall be made to keep all stock piles, racks, and other possible obstructions at least 12 inches below the deflectors of the sprinklers so as to permit effective distribution of water. This clearance shall be maintained at all times.

207. Accessory Construction.

Sprinkler equipments may require: Dry valve closets (see Par. 843); boxing to prevent freezing of tank risers, etc. (see Figure 460); ladders, etc. This work should be promptly attended to if not let with the sprinkler contract.

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 supply required will be influenced by the area, height and value of the property, by the occupancy, by construction features affecting the spread of fire, by the quality and ready availability of public fire department response, and in some cases by the exposures to the building. The necessity for a second supply will depend on various factors such as those mentioned above.

(b) The authority having jurisdiction shall be consulted in every case as to the water supplies which will be required. The minimum supplies acceptable for light hazard and ordinary hazard occupancies are given in succeeding paragraphs. 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 consideration among other things to the number of sprinklers which may be expected to operate from a fire in any one fire area or section.

(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, (4) amount of water needed simultaneously for hose streams.

Where the occupancy presents a possibility of intense fires requiring extra heavy sprinkler discharge, this may be obtained by an increase in the pressure and volume of the water supply, or by a closer spacing of sprinklers, or by a combination of the two methods.

NOTE: Separately published standards on various subjects contain specific provisions for water supplies which should be consulted. (See pamphlets listed at the end of this standard.)

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. Minimum requirements are as follows:

Additional volume may be needed when the water works system must supply hose streams in addition to sprinklers.

(a) LIGHT HAZARD OCCUPANCY. A flow test from an outside hydrant should provide a residual pressure at the hydrant when delivering 250 gallons per minute, to give not less than 15 pounds under the roof, allowing only for loss of pressure due to height of roof above the hydrant.

(b) ORDINARY HAZARD OCCUPANCY. A flow test from an outside hydrant should provide a residual pressure at the hydrant when delivering 500 gallons per minute to give not less than 15 pounds under the roof, allowing only for loss of pressure due to height of roof above the hydrant.

(c) EXTRA HAZARD OCCUPANCY. See section 301 and Note.

313. 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.

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

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

316. 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 sufficient to give 15 pounds under the roof — *i.e.* a pressure equivalent to the height of the building plus 15 pounds.

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.

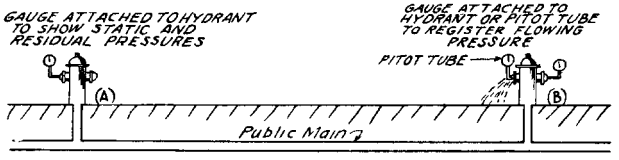


Fig. 316. Method of Conducting Flow Tests.

Referring to Fig. 316, 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.

317. 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.

318. 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.

319. The laying of connections in raceways exposed to frost should be avoided, owing to the difficulty of protecting the pipe near the surface and in the space between the surface of the water and the floor of the building. Such connections, if they cannot be avoided, should go through the wall of the race below the frost line, and enter the building through the solid ground, far enough back from the side of the race to avoid frost.

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 electrically driven and automatically controlled fire pump taking water from a water main of adequate volume, or taking suction 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 and Local Signaling Systems.

323. Minimum requirements are as follows:

(a) LIGHT HAZARD OCCUPANCY. Pump capacity not less than 250 gallons per minute. Where supplying hydrants as well as sprinklers, not less than 500 gallons per minute.

(b) ORDINARY HAZARD OCCUPANCY. Pump capacity not less than 500 gallons per minute. Where supplying hydrants as well as sprinklers, not less than 750 gallons per minute.

(c) EXTRA HAZARD OCCUPANCY. See section 301 and note.

324. Pumps supplying sprinklers only shall furnish rated capacity at a pressure under the roof of at least 15 pounds. Where supplying hydrants as well as sprinklers, the pump pressure shall be determined by the authority having jurisdiction.

NOTE: See 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. Minimum requirements are as follows:

(a) LIGHT HAZARD OCCUPANCY. Capacity not less than 5,000 gallons with bottom not less than 35 feet above the under side of the roof. Where supplying hydrants as well as sprinklers, see separately published Standards on Outside Protection.

(b) ORDINARY HAZARD OCCUPANCY. Capacity not less than 5,000 gallons, with bottom not less than 35 feet above the under side of the roof for a primary or single supply, and 20 feet above the under side of the roof for a secondary supply. Where supplying hydrants as well as sprinklers, see separately published Standards on Outside Protection.

(c) EXTRA HAZARD OCCUPANCY. See section 301 and note.

340. Pressure Tanks.

341. A pressure tank supply may be acceptable in some cases as a single supply.

Where a pressure tank constitutes the sole water supply for sprinklers, the tank should be provided with an approved means for automatically maintaining the required air pressure on the tank. Also there should be provided an approved trouble alarm to indicate low air pressure and low water level.

342. Minimum requirements are 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.

(c) EXTRA HAZARD OCCUPANCY. See section 301 and note.

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 = ⅓ then P = 75 + 1.30H.
A = ½ then P = 45 + 0.87H.
A = ⅔ 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 wrought and cast pipe from underground main should preferably be flange and spigot pipe properly strapped together.

(b) Where the riser is close to the outside wall a long flange and spigot ell should be used if the underground pipe enters building above floor level and a long socket ell if below the floor level in order to avoid lead joints in the wall. Bell end of underground pipe if facing foundation should not be located too close to prevent proper caulking.

(c) Where bell and spigot pipe is used, the wrought and cast pipes should be properly strapped together. A flanged connection should be used on the wrought pipe and not simply clamps with set-screws. (See separately published Standards on Outside Protection, No. 24.)

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

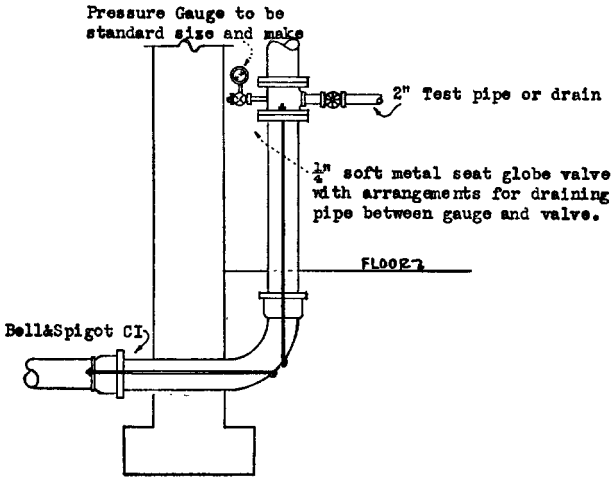


Fig. 371-1. Test Pipe on Watgr Supply with Outside Control. Also applicable to an interior riser.

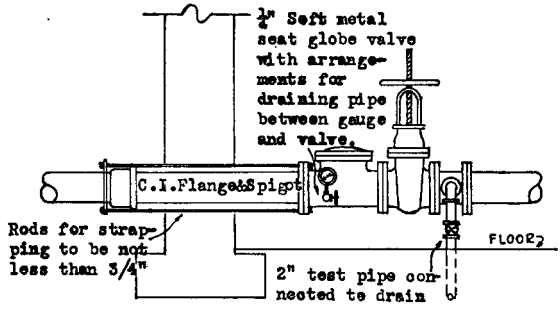


Fig. 371-2. Water Supply Connection with Test Pipe.
Located on the system side of the gate valve, one test pipe may serve for more than one city connection. It will also indicate the condition of the gate valve. Located on the supply side of the check valve, it will serve to test out check valve by closing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

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 a petcock 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.

380. Fire Department Connections.

381. A connection through which the public fire department can pump water into the sprinkler system makes a desirable auxiliary supply. For this purpose one or more fire department connections should be provided.

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.

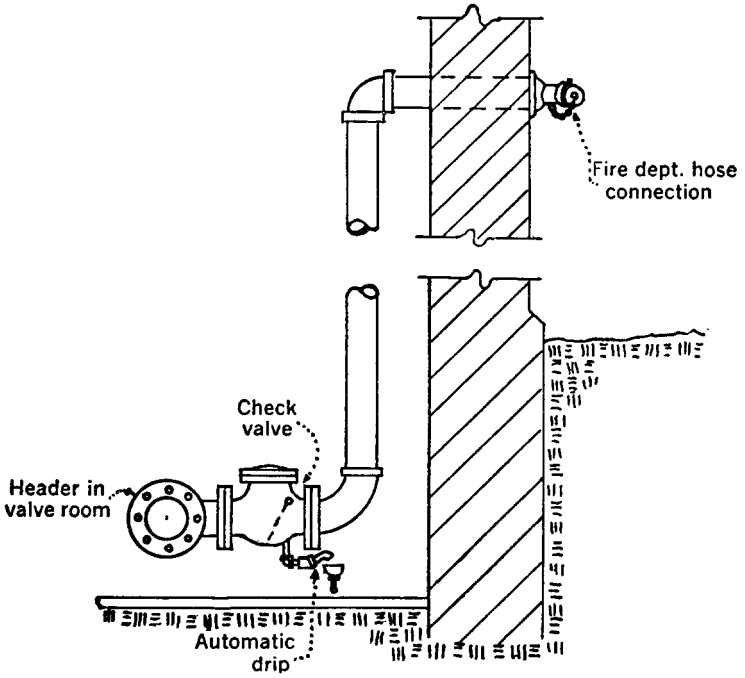


Fig. 380. Fire Department Connection.

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."

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 120–47 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.

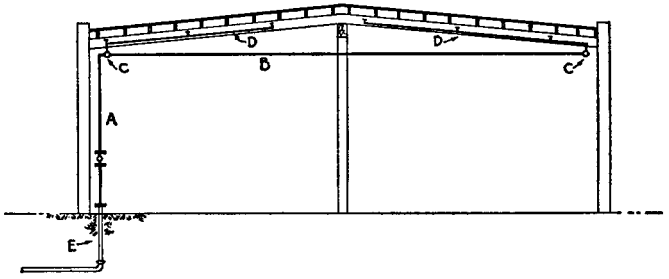


Fig. 411. Building Elevation Showing Parts of Sprinkler Piping System. A — Riser; B — Feed Main; C — Cross Main; D — Branch Line; E — Underground Supply.

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.

(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.

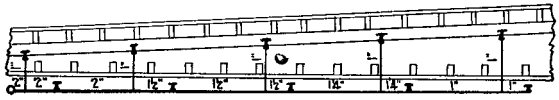


Fig. 413(b)-1. Arrangement of Branch Lines Supplying Sprinklers Above and Below a Ceiling.

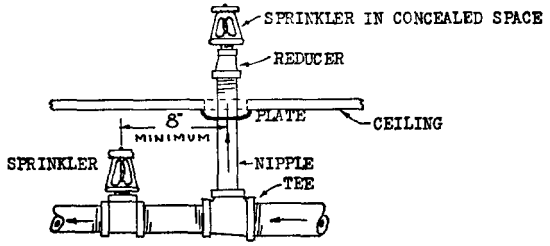
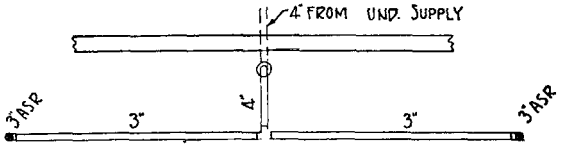
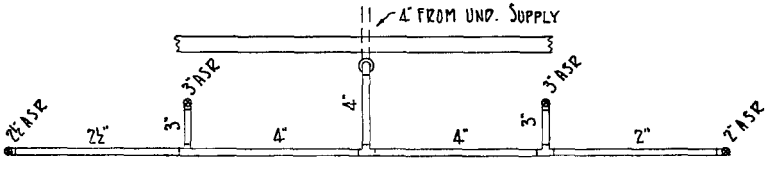


Fig. 413(b)-2. Sprinkler on Riser Nipple from Branch Line in Lower Fire Area.

(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 Rixers 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:

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 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

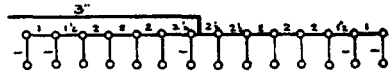
Where the total number of sprinklers above and below the ceiling exceeds 60 the pipe supplying more than 60 sprinklers shall be sized by the pipe schedule of 414 (a) for the number of sprinklers above or below the ceiling whichever is larger.

415. Schedule for Extra Hazard Occupancies.

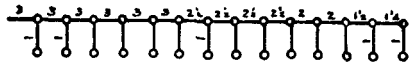
Branch lines should not exceed six sprinklers on either side of a cross main. Pipe sizes should be as follows:

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 system pipe schedule see paragraph 1043 (d).



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 is concealed with sprinklers installed in a pendent position below a ceiling, the sprinklers should be connected, where practicable, to the tops of branch lines by means of U-bends, 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.

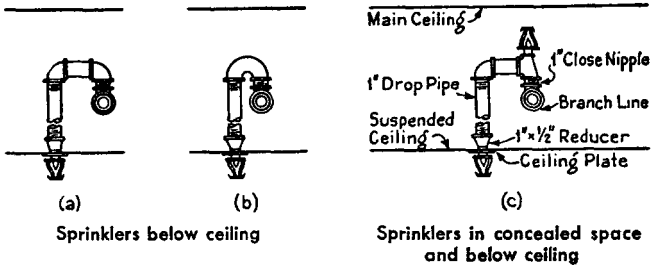


Fig. 418. Pendent Sprinklers at Suspended Ceiling.

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.

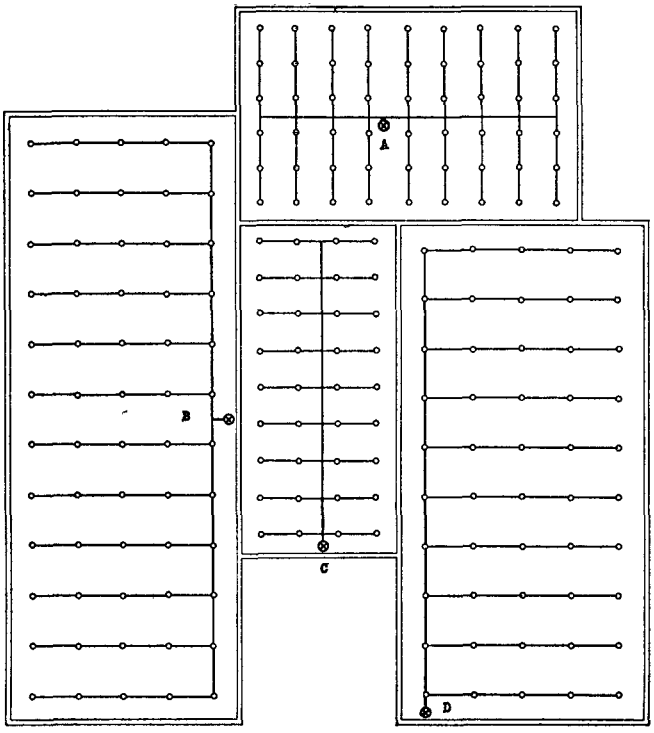


Fig. 422. Location of Risers.

A — Center Central Feed **C — Central End Feed**

B — Side Central Feed **D — Side End Feed**

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

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.

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.

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 terminating 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.

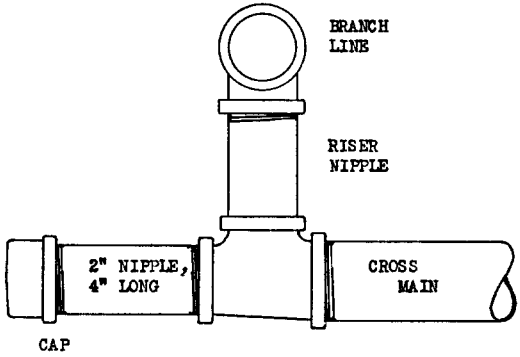


Fig. 435. Flushing Connection.

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 shall be pitched at least ½ inch in 10 feet, and more where settling may occur. A pitch of ¾ inch to 1 inch is usually not impracticable with short sprinkler lines, and should be provided where there is a chance of settling.

(e) Where settling may occur and deprive a dry pipe system of its drainage, ends of lines should not be raised to violate para-

graph 782 (b). The drainage should be restored by shortening the vertical piping.

442. 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.

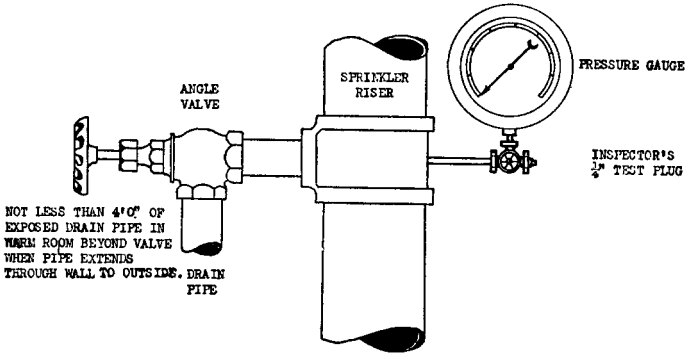


Fig. 442. Drain Connection for Sprinkler Riser.

443. AUXILIARY DRAINS.

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

(b) Auxiliary drains on wet pipe systems shall be not 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

(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 discharge outside the building wall, the drain should be piped to

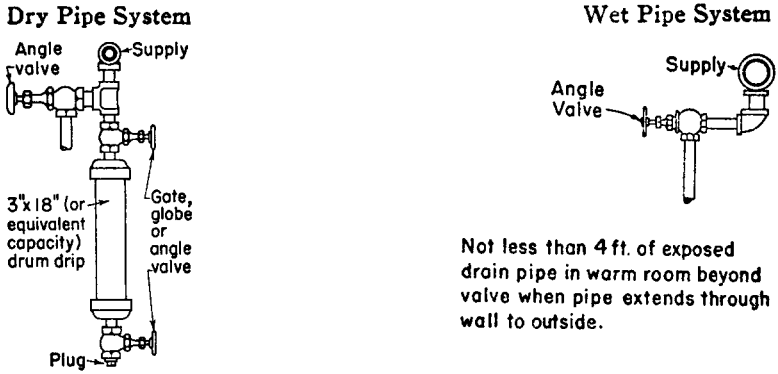


Fig. 443. Auxiliary Drains.

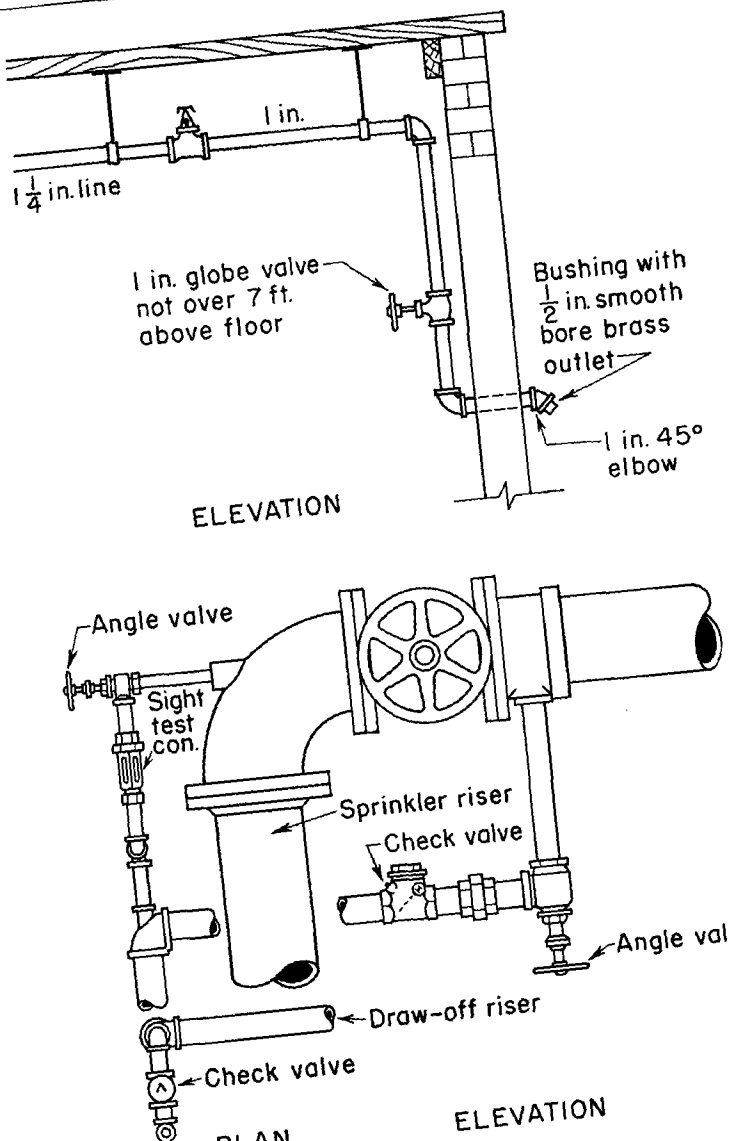


Fig. 451. One-inch System Test Pipes on Wet-Pipe Systems. Connect to top of main riser or to sprinkler main in the highest part of system, which main must be at least 1¼ in. in size.

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.

(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 brass outlet giving a flow equivalent to one sprinkler shall be provided. This test pipe shall be provided for each main riser through a pipe not less than 1¼ inch in diameter, in the upper story. 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.

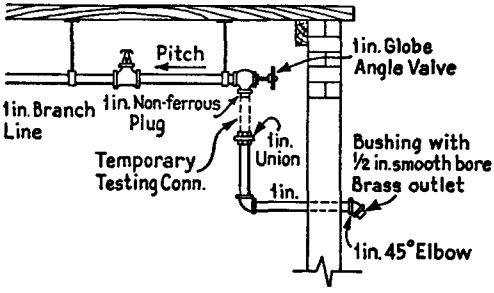


Fig. 453. One-inch System Test Pipes on Dry-Pipe Systems.

453. On dry-pipe systems a 1 inch inspector's test with a brass 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.

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

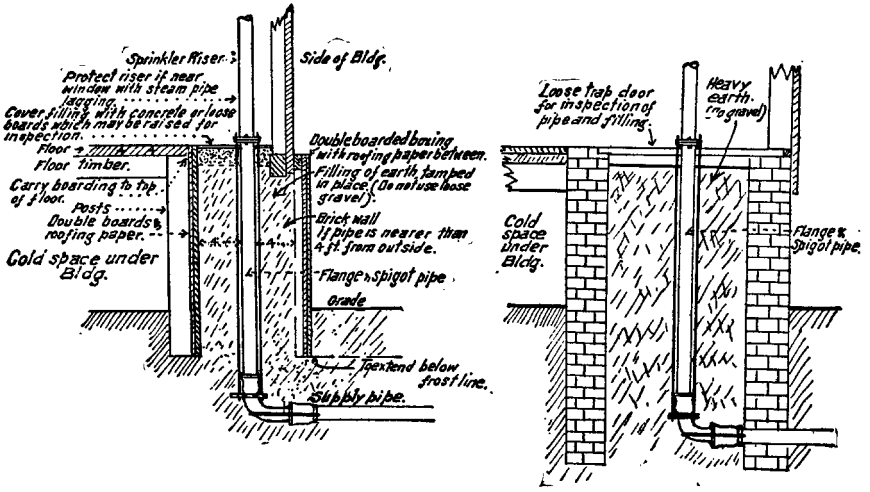


Fig. 460. Protection of Sprinkler Risers Against Freezing.

of a filling of not less than four feet, all around the pipe. The enclosure 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 obtained 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 prefer-

ably 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.

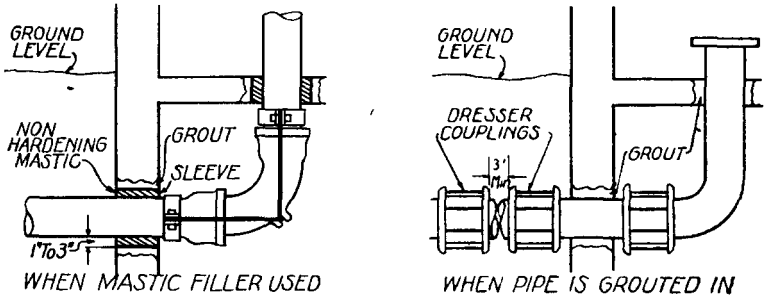


Fig. 475. Arrangement of Supply Pipe Entering Building.

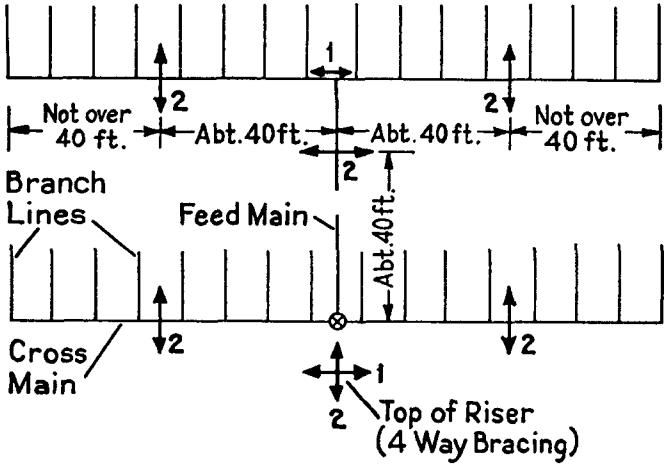
(e) Tank risers or discharge pipes should be treated the same as sprinkler risers for their portion within a building. The discharge pipe of tanks on buildings shall have a control valve above the roof line so any pipe-break within the building can be controlled.

476. SWAY BRACING.

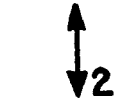
(a) Feed and cross mains must be braced to prevent excessive oscillation. The tops of risers shall be secured against drifting in any direction. Branch lines will not require bracing.

(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.)

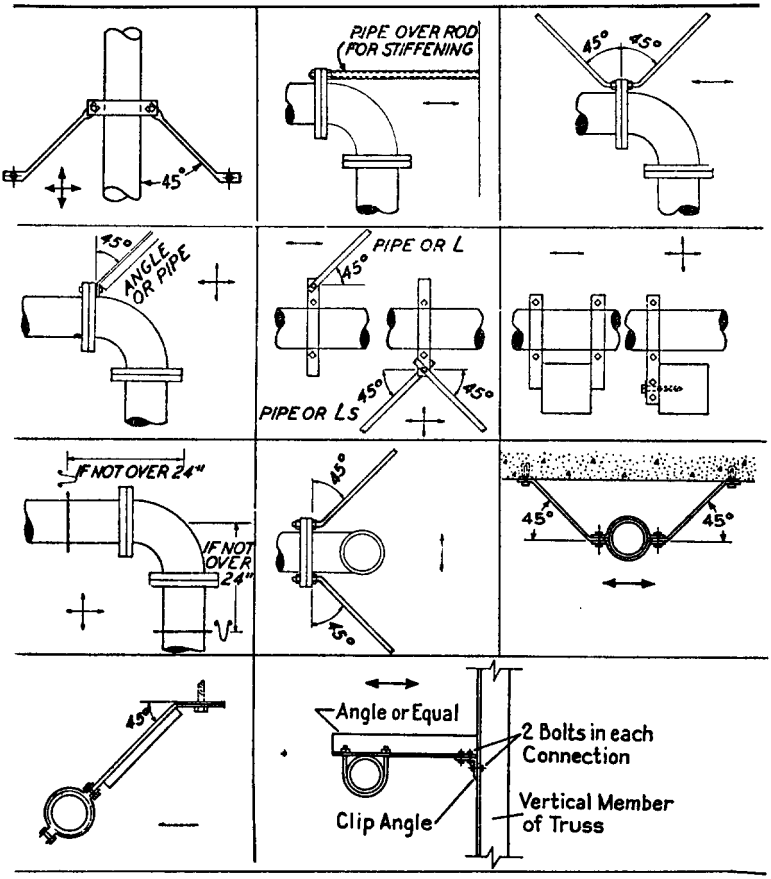


Fig. 476-2. Acceptable Types of Sway Bracing.

(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

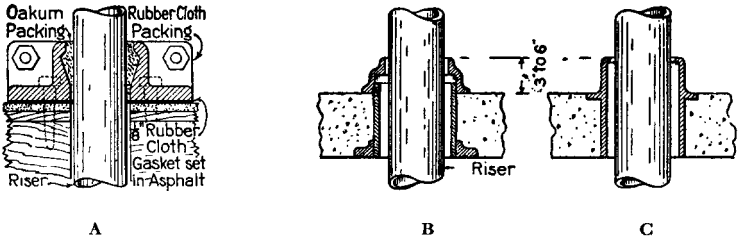


Fig. 480. Watertight Riser Sleeves.
A — For wood or concrete floors; B and C — for concrete floors.

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.

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.

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

(c) Check valves shall be of approved straightway type.

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 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.

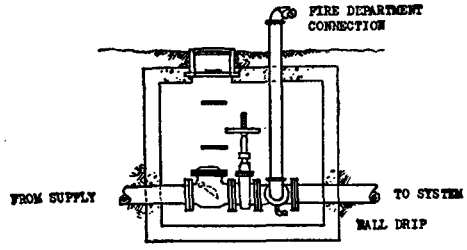


Fig. 512(d). Pit for Gate Valve, Check Valve and Fire Department Connection.

(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.

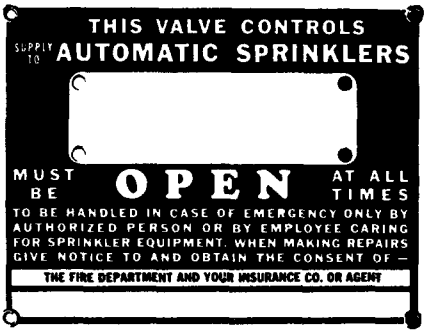
516. Pits for Underground Valves.

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.)

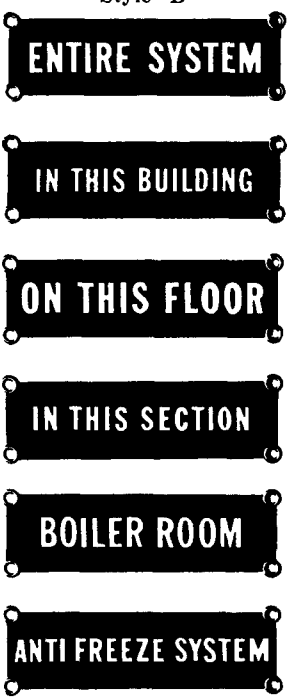
517. Securing.

All gate valves in supply pipes to automatic sprinklers, whether or not of indicator or post pattern, should be sealed open in a satisfactory manner.

Style "A"



Style "B"



Style "B" continued

Style "C"

Style "D"

Fig. 518. Identification Signs.

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.

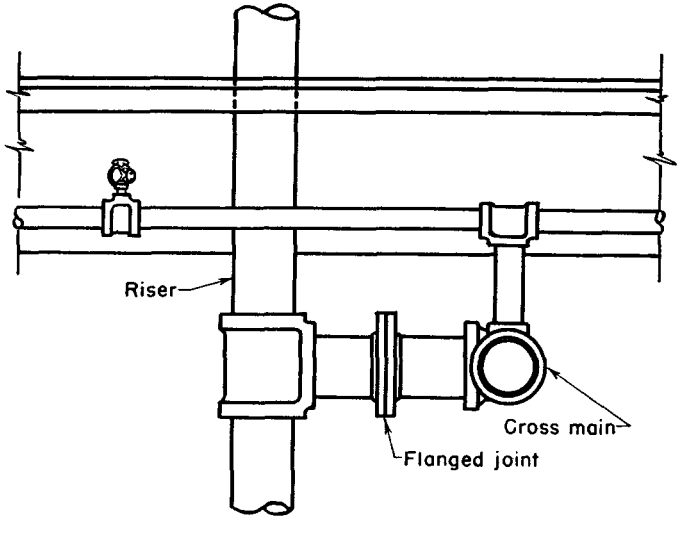


Fig. 521. One Arrangement of Flanged Joint at Sprinkler Riser.

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

(f) Where risers are 3 inch 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.

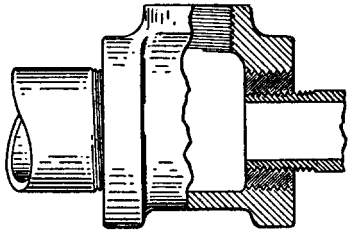


Fig. 523. Flush Bushing.

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.

(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. Unprotected steel ⅛-inch in thickness is acceptable for retaining straps used with "C" clamps.

(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.

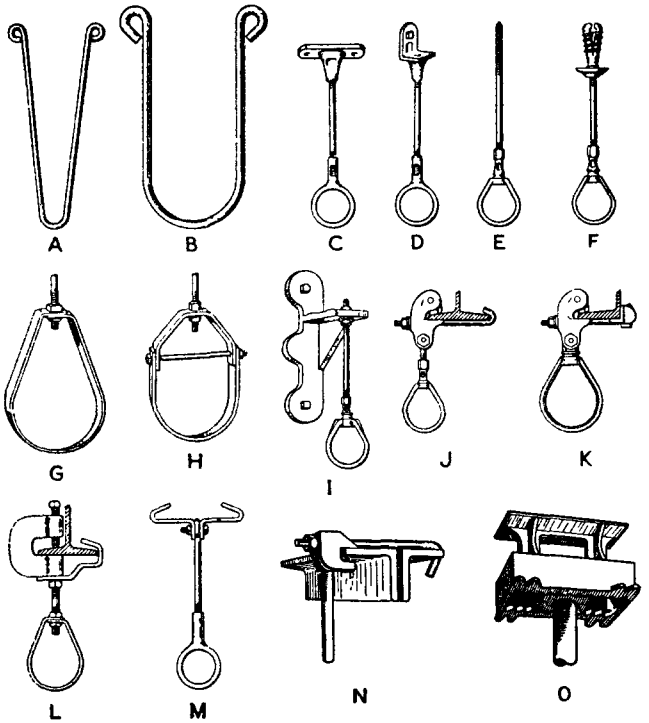


Fig. 531. Common Types of Acceptable Hangers.

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.

(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.

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.

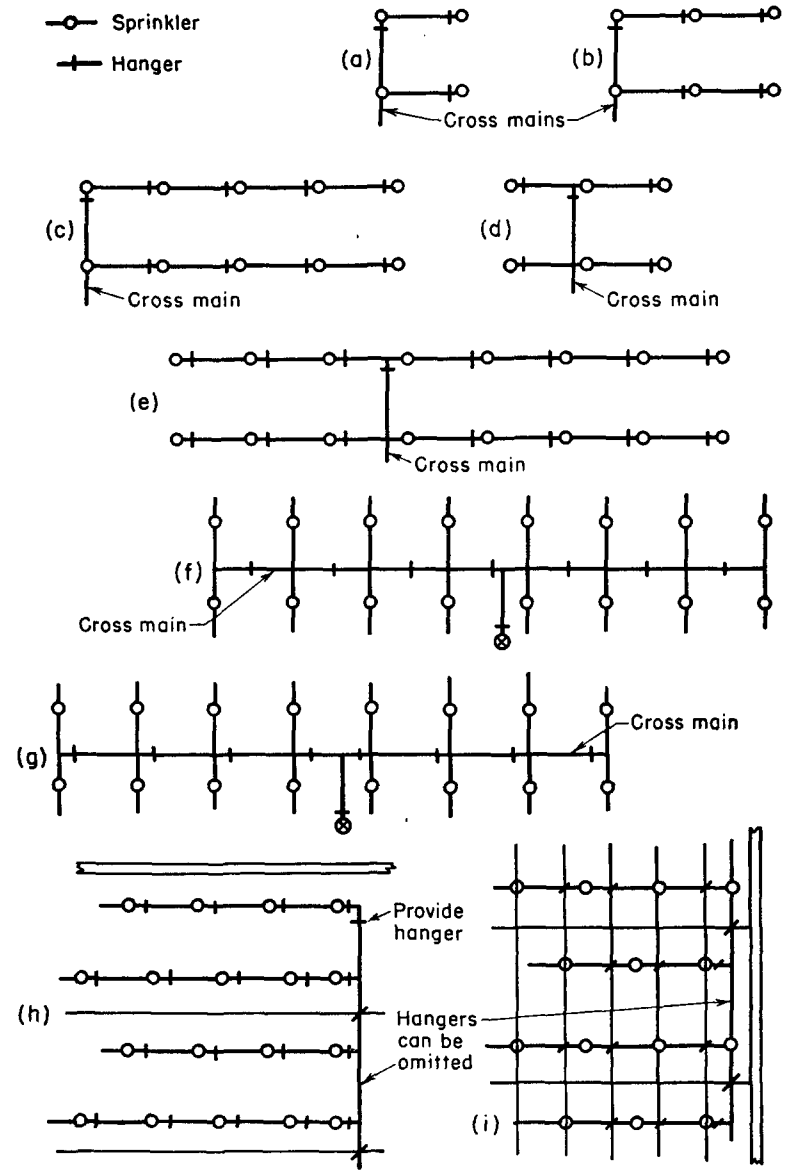


Fig. 533. Location of Hangers. (Not to scale.)

533. Location of Hangers.

(a) On branch lines there shall be at least one hanger for each length of pipe with one hanger within 30 inches of the end sprinkler and with hangers not over 12 ft. apart, except that where one hanger for each length of pipe would require hangers closer than 5 ft. apart, hangers may be spaced not to exceed 10 ft. apart. Where starter lengths are less than 6 ft. in length hangers may be omitted, except at end branch lines.

(b) 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.

(c) On cross mains there should ordinarily be one hanger between each two branch lines. On feed mains there shall be at least one hanger for each 12 feet of pipe. Where cross mains are located between purlins and where construction is such that piping must be supported from roof or floor framing members, those hangers needed for cross main piping between branch lines coming within the truss or girder bays should be attached to steel angles bolted between purlins. In lieu thereof additional branch line hangers attached to the purlins and located thereon as close to the cross main as purlin location permits, together with a hanger on the end length of the cross main attached to steel angles, shall be acceptable. See Fig. 533 (h) and (i). With purlins of average spacing (maximum 7 ft. on centers) 2½ x 2½ x ¼-in. angles may be used to support cross mains up to 4 in. in diameter, and 2½ x 3½ x 5/16-in. angles (longer leg vertical) for piping, 5, 6 and 8 ins. in diameter.

(d) Where sprinkler piping must be supported from roof framing members, as in the case of gypsum or steel deck roofing, and the unsupported length between the end sprinkler and beam hanger would be greater than 36 inches, the pipe shall be extended beyond the end sprinkler to the next beam for support. If 1¼-in. pipe is used for the end piece, the unsupported length may be up to 48 inches.

(e) Hangers shall not be near enough to sprinklers to obstruct distribution of water. Ordinarily they should not be nearer than 12 inches, except in the case of round iron hangers, where a space of not less than 3 inches may be permitted.

(f) Under "semi-mill" construction where sprinklers are located under the center line of beams, hangers may be used on the

side of these beams provided the beams are of such width that hangers will not be closer than 3 inches to the sprinklers. Where beams are less than 6 inches in width, offset hangers may be used or the hangers located 12 to 18 inches from sprinklers.

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 be not less than that given in the following table:

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.

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.

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 Temperature, °F.*	*Color*	*Maximum Ceiling Temperature, °F.*
Ordinary	135°–150°–160°–165°	Uncolored*	Up to 100°
Intermediate	175°–212°	White*	100°–150°
Hard	250°–280°–286°	Blue	150°–225°
Extra Hard	325°–340°–360°	Red	225°–300°

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

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 Intermediate, Hard and Extra-Hard Degree ratings 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 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

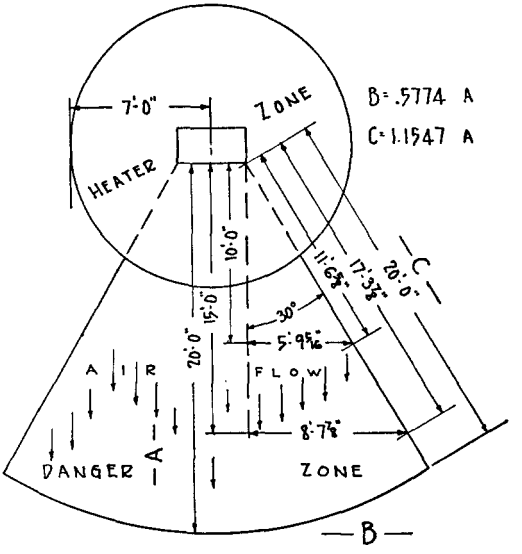


Fig. 611. Heater and Danger Zones at Unit Heaters.

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 should not be applied to sprinklers by anyone other than the manufacturer of the sprinklers.

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 ordinarily should not be substituted for regular automatic sprinklers. (See section 770.)

(b) The authority having jurisdiction should be consulted where sidewall sprinklers are to be used.

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

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

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

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

(g) 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.

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

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.

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 usually 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.

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, inside

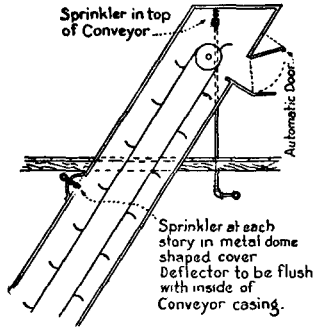


Fig. 712(a). Sprinklers in Conveyor Enclosure.

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) NON-COMBUSTIBLE 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 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 heads 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 econo-

mizers 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 ROOMS having unprotected combustible roofs should be provided with sprinkler protection. Metal shields or hoods may be used to protect generators, switchboards, or other important electrical equipment, but they should be so arranged as not to interfere with the sprinkler protection of the ceiling.

(k) GENERATOR OR TRANSFORMER ROOMS: Sprinklers may be omitted where they are of fire-resistive construction or combustible construction adequately fireproofed. If voltages exceed 600 and the service rendered is important, such rooms should preferably be of noncombustible construction.

713. BLIND SPACES. (a) Sprinklers should be installed in all blind spaces enclosed by combustible construction, as in walls, floors and ceilings, where it is practicable to install sprinklers, 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 also be installed whenever the total depth of the space exceeds 14 inches.

(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 underside of the supporting beams of a combustible roof or floor or otherwise installed to make the installation of sprinklers impracticable.
2. 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 feet intervals for horizontal divisions or at closer intervals if required by authority having jurisdiction.

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.

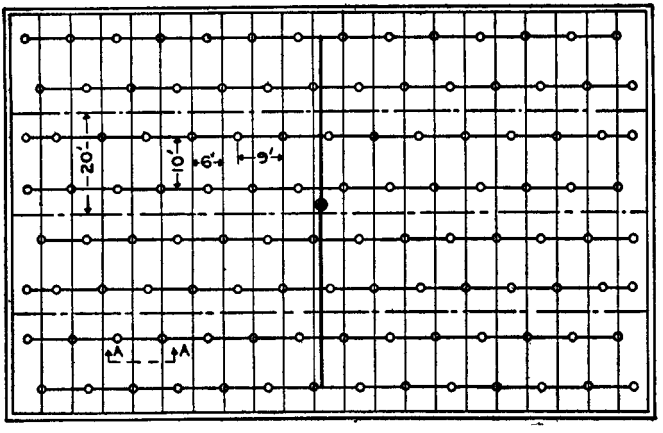
717. TABLES. (a) Sprinklers should be installed under cutting, pressing, sewing machine and other work tables wider than 5½ feet, also under tables less than 5½ feet but wider than 4 feet unless provided underneath with tight vertical partitions of galvanized iron or other noncombustible material not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

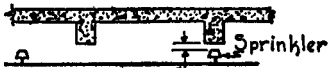
(c) The outer edges of each partition should be smoothly finished (rounded if of metal) so as to prevent injury to employees.

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

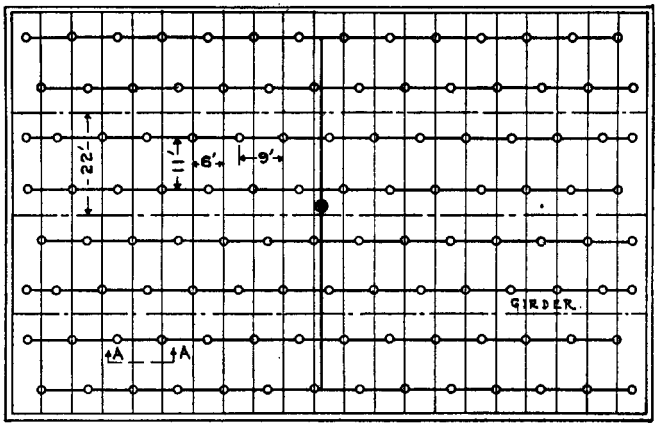
718. EXTERIOR DOCKS AND PLATFORMS. (a) Sprinklers should be installed under awnings or roofs over outside platforms except where construction is noncombustible and the platform is not used for storage.



Bays 6 ft. by 20 ft.



Enlarged Section A-A.



Bays 6 ft. by 22 ft.

Fig. 721-1. Spacing of Sprinklers Under Fire-Resistive and Noncombustible Construction.

(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.

NOTE: For occupancy classification, see section 104.

721. FIRE-RESISTIVE AND NONCOMBUSTIBLE CONSTRUCTION.

(a) The term "fire-resistive" refers to construction such as reinforced concrete on protected steel supports. "Noncombustible" refers to construction such as precast concrete, gypsum or steel floor or roof deck on unprotected steel supports.

With these types of construction the location and arrangement of sprinklers shall be such that adequate protection will be given the building contents and keep any unprotected steel cool. Where the type of construction is "noncombustible" the arrangement of sprinklers should be as indicated for mill or semi-mill construction depending upon the spacing and arrangement of beams and girders. For spacing under bar joist construction see paragraph 724.

(b) With LIGHT HAZARD OCCUPANCY, the protection area allotted per sprinkler shall not exceed 196 square feet with the distance between lines and between sprinklers on lines not in excess of 14 feet.

(c) With ORDINARY HAZARD OCCUPANCY, the protection area allotted per sprinkler should not exceed 100 square feet with the distance between lines and between sprinklers on lines not in excess of 12 feet, except as covered by paragraph 721 (f).

(d) Under smooth ceilings or under flat-slab concrete construction, branch lines may be run in either direction. It is usually desirable to treat each space between columns as a unit, that is, install the same number of lines in each space. This avoids the possibility of obstructed distribution by columns or column caps and permits the erection of partitions along the columns between lines without affecting the protection.

(e) Under so-called "joisted" type of concrete construction a staggered spacing of sprinklers will provide more uniform protection for the room contents, and in some cases this arrangement of sprinklers or a closer spacing may be advisable.

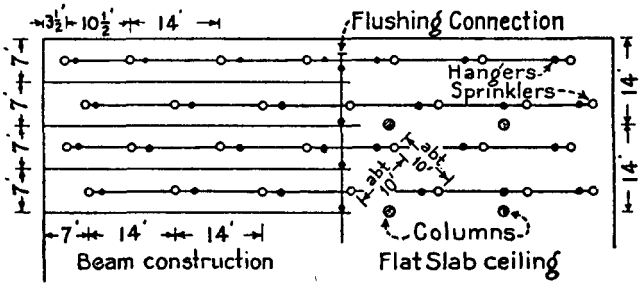


Fig. 721-2. Layout for Sprinklers Under Fire-Resistive Construction in Unobstructed Bays and Under Flat-Slab Ceilings.

(f) Fig. 721–2 illustrates an acceptable method of spacing sprinklers to obtain 100 square feet per sprinkler in unobstructed bays 7 feet wide and under flat-slab ceilings with columns 14 feet on centers. Sprinklers on alternate lines are staggered. The same method may be applied to 6-foot bays and sprinklers spaced 16 feet 8 inches apart on lines and to 7½-foot bays and sprinklers spaced 13 feet 4 inches apart on lines. With these arrangements, the diagonal spacing is approximately 10 feet by 10 feet.

(g) With EXTRA HAZARD OCCUPANCY, the protection area allotted per sprinkler shall not exceed 90 square feet with the distance between lines and between sprinklers on lines not in excess of 10 feet.

722. MILL CONSTRUCTION.

(a) Under ceilings of mill construction (smooth, solid plank and timber, or plank on steel construction, with bays 6 to 12 feet in width, center to center of beams or trusses) one line of sprinklers shall be placed in the center of each bay.

(b) With LIGHT HAZARD OCCUPANCY, the protection area allotted per sprinkler shall not exceed 168 square feet with the distance between lines and between sprinklers on lines not in excess of 14 feet.

(c) With ORDINARY HAZARD OCCUPANCY, the protection area allotted per sprinkler shall not exceed 100 square feet with the distance between lines and between sprinklers on lines not in excess of 12 feet. The following table gives the proper spacing of sprinklers on lines in bays of given width. Measurements should be taken from center to center of beams, or trusses.

8 feet in 12 foot bays.	10 feet in 10 foot bays.
9 feet in 11 foot bays.	11 feet in 9 foot bays.
12 feet in 6 to 8 foot bays.	

(d) With EXTRA HAZARD OCCUPANCY, the protection area allotted per sprinkler shall not exceed 80 square feet with the distance between lines and between sprinklers on lines not in excess of 10 feet.

723. SEMI-MILL CONSTRUCTION.

(a) This is a modified form of standard mill construction in which the bays usually are from 3 to 7 feet wide and beams are supported on girders. Where bays are less than 3 feet wide this should be treated as open joist construction.

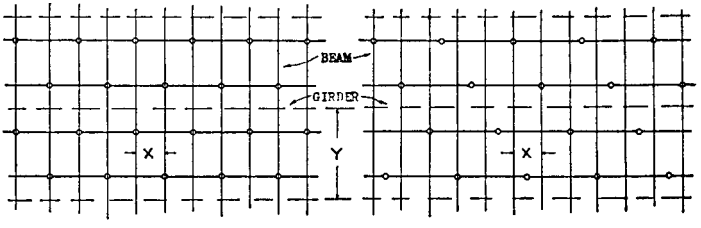
(b) Where girders and beams are framed into each other the construction is designated as panel construction. Under such construction sprinkler branch lines usually should be run at right angles to the beams or panels.

(c) Where beams are 6 inch by 12 inch or smaller (including thickness of nailing strips on steel beams) sprinklers may be placed under beams and in bays, depending on the width of bays and distance between girders, occupancy and other conditions. Sprinklers should be "staggered" on adjacent branch lines.

Where beams are larger than 6 inch by 12 inch (including thickness of nailing strips on steel beam) sprinklers should be placed in the bays. Sprinklers should be staggered in alternate bays or arranged "two and one" depending upon width of bays and distance between girders.

Where beams exceed 14 inches in depth panelling of sprinklers should be required.

(d) With LIGHT HAZARD OCCUPANCY, the protection area allotted per sprinkler shall not exceed 144 sq. ft. with the distance between lines and between sprinklers on lines not in excess of 14 ft.



2 BAY STANDARD STAGGER

Light Hazard

X=Up to 5 ft. then Y=28 ft.
X= 6 ft. then Y=22 ft.

Ordinary Hazard

X=4 ft. then Y=22 ft.
X=4 ft. 6 in. then Y=20 ft.

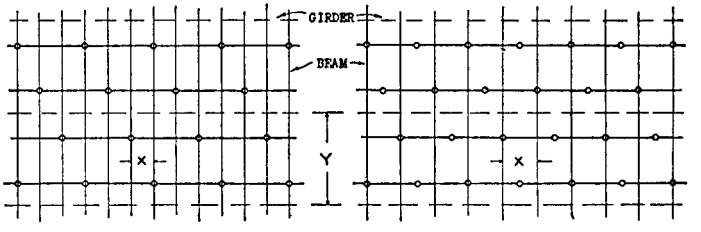
2½ BAY PROGRESSIVE STAGGER

Light Hazard

X=4 ft. then Y=28 ft.
X=5 ft. then Y=22 ft.

Ordinary Hazard

X=4 ft. then Y=18 ft.



3 BAY PROGRESSIVE STAGGER

Light Hazard

X=4 ft. then Y=24 ft.

Ordinary Hazard

X=3 ft. then Y=20 ft.

1½ BAY PROGRESSIVE STAGGER

Light Hazard

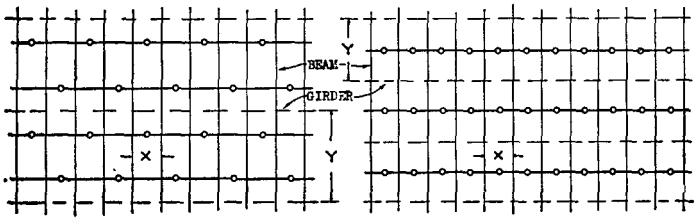
X=6 ft. then Y=28 ft.

Ordinary Hazard

X=6 ft. then Y=20 ft.

Fig. 723(e)-1. Arrangement of Sprinklers Under Semi-Mill Construction with Beams 6 in. by 12 in. or Smaller, Resting on Top of or Framed Into Girders, Forming Panels.

X=width of bay; Y=maximum distance between supporting timbers.



A

2 BAY STANDARD STAGGER

Light Hazard
X=Up to 5 ft. then Y=28 ft.
X= 6 ft. then Y=24 ft.

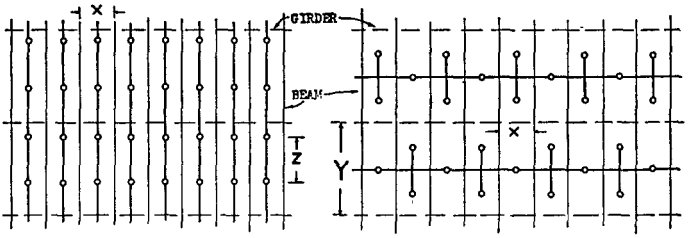
Ordinary Hazard
X=4 ft. then Y=20 ft.
X=5 ft. then Y=18 ft.

B

BAY SPACING

Light Hazard
X=6 ft. then Y=14 ft.

Ordinary Hazard
X=6 ft. then Y=10 ft.



C

BRANCH LINES IN BAYS SPRINKLERS SPACED DISREGARDING GIRDERS

Light Hazard
X=6 ft. then Z=14 ft.

Ordinary Hazard
X=6 ft. then Z=12 ft.

D

TWO AND ONE OR TREE SPACING

Light Hazard
X=6 ft. then Y=28 ft.

Ordinary Hazard
X=6 ft. then Y=20 ft.

Fig. 723(e)-2. Arrangement of Sprinklers Under Semi-Mill Construction with Beams Larger than 6 in. by 12 in., Resting on Top of Girders.

X=width of bay; Y=maximum distance between supporting timbers.

Z=distance between sprinklers.

Where beams and girders are framed into one another, the construction is termed panel construction.

Where beams and girders form panel construction spacing of sprinklers under various conditions may be in accordance with diagrams A, B or D.

(e) With ORDINARY HAZARD OCCUPANCY, the protection area allotted per sprinkler shall not exceed 90 sq. ft. with the distance between lines and between sprinklers on lines not in excess of 10 ft.

Where lines are run in beam panels sprinklers may be staggered not to exceed 12 feet apart on a line.

Where beams are supported on top of girders and the sprinklers are spaced 1⅓, 1½, 2½, or 3 beam spaces apart, a progressive stagger should be used.

(f) With EXTRA HAZARD OCCUPANCY, the protection area allotted per sprinkler shall not exceed 80 sq. ft. with the distance between lines and between sprinklers on lines not in excess of 10 ft.

724. BAR JOIST CONSTRUCTION.

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

(a) With Light Hazard Occupancy:

1. Noncombustible floor or roof deck. The protection area allotted per sprinkler shall not exceed 196 sq. ft. with the distance between lines and between sprinklers on lines not in excess of 14 ft.
2. Combustible floor or roof deck. The protection area allotted per sprinkler shall not exceed 144 sq. ft. with the distance between lines and between sprinklers on lines not in excess of 14 ft.

(b) With Ordinary Hazard Occupancy:

1. Noncombustible floor or roof deck. The protection area allotted per sprinkler shall not exceed 100 sq. ft. Where spacing of joists is 3 ft. or more, the distance between lines and between sprinklers on lines shall not exceed 12 ft. Where spacing of joists is less than 3 ft., the distance between lines shall not exceed 12 ft., with the distance between sprinklers on lines not in excess of 11 ft.
2. Combustible floor or roof deck. The protection area allotted per sprinkler shall not exceed 90 sq. ft. Where spacing of joists is 3 ft. or more, the distance between lines and between sprinklers on lines shall not exceed 12 ft. Where spacing of joists is less than 3 ft., the distance between lines shall not exceed 11 ft., with the distance between sprinklers on lines not in excess of 10 ft.

(c) With Extra Hazard Occupancy:

1. Noncombustible floor or roof deck. The protection area allotted per sprinkler shall not exceed 90 sq. ft. with the distance between lines and between sprinklers on lines not in excess of 10 ft.
2. Combustible floor or roof deck. The protection area allotted per sprinkler shall not exceed 80 sq. ft. with the distance between lines and between sprinklers on lines not in excess of 10 ft.

(d) Branch lines should be run through bar joists when necessary so that sprinklers will be the proper distance below the floor or roof deck, thus avoiding the use of nipples. The distance between sprinklers and floor or roof deck may be increased where conditions warrant but the distance should not exceed 16 inches. Sprinklers on alternate lines should be staggered.

725. OPEN JOIST CONSTRUCTION.

(a) Wood joist or wood plank and beam construction with bays less than 3 ft. wide, center to center, and construction consisting of combustible flooring on steel joists not conforming to definition of bar joists (paragraph 724 a) shall be treated as joist construction.

(b) Under open-finish joisted construction, ceilings, floors, decks, and roofs, the lines shall be run at right angles to the joists and the sprinklers shall be "staggered" so that they will be opposite a point one-half the distance between sprinklers on the adjacent lines.

(c) With LIGHT and with ORDINARY HAZARD OCCUPANCY, the protection area allotted per sprinkler shall not exceed 80 sq. ft. and the distance between sprinklers shall not exceed 8 ft. at right angles to the joists or 10 ft. parallel with the joists; with the end sprinklers on alternate lines not more than 2 ft. from walls or partitions and the end sprinklers on other lines not more than 4 ft. from walls or partitions.

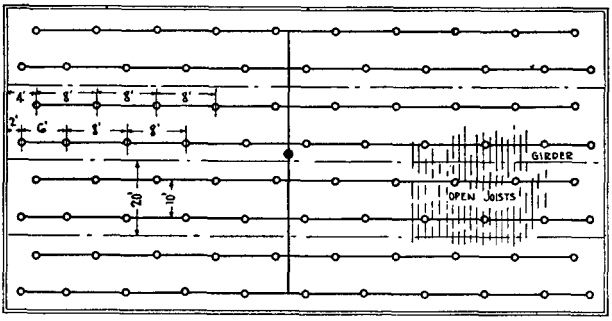


Fig. 725-1. Spacing of Sprinklers under Open Joist Construction — standard one-half stagger.

(d) Open joisted bays, with joists on top of girders, 10 ft. 1 in. to 12 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 the bays next to side or end walls.

(e) With Light or Ordinary hazards the number of sprinklers required on sprinkler lines for any length of bay up to 100 ft. should be in accordance with the following table:

NUMBER OF SPRINKLERS ON LINES UNDER JOISTED CONSTRUCTION.

Length or Width of Room at Right Angles to Joists	*Number of Sprinklers on Lines*	*Length or Width of Room at Right Angles to Joists*	*Number of Sprinklers on Lines*
Up to 8 ft.	1	Over 48 ft. to 52 ft.	7 & 7
Over 8 ft. to 12 ft.	*1 & 2 or *2 & 2	" 52 ft. to 56 ft.	7 & 8
		" 56 ft. to 60 ft.	8 & 8
" 12 ft. to 14 ft.	2 & 2	" 60 ft. to 64 ft.	8 & 9
" 14 ft. to 16 ft.	2 & 3	" 64 ft. to 68 ft.	9 & 9
" 16 ft. to 20 ft.	3 & 3	" 68 ft. to 72 ft.	9 & 10
" 20 ft. to 24 ft.	3 & 4	" 72 ft. to 76 ft.	10 & 10
" 24 ft. to 28 ft.	4 & 4	" 76 ft. to 80 ft.	10 & 11
" 28 ft. to 32 ft.	4 & 5	" 80 ft. to 84 ft.	11 & 11
" 32 ft. to 36 ft.	5 & 5	" 84 ft. to 88 ft.	11 & 12
" 36 ft. to 40 ft.	5 & 6	" 88 ft. to 92 ft.	12 & 12
" 40 ft. to 44 ft.	6 & 6	" 92 ft. to 96 ft.	12 & 13
" 44 ft. to 48 ft.	6 & 7	" 96 ft. to 100 ft.	13 & 13

*In narrow rooms the exact number should be determined by the width of bay, hazards of occupancy, water pressure, etc.

(f) The maximum allowable distance between sprinklers on lines is 8 ft. and the maximum allowable distance between lines should ordinarily be limited to 10 ft. In bays 11 ft. or 22 ft. in width one and two lines respectively may be placed in each bay with sprinklers not over 7 ft. apart.

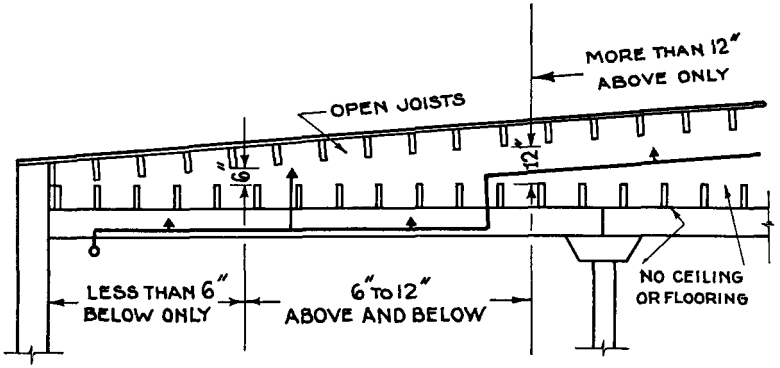


Fig. 725-2. Arrangement of Sprinklers under Two Sets of Open Joists — no sheathing in lower joists.

(g) Where there are two sets of joists under a roof or floor 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.

(h) With EXTRA HAZARD OCCUPANCY, the protection area allotted per sprinkler shall not exceed 70 sq. ft. and the distance between sprinklers shall not exceed 7 ft. at right angles to the joists, or 10 ft. parallel with the joists.

726. JOIST CONSTRUCTION WITH SHEATHED OR PLASTERED CEILING.

(a) With LIGHT HAZARD OCCUPANCY, if sheathing is the equivalent of plasterboard not less than ½ in. in thickness, or is of metal, or of wood lath and plaster, the protection area allotted per sprinkler shall not exceed 168 sq. ft. with the distance between lines and between sprinklers on lines not in excess of 14 ft. Sprinklers need not be staggered.

(b) Where sheathing is combustible, such as matched boarding, the protection area allotted per sprinkler shall not exceed 120 sq. ft. with the distance between lines and between sprinklers on lines not in excess of 12 ft. In basements with such combustible sheathing the distance between lines and between sprinklers on lines shall not exceed 10 ft. With sheathing of light combustible material, the spacing shall be the same as for open joists.

(c) With ORDINARY HAZARD OCCUPANCY, under smooth sheathed ceilings, provided the sheathing is the equivalent of plasterboard, not less than ½ in. thick, or is of metal, or of wood lath and plaster, if tight and in good repair, with no openings to joist channels, the protection area allotted per sprinkler shall not exceed 80 sq. ft. with the distance between lines and between sprinklers on lines not in excess of 10 ft. Sprinklers need not be staggered.

(d) Where wood or other sheathing of similar combustibility is used as a fire stop, the spacing of the sprinklers shall be the same as for open joist construction.

(e) A protection area of 100 sq. ft. with a distance between lines and between sprinklers on lines not in excess of 12 ft. may be allotted for sprinklers under suspended ceilings of combustible construction provided there is a full complement of sprinklers immediately above such ceilings, also under top floor ceilings of combustible construction provided there is a full complement of sprinklers immediately above such ceilings and the attic space is unfloored and unoccupied.

(f) Under smooth sheathed ceilings with cement or gypsum plaster on metal lath or the equivalent, the protection area allotted per sprinkler shall not exceed 100 sq. ft. with the distance between lines and between sprinklers on lines not in excess of 12 ft.

(g) With EXTRA HAZARD OCCUPANCY, where sheathing is the equivalent of metal lath and cement plaster, the protection area allotted per sprinkler shall not exceed 80 sq. ft. with the distance between lines and between sprinklers on lines not in excess of 10 ft. The sprinklers need not be staggered. For other sheathing of lesser value as a fire stop, the spacing shall be the same as for open joist construction.

740. Pitched or Curved Roofs — Quonset Type Buildings.

741. Under a roof of combustible construction having a pitch in excess of one foot in three feet, it is desirable that sprinklers be located in the peak of the roof, and those on either side of the peak be spaced according to the foregoing requirements. The distance between sprinklers shall be measured on a line parallel with the roof. Where the roof meets the floor line, sprinklers shall be installed at a point not to exceed 3½ ft. from the point where timbers and floor meet.

742. Sprinklers installed at a point not more than 2½ ft. distant each way from the peak of the roof measured on a line with the roof, may be used in lieu of sprinklers located in the peak as described in the foregoing paragraph.

743. Under combustible sawtooth roofs end sprinklers on branch lines shall not be less than one foot nor more than 2½ feet from the peaks of these roofs.

744. Under curved roofs, sprinklers should be spaced in accordance with the foregoing requirements for the closest comparable type of ceiling construction. For other than fire-resistive construction the spacing should be based on ceiling coverage. 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.

745. Under curved roofs of steel with ribs 6 inches deep, 4 feet apart, the spacing for ordinary hazard occupancy should not exceed 90 square feet of ceiling area per sprinkler, with the sprinklers preferably staggered.

NOTE: Where complete wetting of the ceiling surfaces is desired to avoid damage to the light steel members, sprinklers may need to be spaced somewhat more closely.

746. 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 extra-hazard occupancies, but in no case shall the spacing on the roof or ceiling be wider than required for ordinary-hazard occupancies.

750. Walls, Obstruction, Special Conditions.

751. 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 paragraphs 725 (c) and section 201.)

752. OBSTRUCTIONS. Sprinklers shall be located a sufficient distance from obstructions such as timbers, uprights, hangers, piping, etc., to avoid interference with the distribution of water from the sprinklers. This will ordinarily mean a distance of at least 12 inches from such members.

753. LIGHTING FIXTURES. (a) Lighting fixtures of the pendent type offer no appreciable obstruction to the discharge from sprinklers except when located at a level less than 3 inches below the deflectors of sprinklers in the upright or pendent position. Fixtures of the surface type (attached to ceiling without pendents) may offer obstructions to the discharge from sprinklers. Recessed lighting fixtures offer no obstructions to sprinkler discharge.

(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 type fixtures located at a level less than 3 inches below the deflectors of sprinklers and surface type fixtures usually make necessary additional branch lines.

754. OPEN GRID CEILINGS. The installation of open grid "louver" or "egg crate" ceilings of 2 in. by 2 in. or larger openings below lights restricts the sidewise travel of the sprinkler discharge but protection as a whole is not adversely affected in buildings of light hazard occupancies. A minimum clearance of 18 in. should be provided between the sprinkler deflectors and

the upper surface of the louver type ceiling. If this is not possible, the protection area per sprinkler should not exceed 80 to 90 sq. ft. with maximum distance between lines and between sprinklers on lines not greater than 10 ft.

760. Protection of Vertical Shafts.

761. 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.

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

763. 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.

765. 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
1¼ in. pipe	6 sprinklers
1½ in. pipe	10 sprinklers
2 in. pipe	20 sprinklers
2½ in. pipe	40 sprinklers
3 in. pipe	80 sprinklers

(c) Sprinklers shall be of approved types 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.

770. Sidewall Sprinklers. (See paragraph 625).

771. 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. In no case shall the protected area per sprinkler exceed that for an ordinary sprinkler under the same occupancy classification.

772. 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 additional sprinkler protection required to supplement the protection given by the sprinklers along the sidewalls. The installation of sidewall sprinklers other than beneath smooth ceilings will require special rulings.

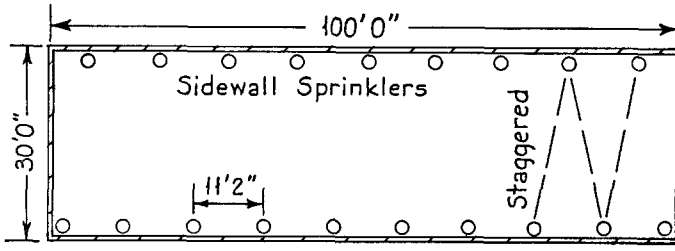


Fig. 772. Spacing of Sidewall Sprinklers under Smooth Ceilings, with Light Hazard Occupancy. Water pressure, construction and occupancy may necessitate additional branch lines of sprinklers in rooms over 20 ft. in width.

773. 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.

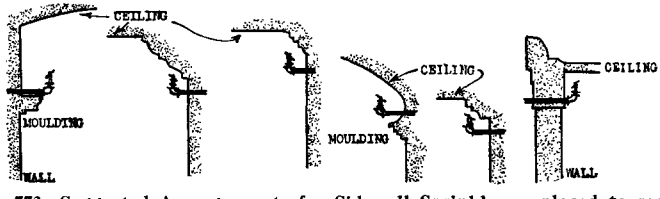


Fig. 773. Suggested Arrangements for Sidewall Sprinklers — placed to receive early heat waves and provide effective distribution.

774. 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 strictly vertically.

775. 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 slope of the ceiling.

780. Position of Sprinklers.

781. (a) Ordinarily sprinklers should be installed in the upright position.

(b) Where it may be necessary to install sprinklers in the pendent position, they shall be of a type approved for that purpose.

782. POSITION OF DEFLECTORS. (a) Sprinkler deflectors 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) The distance of deflectors from ceilings of mill or other smooth construction, or bottom of joists of open joist construction, preferably should be from 5 to 8 in. and should not exceed a maximum of 10 in. The minimum distance should not be less than 3 in.

(c) Where sprinklers are placed under the beams of semi-mill, panel, fire-resistive, or noncombustible construction, deflectors of end sprinklers should be 3 inches below the beams and other sprinklers, whether in bays or under beams, only enough lower to provide drainage. The distance between sprinkler deflectors and floor or roof deck may be increased where conditions warrant but the distance should not exceed 16 inches.

(d) Where regular sprinklers are spaced less than 5 feet apart, baffles, or the equivalent, should be installed to prevent the first sprinkler opening from wetting adjoining sprinklers. Baffles should be so designed and located as not to interfere with the distribution of water from sprinklers.

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

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.

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. (a) 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 822a.

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

(b) The gallons per sprinkler will naturally vary with the arrangement and size of the system. Under standard requirements, the smallest quantity per sprinkler would be 0.741 gal. under 8 ft. stagger in 11 ft. 6 in. to 12 ft. bays joisted construction, and the greatest 1.714 gal. under practically 10 x 10 ft. spacing panel construction, but in equal areas, the total capacity of each system per floor would be nearly the same due to the greater number of sprinklers under the joisted construction. Approximate capacities may be obtained under general types of construction by allowing per sprinkler 1.1 gal. under centre feed; 1.25 gallons under side and end centre feed, and 1.6 gal. under panel construction. These include allowances not in excess of 14 feet for riser pipe and of 10 feet from riser to system on each floor. They do not include any long feed mains from dry pipe valve to system.

TABLE 822b.

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 closet 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.

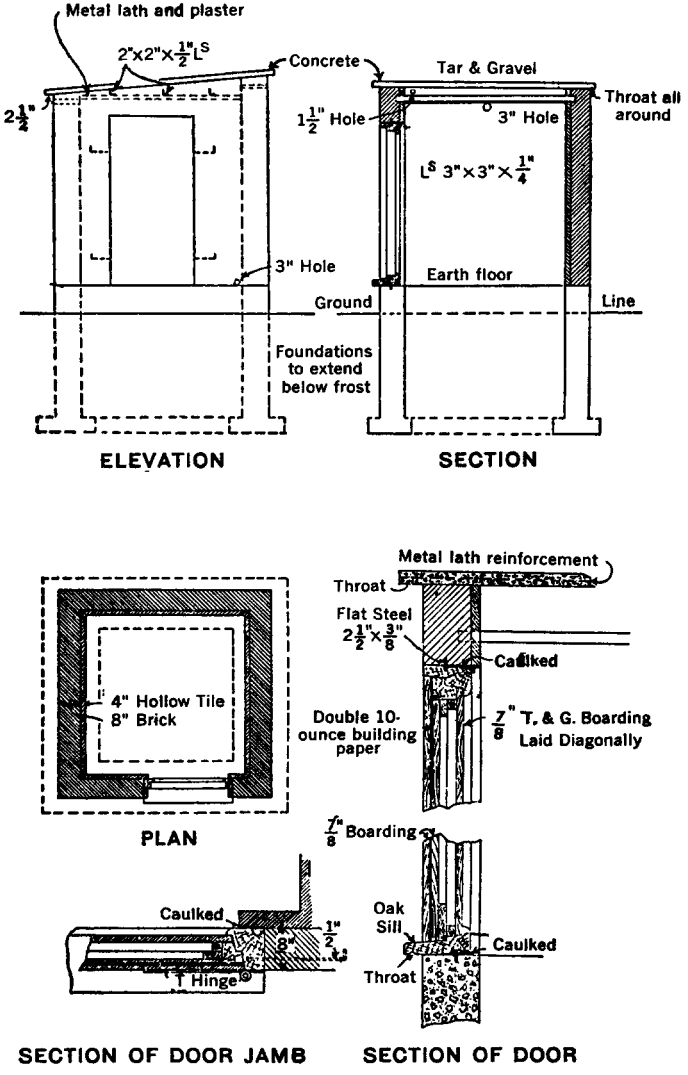
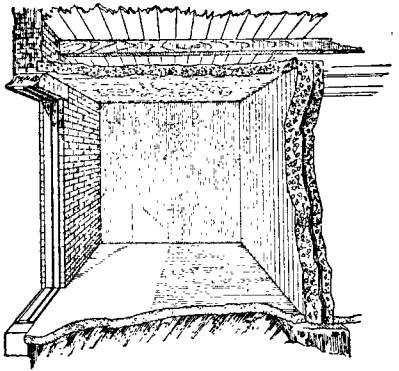


Fig. 843-1. Dry-Pipe Valve Enclosures — Fire-Resistive Construction, Located Outside of Building with no Direct Communication to Building.



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.

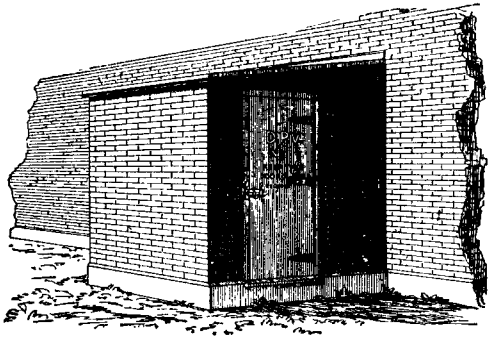
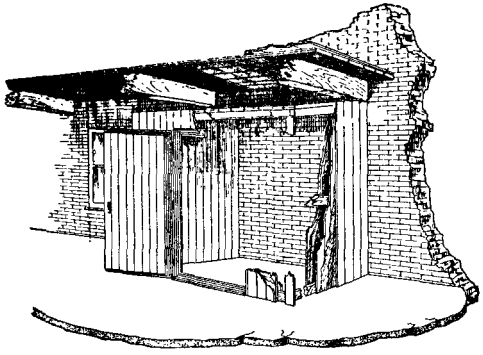


Fig. 843-3. Dry-Pipe Valve Enclosures — Fire-Resistive Construction, Located Outside of Building with no Direct Communication to Building.

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.

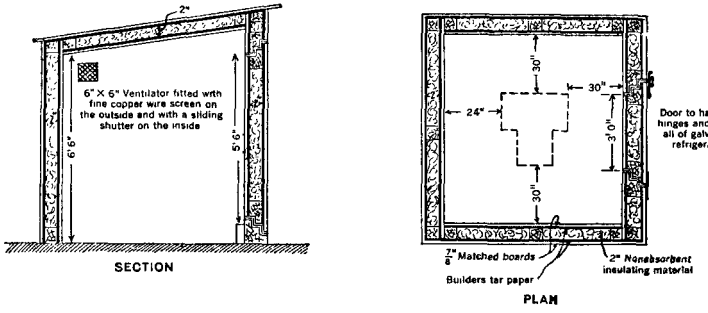
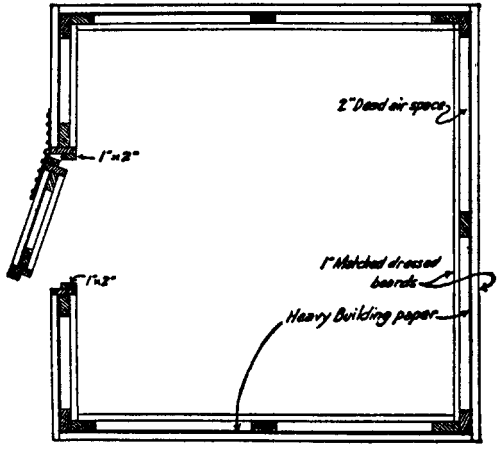


Fig. 843-5. Dry-Pipe Valve Enclosure — Combustible Construction.

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.



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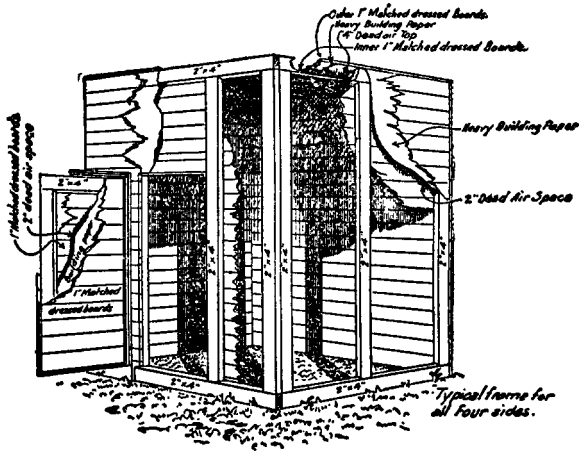


SECTIONAL VIEW

Fig. 843-6. Dry-Pipe Valve Enclosure — For Mild Climates, and Location Inside Building.

843. SKETCHES OF DRY-PIPE VALVE ENCLOSURES.

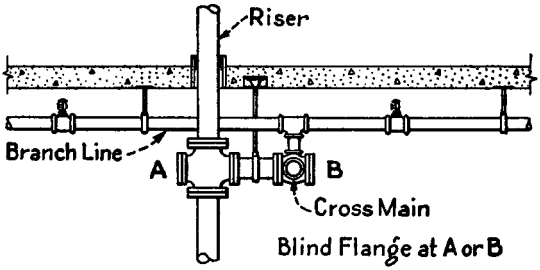
The enclosures shown are intended to serve as illustrations of those already in successful use, rather than as standards, from which to select or modify the design most suitable for local needs, in consideration of the varying climatic conditions. The sketches are not drawn to scale.

850. Cold Storage Rooms.

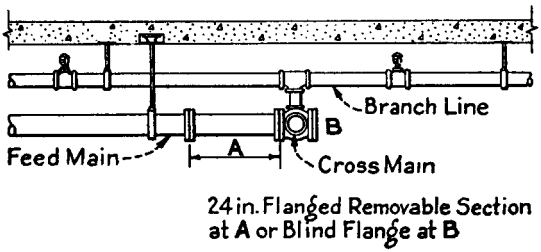
851. Careful installation and maintenance, and some special arrangements of piping and devices as outlined in this section are needed to avoid the formation of ice and frost inside piping in cold storage rooms which will be maintained at or below 32° F. Conditions are particularly favorable to condensation 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



(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.

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.

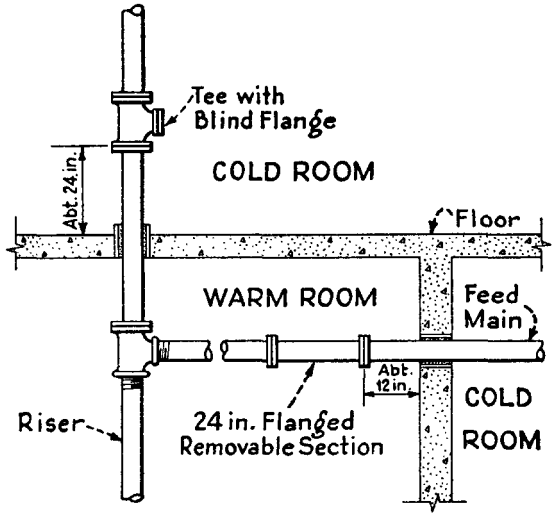


Fig. 852-2. Fittings in Feed Main or Riser Passing Through Wall or Floor from Warm Room to Cold Room.

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.

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.

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.

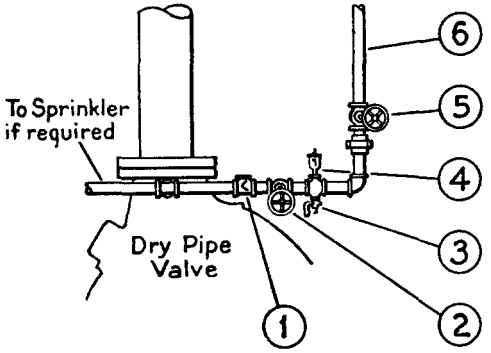


Fig. 863. Air Supply from Shop System.

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

863. INDEPENDENT AIR FILLING CONNECTION. (a) The connection from the air compressor should 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 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) Above and below the 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. NON-FREEZING SOLUTIONS.

901. WHERE USED.

Non-freezing solutions may be used for maintaining automatic sprinkler protection in small unheated areas which would otherwise be shut off and drained during freezing weather. Non-freezing 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 NON-FREEZING SOLUTIONS.

(a) Where sprinkler systems are supplied by public water connections the use of non-freezing 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 non-freezing 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.

(b) If public water is not connected to sprinklers, the commercially available materials indicated in Table 902–2 are suitable for use in non-freezing solutions.

(c) A non-freezing 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 non-freezing 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 non-freezing 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.

TABLE 902–1.

NON-FREEZING 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.

NON-FREEZING 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.

NOTE: Beyond certain limits, increased proportion of Non-Freeze does not lower the freezing point of solution. (See Fig. 902.)

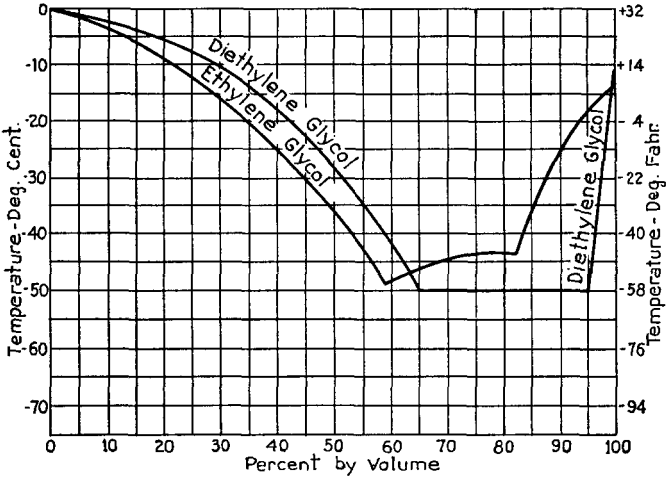


Fig. 902. Freezing Points of Water Solutions of Ethylene Glycol and Diethylene Glycol.

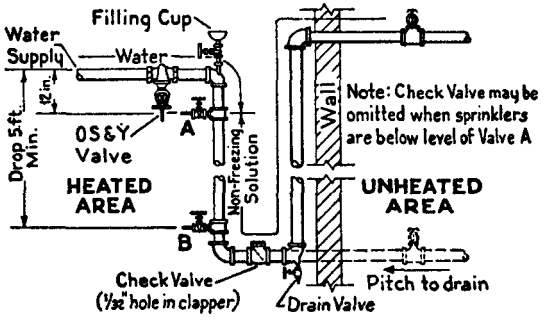


Fig. 903. Arrangement of Supply Piping and Valves.

To avoid leakage, the materials and workmanship must be excellent, the threads clean and sharp, and the joints tight. Use only metal-faced valves.

904. FILLING. With water supply valve closed and the system drained, fill the piping through the filling cup, using a suitable non-freezing 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 non-freezing 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.

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 piping for deluge systems shall conform to the following pipe schedule, except that where necessary to provide uniform sprinkler discharge, the 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.

(b) In designing the piping system the water supply for deluge systems 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) 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.

(d) 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

(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.

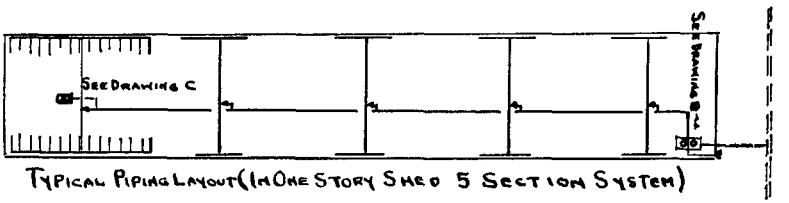


Fig. 1100. Typical Piping Layout for Combined Dry Pipe and Pre-Action Sprinkler System.

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.)

1108. Each dry pipe valve shall be provided with an approved tripping device actuated by the heat responsive system. Dry pipe valves shall be cross connected through a 1-inch pipe connection to permit simultaneous tripping of both dry pipe valves. This 1-inch pipe connection shall be equipped with a gate

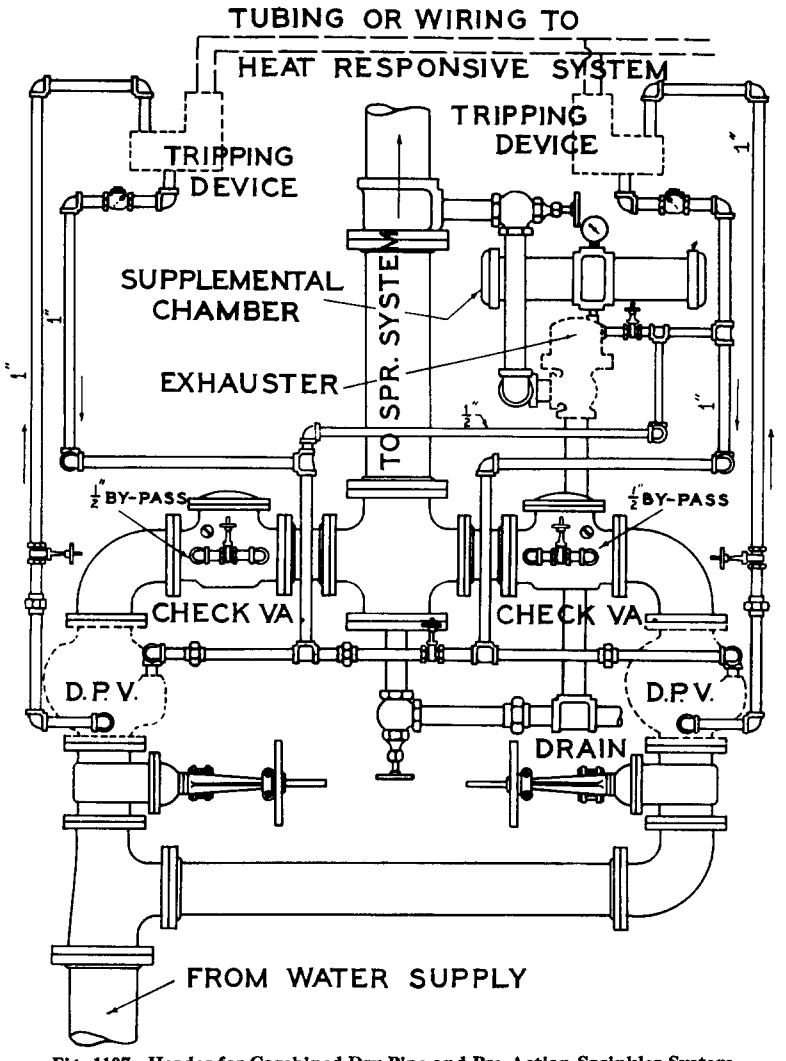


Fig. 1107. Header for Combined Dry Pipe and Pre-Action Sprinkler System. Standard Trimmings Not Shown

valve so that either dry pipe valve can be shut off and worked on while the other remains in service.

1109. The check valves between the dry pipe valves and the common feed main shall be equipped with ½-inch by-passes so

that a loss of air from leakage in the trimmings of a dry pipe valve will not cause same to trip until the pressure in the feed main is reduced to the tripping point. A gate valve shall be installed in each of these by-passes so that either dry pipe valve can be completely isolated from the main riser or feed main and from each other.

1110. One or more approved air exhaust valves of 2-inch or larger size controlled by operation of a heat responsive system shall be installed at the end of the common feed main. (See Fig. 1110.) These air exhaust valves shall have soft seated globe or angle valves in their intakes, also approved strainers shall be installed between these globe valves and the air exhaust valves.

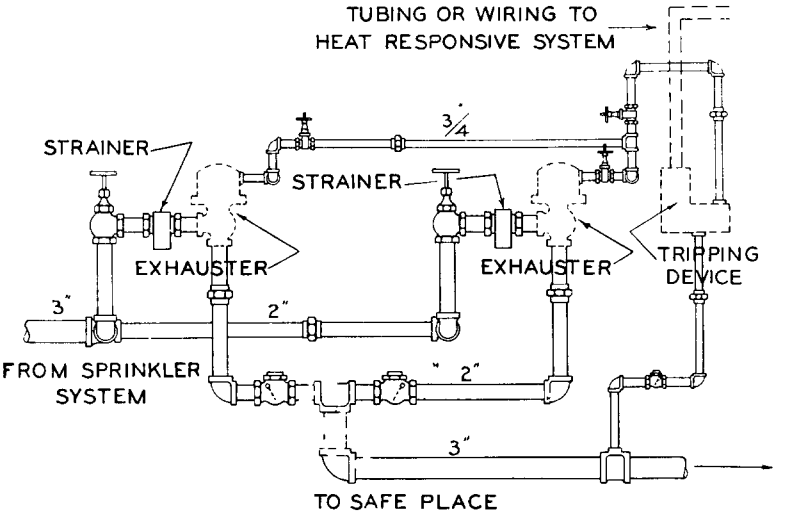


Fig. 1110. Arrangement of Air Exhaust Valves for Combined Dry Pipe and Pre-Action Sprinkler System.

1111. Each combined dry pipe and pre-action system shall be provided with approved quick opening devices at the dry pipe valves.

1112. Where more than 275 sprinklers are required in a single fire area, the system shall be divided into sections of 275 sprinklers or less by means of check valves. If system is installed in more than one fire area or story, not more than 600 sprinklers shall be supplied through any one check valve. Each section shall have a 1¼-inch drain on the system side of each check valve supplemented by a drum drip.

1113. Section drain lines and drum drips should be located in heated areas or inside of thermostatically controlled electrically heated cabinets of sufficient size to enclose drain valves and drum drips for each section. Drum drips should also be provided for all low points except that heated cabinets need not be required for 20 sprinklers or less. Air exhaust valves at end of feed main shall also be protected against freezing.

1114. The sprinkler system shall be so constructed and the number of sprinkler heads controlled shall be so limited that water shall reach the furthest sprinkler within a period of time not exceeding one minute for each 400 feet of common feed main from the time heat responsive system operates. Maximum time permitted not to exceed three minutes.

1115. The end section shall have an inspector's test connection as required for dry pipe systems.

SECTION 12. SPRINKLER ALARMS.

1201. DEFINITION. A local alarm unit is an assembly of apparatus approved for the service and so constructed and installed that any flow of water from a sprinkler system equal to or greater than that from a single automatic sprinkler will result in an audible alarm signal on the premises.

1202. WHERE REQUIRED. (a) Water flow alarms should be provided on all sprinkler installations. Central station water flow alarm service is desirable but central station water flow alarm service does not necessarily waive the local alarm requirement.

(b) Either outdoor water motor or electric alarm gongs should be installed in every case where there is no watchman with watch service or where sprinkler system is not provided with approved water flow alarm to a central station.

(c) Under conditions where central station water flow alarm service is not available it may be advisable to connect electrical alarm units to public Fire Department headquarters or nearest Fire Department station or other suitable place where aid may be readily secured.

1203. WET-PIPE SYSTEMS. The alarm apparatus for a wet-pipe system shall consist of an approved alarm check valve or other approved water flow detecting alarm device with the necessary attachments required to give an alarm.

1204. DRY-PIPE SYSTEMS. The alarm apparatus for a dry-pipe system shall consist of approved alarm attachments to the

dry-pipe valve. When a dry-pipe valve is located on the system side of an alarm valve, the actuating device of the alarms for the dry-pipe valve may be connected to the alarms on the wet-pipe system.

1205. PRE-ACTION AND DELUGE SYSTEMS. The alarm apparatus for pre-action and deluge systems shall consist of approved electric alarm attachments, actuated by a thermostatic system independently of flow of water in the system. A mechanical alarm (water motor gong) may also be required.

1206. Water flow indicators (paddle type) should not be installed in dry-pipe, pre-action or deluge systems as the surge of water when valve trips would seriously damage the device.

1210. Attachments — General.

1211. An alarm unit shall include an approved mechanical alarm, horn or siren, or an approved weatherproof electric gong, bell, horn or siren on the outside of the building or approved electric gongs, bells, horns, or sirens inside the building, or a combination of such devices, as required by the authority having jurisdiction.

1212. All alarm apparatus shall be so located and installed that all parts are readily accessible for inspection, removal, and repair, and shall be substantially supported. Outdoor mechanical or electrically operated bells shall be of weatherproof and guarded type.

1213. Where alarm check valves are used under conditions of variable water pressure, a retarding device shall be installed. Suitable valves shall be provided in the connections to retarding chambers, to permit repair or removal without shutting off sprinklers; these valves shall be so arranged that they may be locked or sealed in the open position.

1214. Dry-pipe, pre-action and deluge valves shall be fitted with a test connection for electric alarm switch and/or water motor gong. This pipe connection shall be made on the water side of the system and provided with a control valve and drain for the alarm piping. A check valve shall be installed in the pipe connection to the intermediate chamber of the dry-pipe valve.

1215. It is not advisable to test a water motor alarm in extremely cold weather and where they are used a properly valved pipe by-pass from a compressed air supply may be provided for test purposes.

1216. A control valve shall be installed in connection with pressure-type contractor and water motor-operated alarm devices and such valves shall be of the type which will clearly indicate whether they are open or closed and be so constructed that they may be locked or sealed in the open position. The control valve for the retarding chamber on alarm check valves of wet-pipe systems will be accepted as complying with this paragraph.

1217. PRESSURE GAUGES. Approved pressure gauges conforming to paragraph 373 shall be installed in sprinkler risers, above and below each alarm check valve.

1220. Attachments — Mechanically-Operated.

1221. Water-motor-operated devices shall be located as near the alarm valve, dry-pipe valve or other waterflow detecting device as practicable in order to avoid long runs or many fittings in the pipe to the water-motor-operated device. The total length of the pipe should not exceed 75 feet nor shall the water-motor-operated device be located over 20 feet above the alarm device or dry-pipe valve. If absolutely necessary to exceed 75 feet, the pipe line to the water-motor-operated device shall be increased one or more sizes to compensate for loss of pressure due to hydraulic friction. Such devices shall be protected from the weather, and shall be properly aligned and so installed as not to get out of adjustment. All piping to these devices shall be galvanized or brass of a size not less than ¾-inch, and larger for long runs of piping or where pressures are low. Piping shall be arranged to drain properly through a brass bushed orifice not larger than ⅛-inch. Drains shall be conducted to a proper place. (See paragraph 444 and section 1250.)

1222. No single mechanical alarm device should be connected to more than three alarm check or dry-pipe valves and the systems controlled by the valves should be in the same fire area.

1230. Attachments — Electrically Operated.

1231. (a) Water-flow devices controlling electric alarm circuits should be provided with means for testing the electrical supply, circuits, connections, and devices. An actual water flow, through the use of inspector's test connection, shall be the method employed for testing the reliability of the sprinkler alarm unit as a whole.

(b) Short circuiting switches for alarm test purposes should not be installed in the alarm circuit from alarm or dry-pipe valve.

1232. Under some conditions it may be advisable to connect electrical alarm units to public fire department headquarters or nearest fire department house or other suitable place where aid may be readily secured.

1233. Electrical alarm devices, their wiring and power supply shall be installed in accordance with the National Electrical Code and with the Standards for the Installation, Maintenance and Use of Proprietary, Auxiliary and Local Systems for Watchman, Fire Alarm and Supervisory Service. This permits the use of open circuit type of alarms.

1234. Outdoor electric alarm devices shall be of a type specifically approved for outdoor use and for sprinkler alarm service, and the outdoor wiring shall be in approved conduit, properly protected from the entrance of water in addition to the requirements of paragraph 1233.

1240. Identification Signs.

1241. It is desirable and often essential to provide approved identification signs for outside alarm devices. The sign should be located near the device in a conspicuous position and should be worded as follows: "Sprinkler Fire Alarm — When alarm sounds call fire or police department." See Fig. 518.

1250. Drains.

1251. Where vents are necessary for satisfactory electric alarm switch operation, such vents should be properly piped to a drain.

1252. Drains from alarm devices shall be so arranged that there will be no danger of freezing, and so that there will be no overflowing at the alarm apparatus, at domestic connections or elsewhere with the sprinkler drains wide open and under pressure.

1253. Drain from retarding chamber and electric alarm switch should preferably discharge through an open cone and be run separate from main system drains to a safe and visible point of free discharge or to sewer or ground drain. Drain from water-motor-operated alarm device may run separately to sewer or ground drain or may be connected to drain from retarding chamber at a point between such sewer and a check valve on this drain, a union or plug being inserted in the drain from the alarm device to permit inspection. Where checks are used they shall be so located as to have the equivalent of at least a four-foot head and shall not be installed in a vertical position.