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Standards for

OUTSIDE PROTECTION

May 1955

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NATIONAL FIRE PROTECTION ASSOCIATION
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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 ninety national and regional societies and associations (list on outside back cover) and more than fifteen thousand individuals, corporations, and organizations. Anyone interested may become a member; membership information is available on request.

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

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

Definitions

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

SHALL is intended to indicate requirements.

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

APPROVED refers to approval by the authority having jurisdiction.

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

Approved Equipment

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

Outside Protection.

NFPA No. 24—1955

This edition of the Standards for Outside Protection incorporates revisions adopted by the National Fire Protection Association on May 18, 1955, on recommendation of the Committee on Standpipes and Outside Protection. It supersedes the edition of 1953 as printed in the National Fire Codes, 1954, and all prior editions.

Changes from the 1953 edition deal solely with the detail of anchoring mechanical joint pipe, paragraph 9601, figures 96A–96F.

In 1953, these Standards were extensively revised from prior editions, and incorporated the material on Hose Houses for Mill Yards formerly published in a separate Standard No. 25.

NFPA Committee activity in this field dates from 1903 when the then Committee on Hose and Hydrants first presented specifications for Mill Yard Hose Houses. These Standards were revised and reissued in successive editions with enlarged scope. The material on Underground Piping was transferred from the Automatic Sprinkler Standards to the present Standard in 1920. These revisions were handled by several different Committees, predecessors of the present Committee on Standpipes and Outside Protection.

For more complete summary of history, see 1953 edition of these Standards.

These standards have been adopted and published by the National Board of Fire Underwriters in NBFU No. 24.

Contents

STANDARDS FOR OUTSIDE PROTECTION.

FOREWORD.

This Standard covers only the general details of yard piping supplying automatic sprinklers, open sprinklers, water spray systems, foam systems, yard hydrants, monitor nozzles, roof hydrants, or standpipes, with references also to hose houses and care and maintenance of fire hose.

Separately published Standards should be consulted for information concerning:

Centrifugal Fire Pumps	Standard No. 20
Fire Department Hose Connections	" " 23
Foam Extinguishing Systems	" " 11
Sprinkler Systems	" " 13
Standpipe and Hose Systems	" " 14
Supervision and Care of Valves Controlling Water Supplies for Fire Protection	" " 26
Water Tanks for Private Fire Protection Service	" " 22
Water Spray Systems for Fire Protection	" " 15

The authority having jurisdiction should always be consulted before installing or remodeling the yard piping.

CHAPTER 1. GENERAL INFORMATION.

11. A layout plan should be secured from or approved by the authority having jurisdiction in every case where new yard piping is contemplated.

12. The plan should be drawn to scale and should include all essential details including:

(a) Size and location of all water supplies.

(b) Size and location of all piping indicating the class and type of existing pipe where possible and the class and type of new pipe to be installed and the depth to which it is buried.

(c) Size, type and location of valves. Indicate if located in pit or if operation is by post indicator or key wrench through a curb box. The size, type and location of meters, regulators and check valves should be indicated.

(d) Size and location of hydrants indicating size and number of outlets and if outlets are to be equipped with independent gate valves. Indicate if hydrant house and equipment is to be provided and by whom.

(e) Sprinkler and standpipe risers and monitor nozzles to be supplied by the system.

(f) Location of fire department connection, if part of yard system, including detail of connection.

13. Provision should be made for probable future expansion. So far as possible, piping should be laid out so that the system can be extended with a minimum of expense. Probable future expansion of buildings should also be considered and the piping so laid out as to avoid being covered by buildings.

14. Installation work should be done by fully experienced and responsible persons.

15. One or more framed plans of the completed system (kept corrected up to date) should be conspicuously posted.

CHAPTER 2. WATER SUPPLIES.

21. Nature of Supply. The choice of water supplies should be determined in cooperation with the authority having jurisdiction.

22. Public Water System. (Applicable also to private reservoir and standpipe systems).

2200. One or more connections from a reliable public water system of good pressure and adequate capacity furnishes an ideal primary supply. A high static water pressure should not, however, be a criterion by which the efficiency of the supply is determined.

2201. Satisfactory evidence by a flow test or otherwise as to adequacy of water supply shall be provided. Where flow tests are made the flow in gallons per minute together with the static and residual pressures should be indicated on the plan.

2202. Street mains should be of ample size, in no case smaller than 6 inches. Dead-end mains should be avoided if possible by arranging for mains supplied from both directions.

2203. No pressure regulating valve should be used in water supply except by special permission of the authority having jurisdiction. Where meters are used they should be of an approved type.

2204. Where connections are made from public waterworks systems it may be necessary to guard against possible contamination of the public supply. The requirements of the public health authority should be determined and followed.

2205. Connections to public waterworks systems should be controlled, where feasible, by indicator post valves of a standard type and located not less than 40 feet from the buildings protected. If this cannot be done, the indicator post valves should be placed where they will be readily accessible in case of fire and not liable to injury. (See 33, Indicator Post Valves.) Where indicator post valves cannot readily be used, as in a city block, underground gate valves should conform to these provisions as far as possible and their locations and direction of turning to open should be plainly marked on the buildings.

2206. Connections for domestic or standpipe use over 2 inches in size should conform to paragraph 2205.

23. Pumps.

2300. A well located fire pump is under usual conditions, the most satisfactory source of "secondary supply", as with an ample water supply it is capable of delivering the required quantity of water at adequate pressure for a long period of time. 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.

2301. The capacity of the pumping plant, the kind of pump and its source of water supply, should be determined by conditions, and should be the subject of special consideration in each case by the authority having jurisdiction. See Standards for the Installation and Operation of Centrifugal Fire Pumps (No. 20).

24. Tanks.

2401. Gravity Tanks. The capacity and elevation should be determined by the authority having jurisdiction. See Standards for the Construction and Installation of Water Tanks for Private Fire Protection Service (No. 22).

2402. Pressure Tanks. When considered the authority having jurisdiction should be consulted. See Standards for the Construction and Installation of Water Tanks for Private Fire Protection Service (No. 22).

25. Elevated Reservoirs, Penstocks or Flumes.

2501. Where connections are made from these, they should be arranged to avoid mud, sediment and other foreign materials entering the piping. This will ordinarily involve providing screens installed in accordance with the requirements of the authority having jurisdiction.

26. Fire Department Connections.

2600. A connection through which the public fire department can pump water into the sprinkler, standpipe or other system furnishing water for fire extinguishment makes a desirable auxiliary supply. For this purpose one or more fire department connections should be provided where there is a public fire department equipped with pumpers.

2601. Fire department connections shall be properly supported.

2602. There shall be no shut-off valve in the fire department connection.

2603. 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.

2604. The pipe between the check valve and the outside hose coupling shall be equipped with an approved automatic drip, arranged to discharge to a proper place.

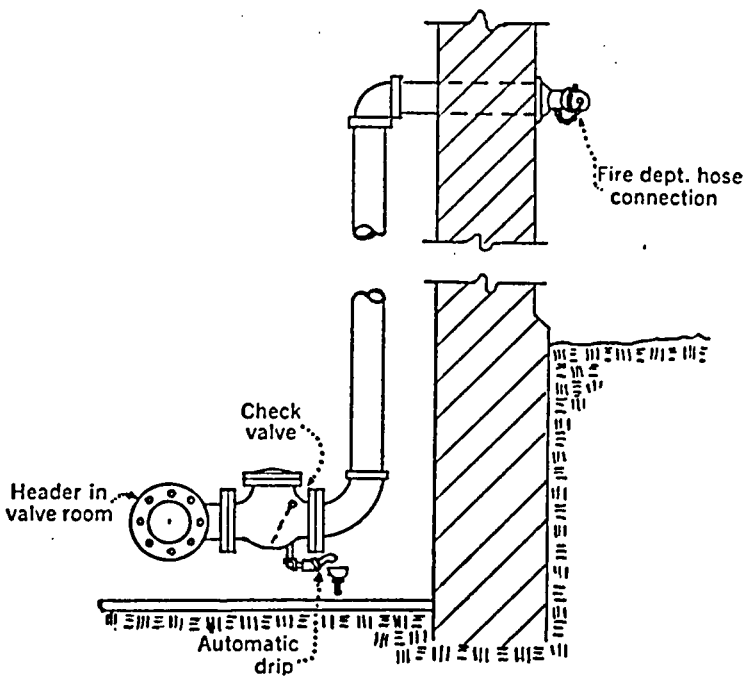


Fig. 26. Fire Department Hose Connection

2605. Hose connections shall be approved type conforming to the Standards for Fire Department Hose Connections for Sprinkler and Standpipe Systems (No. 23).

2606. Hose coupling threads shall conform to those used by the local fire department. (American) National Standard Fire-Hose Coupling Screw Threads shall be used whenever they will fit the local fire department hose threads.

2607. Hose connections shall be equipped with standard caps, properly secured and arranged for easy removal by fire departments.

2608. Hose connections should be on street side of building and shall be so located as to permit prompt and easy attachment of the hose.

2609. 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: e.g.—"AUTO-SPKR." or "OPEN SPKR." or "STANDPIPE", etc.

CHAPTER 3. VALVES.

31. Types of Valves.

3101. All control valves shall be approved outside screw and yoke or other approved indicator pattern. Underground gate valves of approved pattern equipped with approved indicator posts fulfill this rule.

3102. Check valves should be of an approved type.

32. Valves Controlling Water Supplies.

3201. At least one gate valve shall be installed in each source of water supply except fire department connections.

3202. 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.

3203. A gate valve should be installed on each side of each check valve, 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.

3204. 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.

3205. 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 buildings.

3206. 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.

3207. All gate valves controlling water supplies for sprinklers should be located where readily accessible.

33. Indicator Post Valves.

3301. Every connection from the yard main to a building shall be provided with an indicator post valve, except where other arrangements are acceptable to the authority having jurisdiction.

3302. 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.

3303. Indicator post valves shall be set with regard to the final grade line so that the top of the post will be about 36 inches above the ground.

34. Valves in Pits.

3401. Where it is impracticable to provide an indicator post valve, valves may be placed in pits by permission of the authority having jurisdiction. The pit should be in accordance with the provisions of Standards for the Construction and Installation of Water Tanks for Private Fire Protection Service (No. 22).

3402. A wrench or crow-foot with long handle should be provided for each valve, and kept in the pit where it can be reached from the yard level. The location of the valve should be clearly marked on neighboring buildings, and the cover of the pit should be kept free from dirt and snow at all times.

35. Sectional Valves.

3501. Large yard systems should have sectional controlling valves so arranged as to provide the maximum reliability of the various supplies.

3502. A valve should be provided on each bank where a main crosses water; it is also recommended that valves be so installed as to cut out sections of pipe under buildings. (See Paragraph 9301.)

36. Securing and Identifying.

3601. All gate valves, whether or not of indicator or post type, shall be sealed open in an approved manner. All control valves shall be plainly marked indicating the section or portion controlled.

CHAPTER 4. HYDRANTS.

41. Type of Hydrants.

4101. Hydrants shall be of an approved post type having not less than two 2½-inch outlets, 6-inch riser barrel, 5-inch bottom valve and 6-inch connection with main. Independent gate valves on 2½-inch outlets may be used. (See Chapter 5.) A hose house and equipment should be provided at each hydrant unless well located portable hose reels and equipment are accepted by the authority having jurisdiction.

42. Number and Location.

4201. A sufficient number of hydrants shall be provided to have two streams available to every part of the interior of each building not covered by standpipe protection and to provide hose stream protection for every exterior part of each building by the use of the lengths of hose normally attached to the hydrants; also to have sufficient hydrants to concentrate the required fire flow about any important building with no hose line exceeding 500 feet in length.

NOTE: Public hydrants when available on an acceptable public water system may be considered to comply with this requirement.

4202. For average conditions hydrants should be placed about fifty feet from the buildings protected. Where it is impossible to place them at this distance, they may be put nearer, provided they are set in locations where the chance of injury by falling walls is small, and from which men are not likely to be driven by smoke or heat. Usually in crowded mill yards they can be placed beside low buildings, near brick stair towers, or at angles formed by substantial brick walls which are not likely to fall.

43. Setting.

4301. Hydrants shall be set on flat stones or concrete slabs and about half a barrel of small stones (or equivalent) placed about the bottom to insure quick drainage from the drip. They shall not be placed near retaining walls where there is danger of frost through the wall.

4302. Where soil is of such a nature that the hydrants will not drain properly with the arrangement specified in Paragraph 4301, the hydrant drain shall be connected to a drain by not less than a 2-inch cast iron pipe; or some other means acceptable to the authority having jurisdiction shall be provided to keep the hydrant barrels clear of water.

4303. In setting hydrants due regard should be given to final grade line; center of hose outlets should be about 18 inches above floor of hose house or 18 inches above ground.

4304. Hydrants shall be fastened to piping by standard clamps or be properly anchored. (See Fig. 96.)

CHAPTER 5. HOSE HOUSES AND EQUIPMENT.

51. Location.

5101. A hose house should be located over the hydrant and arranged so that the hydrant will be as close to the front of the house as possible and still allow sufficient room back of the doors for the hose gates and attached hose.

52. Construction.

5201. Hose houses shall be of substantial construction on adequate foundations. The construction shall be such as to protect the hose from weather and vermin and designed so that hose lines can be quickly brought into use. Proper ventilation shall be provided. The exterior shall be painted or otherwise suitably protected against deterioration.

53. Size and Arrangement.

5301. Hose houses shall be of a size and arrangement to provide shelves or racks for the hose and equipment. For a typical hose house see Figures 53–1 and 53–2. For other types of hose houses or equivalent enclosures consult the authority having jurisdiction.

54. Marking.

5401. Hose houses shall be plainly marked in large letters with the fire hydrant number or hose house number.

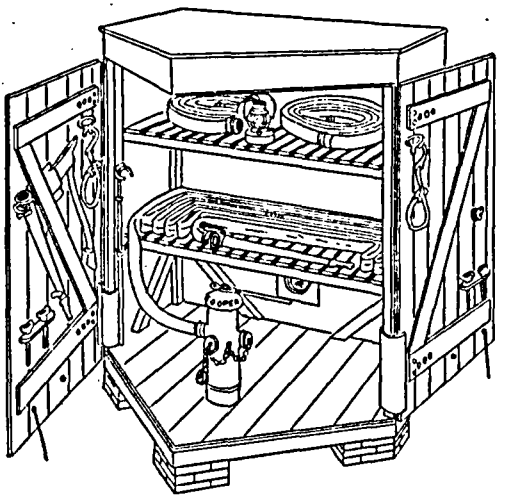


Fig. 53-1. Typical Hose House. For equipment details see Sections 55, 56, 57, and 58

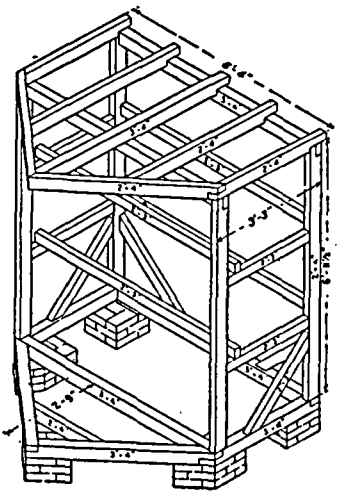


Fig. 53-2. Typical Hose House Framing Plan

55. Equipment — General.

5501. Each hose house shall be equipped with one fireman's axe, one steel crow-bar or pinch bar, one play pipe for each hydrant outlet, two or more hose straps (for strapping hose to ladders), six coupling spanners, two hydrant wrenches, and several extra hose coupling gaskets. The authority having jurisdiction should be consulted when equipment other than herein noted is required.

56. Hose.

5601. At least 100 feet and preferably 150 feet of approved 2½-inch cotton rubber-lined hose should always be attached to a hydrant outlet, and so arranged, or laid that a fire stream can be placed in action with minimum delay. The total amount of hose that should be maintained at any individual location will depend on local conditions and the authority having jurisdiction should be consulted.

57. Couplings.

5701. Couplings shall be of the same size and thread and directly interchangeable with those of the nearest fire department that would respond to an alarm, or where there is no fire department, couplings shall be interchangeable with those of the nearest plant that would be able to render practical assistance.

5702. National Standard couplings should be provided where possible. Where couplings are not interchangeable, proper adapters shall be provided in the hose house.

5703. Where the fire department does not have double female couplings, it is an excellent practice to provide them with the hose equipment.

NOTE: These are for use during an emergency for connecting hose from hydrant to hydrant.

58. Nozzles.

5801. Nozzles shall be of approved type.

NOTE: Standard play pipes are smooth tapering tubes 30 inches long wound and painted, with a 1⅛-inch smooth bore nozzle. For use of other types of approved nozzles consult the authority having jurisdiction.

59. Domestic Service Use Prohibited.

5901. The use of hydrants and hose for purposes other than fire or fire drills should be strictly prohibited.

CHAPTER 6. FIRE HOSE CARE AND MAINTENANCE.

61. General.

6100. Cotton rubber-lined fire hose should preferably be kept in a cool, dry location such as a small, well-ventilated hose house with slatted shelves for good air circulation. Mildew will attack hose fabric if the hose is stored in a damp location. Hose is available having the fabric treated to retard mildew growth. Corrosive chemicals will also weaken the fabric and cause the hose to fail. Gasoline, oils, or organic solvent will deteriorate the rubber lining. Continued exposure to high temperatures will cause the rubber lining to harden and crack. The useful life of cotton rubber-lined hose at inside hose connections in dry, well ventilated rooms with ordinary temperatures will be about the same as yard hose, having the same maintenance.

6101. When hose is kept in a hose house at a hydrant, it is good practice to have two or three lengths connected together and attached to the hydrant ready for instant use. Where hose is folded on the shelves for easy removal, the folds should be as long as possible. Hose that is not connected to the hydrant should be kept in rolls, as this eliminates the many sharp bends and kinks which tend to crack the rubber lining when hose is folded. In rolling the hose, place the male coupling on the inside of the coil, using care to prevent sharp bends near this coupling.

6102. Fire hose should be reserved for fighting fires; for other uses, a separate supply should be provided.

6103. The hose should not be stored inside a main building, where it might be inaccessible in case of fire.

6104. Where hose may be subjected to acids, acid fumes, or other corrosive materials, as in chemical plants, the purchase of approved rubber-covered cotton rubber-lined hose is advised. For plant yards containing rough surfaces that will cause heavy wear or where working pressures are above 150 pounds per square inch, double jacketed hose should be provided.

62. Testing Hose.

6201. Water should be run through the hose at least twice a year and in addition yearly tests should be made at the maximum pressure expected at a fire. When a fire pump or hydrostatic test pump is used to develop the test pressure, 100 pounds per square inch will ordinarily be sufficient. These tests relieve stresses which are set up in the jacket and in the rubber lining when it is held in one position for a long time. Pressure used and date of test should be recorded on a card tacked on the hose house door.

NOTE: The hydrostatic pressure test may be made as follows: A threaded cap with petcock or small valve for air outlet should be attached to one end of the hose line, and the other end connected to the fire or hydrostatic test pump if there is one available, or otherwise to the normal water supply. The hose should be completely filled with water and the pressure applied gradually. Care should be taken to remove all the air from the hose before applying the test pressure, as a serious accident may result from the sudden expansion of any entrapped air in case the hose should burst or a coupling pull off. The test pressure should be maintained for at least one minute and then released. It is best to make these tests in warm weather to facilitate drying and prevent freezing the hose.

6202. All hose in a hose house should not be removed for testing at the same time because the time lost in returning it in case of a fire might allow the blaze to spread beyond control.

6203. Faulty hose should be replaced promptly with new hose of approved make. Faulty hose should be discarded and not stored in hose houses.

63. Cleaning Hose.

6301. After the hose has been tested, or after it has been used at a fire, all dirt should be carefully brushed off, or if the hose is very dirty, it should be washed. When the fabric has been oil-soaked, the oil should be removed by washing with warm water and a good grade of washing soap. This soap should be rinsed off before the hose is dried.

64. Drying Hose.

6401. Before returning the hose to service it should be carefully drained and dried. This can be done by hanging the hose vertically or by laying it in a dry spot with a slope of about 2 feet in 50. Sometimes, a sectional slatted rack about 52 feet long and having this slope is provided. When drying hose, be careful that the water will not drain from the hose and drop on the jacket of other hose underneath.

6402. When the hose is returned to the hose house, any folds that are made in the hose should be arranged to come at a different point each time the hose is replaced. Whenever possible, hose that has been stored in rolls should be used to replace that which has been stored folded since the last test or use.

CHAPTER 7. HEAVY CALIBER HOSE STREAMS.

7100. Where large amounts of combustible materials are located in yards, such as log piles, lumber yards, railway car storage, etc., it is necessary to provide a ready means of delivering large quantities of water at effective pressures. This can best be accomplished by installing permanent monitor nozzles on

the ground around the piles, and occasionally where necessary on special trestles or on roofs of buildings. (See Fig. 71.) Portable deluge sets for use with siamesed hose lines are also valuable in many cases.

7101. The location of this apparatus, the size of piping supplying it, the arrangement of control valves and the necessary water supplies, all demand special consideration in each individual case and the authority having jurisdiction should be consulted.

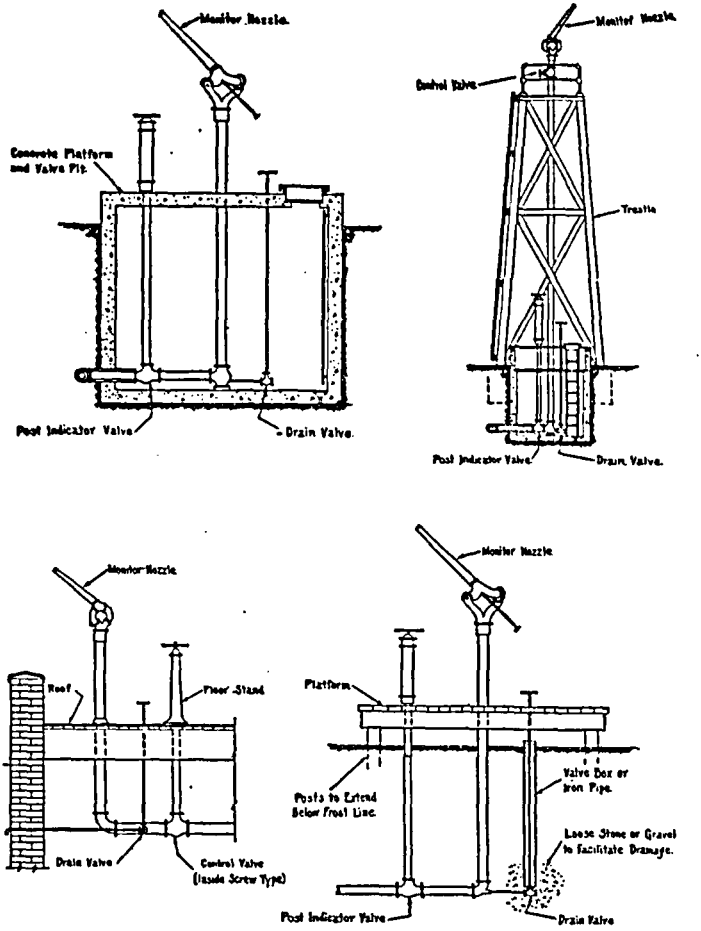


Fig. 71. Standard Monitor Nozzles.

CHAPTER 8. UNDERGROUND PIPE AND FITTINGS.

81. Type and Weight of Pipe.

8101. Piping should be cast iron or approved asbestos-cement pipe.

8102. The class of pipe should be based on maximum working pressures. For working pressures up to 150 pounds per square inch, Class C or Class 150 should be provided. For higher pressures and for pipes under rivers or other places where access to pipe in case of leaks or breakage would be difficult, heavier pipe is recommended. (See Paragraph 9302.)

8103. Cast iron pipe should conform to one of the following or equivalent specifications:

(a) American Standard Specifications for Cast Iron Pit-Cast Pipe for Water or Other Liquids* (ASA-A21.2 — 1953; AWWA-C-102)

(b) American Standard Specifications for Cast Iron Pipe Centrifugally Cast in Metal Molds, for Water or Other Liquids* (ASA-A21.6 — 1953; AWWA-C-106)

(c) American Standard Specifications for Cast Iron Pipe Centrifugally Cast in Sand-Lined Molds for Water or Other Liquids* (ASA-A21.8 — 1953; AWWA-C-108)

(d) Federal Specification for Pipe, Cast Iron, Bell-and-Spigot, Water** (WW-P-421a, March 2, 1955)

8104. Asbestos-cement pipe should not be used for above-ground service. Manufacturer's installation rules should be followed.

82. Fittings.

8201. Fittings shall conform to the type and weight of pipe used.

83. Sizes of Pipe.

8301. No pipe smaller than 6-inch shall be installed underground in yard systems for mains or hydrant branches.

8302. In moderately large plants a loop system is advised on account of its larger carrying capacity. In small plants a less amount of larger pipe may be preferable, which may be later extended to form a loop as the plant is enlarged.

*Available from American Water Works Assn., Inc., 521 Fifth Ave., New York 17, N. Y.; Cast Iron Pipe Research Assn., 122 South Michigan Ave., Chicago, Ill.; and American Standards Assn., Inc., 70 East 45th St., New York 17, N. Y.

**Available from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. 30¢

8303. The size of the pipe supplying sprinkler systems and yard systems shall be determined by the authority having jurisdiction, due consideration being given to the construction and occupancy of the plant, to the volume and pressure of water required and to the adequacy of the supply.

8304. For purposes of computing friction loss in unlined cast iron pipe, use 100 as the coefficient–C in Hazen & Williams Formula; for cement-lined or asbestos-cement pipe, use 120.

NOTE: The coefficients specified above are those commonly used in water works practice which uses nominal pipe sizes and makes no special allowance for fittings. The authority having jurisdiction may accept a coefficient of 140 for cement-lined or asbestos-cement pipe where the design is based on actual internal pipe sizes and with proper allowance for added friction loss in all fittings and design calculations on this basis are submitted for approval.

CHAPTER 9. RULES FOR LAYING PIPE.

91. Depth of Cover.

9101. The depth of cover over water pipes should be determined by the maximum depth of frost penetration in the locality where the pipe is laid, and in those locations where frost is not a factor, the depth of cover should be not less than 2½ feet to prevent mechanical injury. Pipe under driveways should be buried a minimum of 3 feet and under railroad tracks a minimum of 4 feet. Recommended depth of cover above the top of underground yard mains is indicated in Fig. 91.

9102. Depth of covering shall be measured from top of pipe to ground level and due consideration shall always be given to future or final grade and nature of soil.

NOTE: Greater depth is required in a loose gravelly soil (or in rock) than in compact, clayey soil. A safe rule to follow is to bury the top of pipe not less than one foot below the lowest frost line for the locality.

9103. As there is normally no circulation of water in private fire mains, they require greater depth of covering than do public mains.

92. Protection Against Freezing.

9201. Where it is impracticable to bury pipe it may be laid aboveground, provided the pipe is protected against freezing and mechanical injury, to the satisfaction of the authority having jurisdiction.

9202. Placing pipes over raceways or near embankment walls shall be avoided as far as possible, and special attention given to protection against frost where it is necessary so to locate them.

9203. Where pipe is laid in raceways or shallow streams care shall be taken that there will be sufficient depth of running water between the pipe and the frost line during all seasons of frost; a safer method is to bury the pipe one foot or more under the bed of the waterway. Care shall also be taken to keep the pipe back from the banks a sufficient distance to avoid any danger of freezing through the side of the bank above the water line. Pipe shall be buried below frost line where entering the water.

93. Protection Against Breakage.

9301. Pipe should not be run under buildings or under heavy piles of iron, coal, etc. Where piping necessarily passes under building, the foundation walls shall be arched over the pipe. (See Paragraph 3502.)

9302. Special care is necessary in running pipes under railroad tracks, under roads carrying heavy trucking, under large piles of iron, under buildings having heavy machinery liable to fall and under buildings containing hammers or other machinery or having heavy trucking which will subject the buried pipes to shock or vibration. Where subject to such breakage, pipes should be run in a covered pipe trench or be otherwise properly guarded. (See Section 81.)

94. Care in Laying.

9401. Pipes shall be clean inside when put in trenches and open ends shall be plugged when work is stopped, to prevent stones rolling inside.

9402. Pipes shall bear throughout their length and not be supported by the bell ends only.

9403. If ground is soft, or of a quicksand nature, special provision must be made for supporting pipe. For ordinary conditions of soft ground, longitudinal wooden stringers with cross ties will give good results. A reinforced concrete mat 3 inches or 4 inches thick in the bottom of the trench has also been used with excellent results. In extreme cases the stringers and cross ties or concrete mat may have to be supported on piles.

95. Pipe Joints.

9501. Joints shall be made tight. Poured lead joints, properly caulked, have proved satisfactory. Special joint compounds may be used when approved by the authority having jurisdiction; such joints if employed shall be made by persons familiar with the particular material used.

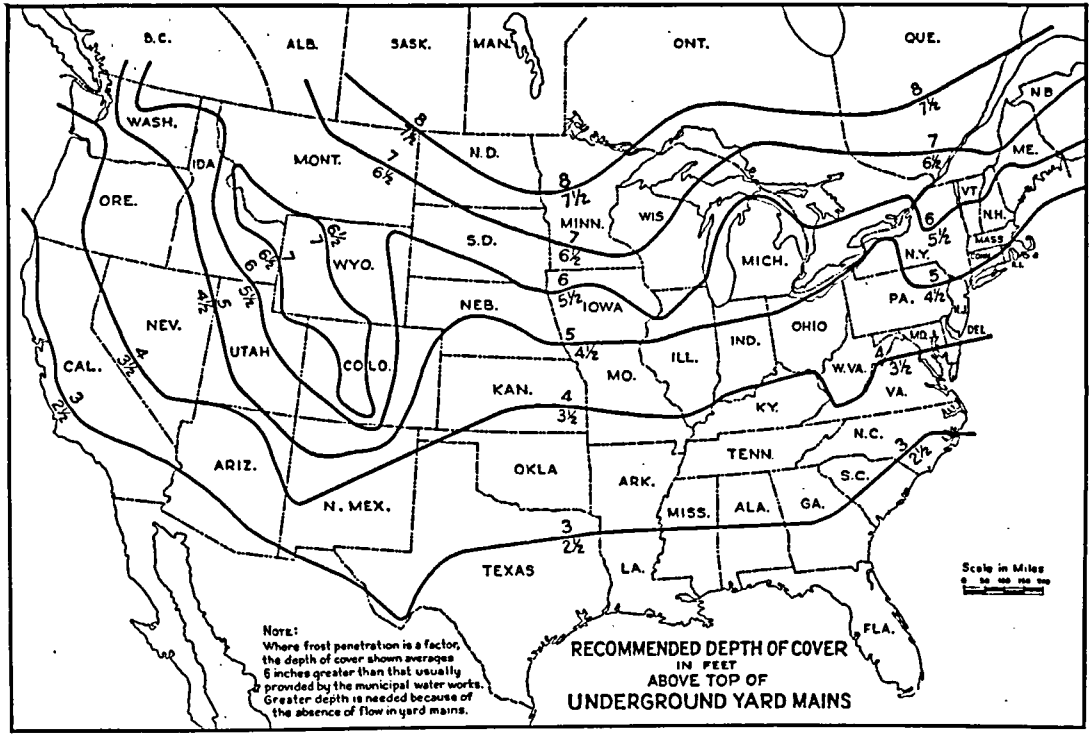

B.C.
ALB.
SASK.
MAN.
ONT.
QUE.
N.B.
WASH.
IDA.
MONT.
N.D.
ME.
ORE.
MINN.
WIS.
VT.
N.H.
MASS.
S.D.
MICH.
N.Y.
WYO.
NEB.
IOWA
PA.
N.J.
DEL.
MD.
NEV.
UTAH
COLO.
OHIO
IND.
ILL.
W.VA.
CAL.
KAN.
MO.
KY.
VA.
N.C.
ARIZ.
OKLA
TENN.
S.C.
N. MEX.
ARK.
MISS.
ALA.
GA.
TEXAS
LA.
FLA.
Scale in Miles
NOTE:
Where frost penetration is a factor, the depth of cover shown averages 6 inches greater than that usually provided by the municipal water works. Greater depth is needed because of the absence of flow in yard mains.
RECOMMENDED DEPTH OF COVER
IN FEET
ABOVE TOP OF
UNDERGROUND YARD MAINS

Fig. 91

9502. When using bell and spigot pipe or fittings changes in grade or direction should never be made by shifting the pipe in the joints, as uneven lead joints result and these are likely to leak. When using mechanical joint pipe or fittings, deflection should not exceed that recommended by the manufacturer.

9503. Joints other than the bell and spigot type should be used only when approved.

96. Anchoring Fire Mains.

9601. When using "Bell and Spigot" pipe, all tees, plugs and bends should be anchored by means of tie-rods and pipe-clamps as shown (Figs. 96–1, 2, 3, 4, 5, 6) or equal; and when using "Mechanical Joint" pipe, anchoring should be made at all tees and bends by tie-rods as shown (Figs. 96-A, B, C, D, E, F) or equal. In lieu of these methods of anchoring, concrete backing may be used.

9602. Dimensions are in inches unless otherwise indicated, and are for American Water Works Association standard fittings. Dimensions can be varied for other types of fittings. When ordering fittings specify lugs, if clamps and rods are to be used.

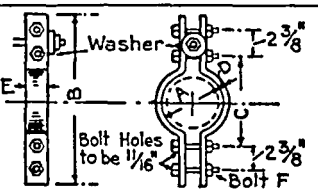
9603. After installation, rods and clamps should be thoroughly covered with asphalt to prevent corrosion.

9604. Down steep hills, mains shall be properly anchored to prevent slipping. A general rule is to anchor the pipe at the bottom of the hill, at any turns, and otherwise on straight runs about every forty-eight feet. The anchoring shall be done either to natural rock or by means of brick or concrete piers built on the downhill side of the bell. Bell ends shall be installed facing uphill.

9605. Where asbestos-cement pipe is used, thrust blocks shall be cast in place at each change in the direction of a pipe line and at all tees, plugs, and bends. The thrust blocks shall be of concrete of a mix not leaner than 1 part cement, 2½ parts sand, and 5 parts stone. Backing shall be placed between solid ground and the fitting to be anchored and shall be of such bearing area as to assure adequate resistance to the thrust to be encountered. In general, backing shall be so placed that the joints will be accessible for inspection and repair.

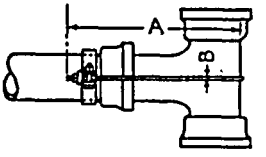
97. Back Filling.

9701. Earth shall be well tamped under and around pipes (and puddled where possible) to prevent settlement or lateral



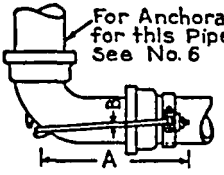
No. 1 PIPE CLAMP

Size	A	B	C	D	E	F
4	5	14 1/16	7 1/4	1/2	2	5/8 x 3 1/2
6	7 1/8	16 15/16	9 1/2	1/2	2	5/8 x 3 1/2
8	9 5/16	19 5/16	11 3/4	1/2	2	5/8 x 3 1/2
10	11 3/8	21 1/16	14	1/2	2	5/8 x 3 1/2
12	13 1/2	23 13/16	16 3/8	1/2	2	5/8 x 3 1/2



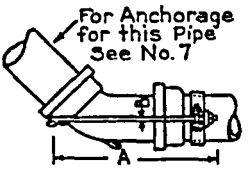
No. 2 TEE ANCHOR

Size	A	B
6	25 1/2	3/4
8	27 1/2	3/4



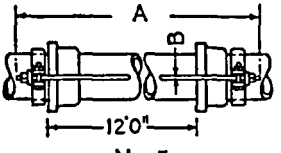
No. 3 1/4 BEND ANCHOR

Size	A	B
4	21	3/4
6	22 1/2	3/4
8	24 1/4	3/4
10	26	3/4
12	27 3/4	3/4



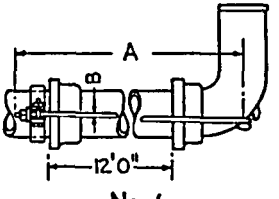
No. 4 1/8 BEND ANCHOR

Size	A	B
4	23 1/2	3/4
6	25	3/4
8	27	3/4
10	29	3/4
12	31	3/4



No. 5 PIPE ANCHOR

Size	A	B
6	13' 3"	3/4
8	13' 3"	3/4
10	13' 3"	3/4
12	13' 3"	3/4

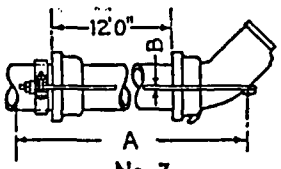


No. 6 1/4 BEND BELL ANCHOR

Size	A	B
4	13' 3"	3/4
6	13' 5"	3/4
8	13' 5"	3/4
10	13' 6 3/4"	3/4
12	13' 10"	3/4

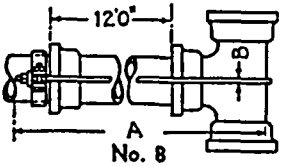
NOTE: In Nos. 5 and 6, if less than 12' 0" between joints, anchorage should extend to 2nd bell.

Fig. 96-1



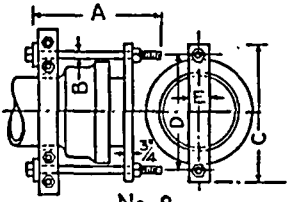
No. 7
1/8 BEND BELL ANCHOR

Size	A	B
4	13' 3"	¾
6	13' 5"	¾
8	13' 7"	¾
10	13' 9"	¾
12	13' 11"	¾



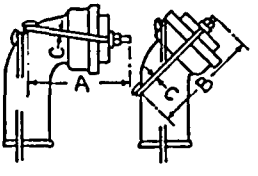
No. 8
TEE ANCHOR — BELL OUTLET

Size	A	B
4	13' 4½"	¾
6	13' 7"	¾
8	13' 9"	¾
10	14' 0"	¾
12	14' 2"	¾



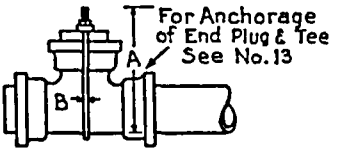
No. 9
PLUG CLAMP
BELL END PIPE

Size	A	B	C	D	E
4	13½	¾	12⅛	9¾	2
6	13½	¾	14⅜	12	2½
8	13½	¾	16⅝	14¼	2½
10	13½	¾	18⅞	16½	2½
12	13½	¾	21¼	18⅞	2½



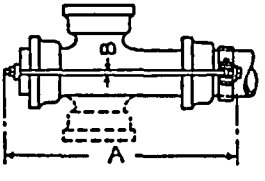
No. 10
PLUG CLAMP
BELL END 1/4 & 1/8 BENDS

Size	A	B	C
4	14½	14½	¾
6	15½	16½	¾
8	17	18½	¾
10	18¾	21	¾
12	20½	23	¾



No. 11
PLUG CLAMP
BELL OUTLET TEE

Size	A	B
4	18	¾
6	20½	¾
8	21	¾
10	24	¾
12	26	¾

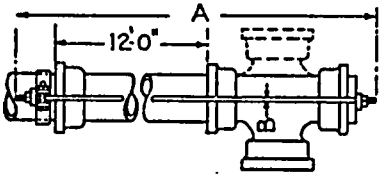


No. 12
SPIGOT TEE OR CROSS CLAMP

Size	A	B
6	35	¾
8	38	¾

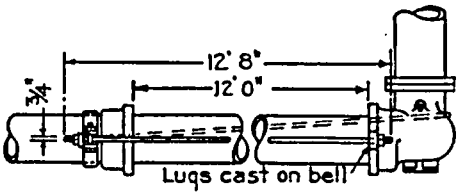
NOTE: In Nos. 7 and 8, if less than 12' 0" between joints, anchorage should extend to 2nd bell.

Fig. 96-2



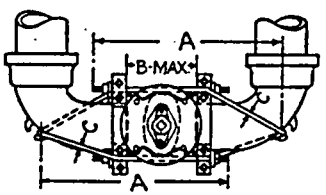
No. 13
BELL END TEE — PLUG ANCHOR

Size	A	B
4	14' 3"	¾
6	14' 8"	¾
8	14' 8"	¾
10	15' 3"	¾
12	15' 3"	¾



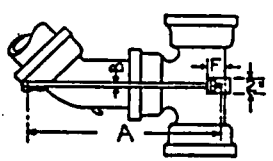
No. 14
HYDRANT ANCHOR
DIMENSIONS AS INDICATED

If hydrant not fitted with lugs, rod should be attached as per dotted lines (hyd. dimensions vary.)



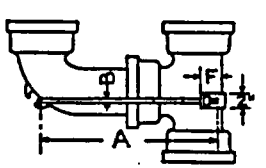
No. 15
¼ BEND (Spigot End) — INDICATOR POST ANCHOR

Size	A	B	C
4	2' 3"	12	¾
6	2' 5¼"	12¾	¾
8	2' 8¼"	14	¾



No. 16
BELL END TEE — ⅛ BEND ANCHOR

Size	A	B	C	D	E	F
4	26	¾	12⅛	9¾	2½	1¼
6	29	¾	14⅛	12	3⁹⁄₁₆	2⅛
8	32	¾	16⅛	14¼	4⅝	3¹⁵⁄₁₆
10	35½	¾	18⅞	16½	5¾	4¹⁵⁄₁₆
12	38	¾	21¼	18⅞	6¾	6

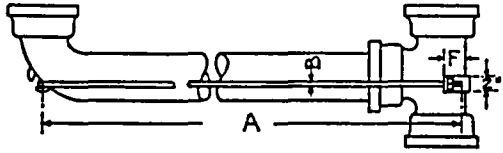


No. 17
BELL END TEE — ¼ BEND ANCHOR

Size	A	B
4	24	¾
6	26½	¾
8	29½	¾
10	33	¾
12	36	¾

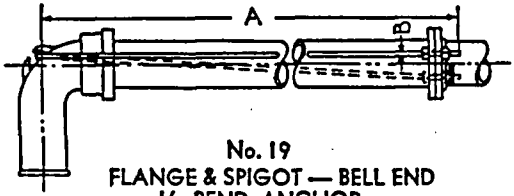
NOTE: In Nos. 13 & 14 if less than 12' 0" between joints, anchorage should extend to 2nd bell.

Fig. 96-3



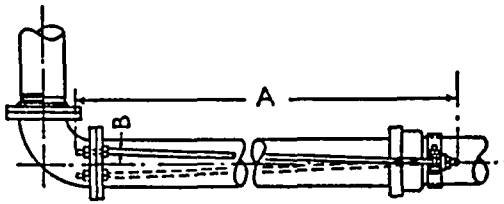
No. 18
BELL END TEE & LONG 1/4 BEND ANCHOR

Size	A	B
4	5' 8½"	¾
6	5' 10"	¾
8	5' 11½"	¾



No. 19
FLANGE & SPIGOT — BELL END 1/4 BEND ANCHOR

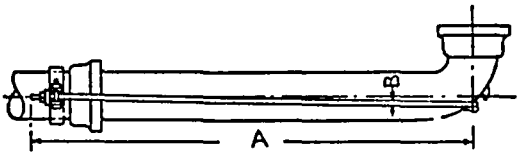
Size	A (6' 0" Flg. Spigot)	A (3' 0" Flg. Spigot)	B
4	6' 9"	3' 9"	¾
6	7' 0"	4' 0"	¾
8	7' 0"	4' 0"	¾
10	7' 4"	4' 4"	¾
12	7' 4"	4' 4"	¾



No. 20
FLANGE & SPIGOT — BELL END PIPE ANCHOR

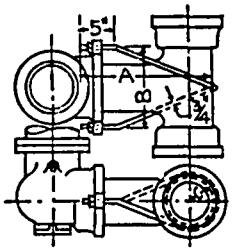
Size	A (6' 0" Flg. Spigot)	A (3' 0" Flg. Spigot)	B
4	6' 9¼"	3' 9¼"	¾
6	6' 9¼"	3' 9¼"	¾
8	6' 9¼"	3' 9¼"	¾
10	6' 9½"	3' 9½"	¾
12	6' 9½"	3' 9½"	¾

Fig. 96–4



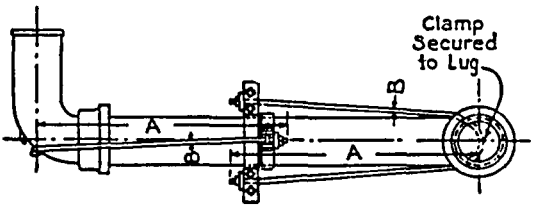
No. 21
BELL END PIPE — LONG SPIGOT
1/4 BEND ANCHOR

Size	A	B
4	5' 6½"	¾
6	5' 6½"	¾
8	5' 6½"	¾



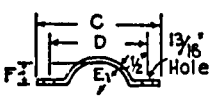
No. 22
SPIGOT TEE —
HYDRANT ANCHOR

Size	A	B	C
6 x 6 x 6	20	12	3 9/16
8 x 8 x 6	22	12	4 5/8



No. 23
LONG AND SHORT SPIGOT 1/4 BEND ANCHOR

Size	A	B
4	3' 2"	¾
6	3' 2"	¾
8	3' 2"	¾



ANCHOR STRAP
For Nos. 16, 17 & 18
1/4 BEND ANCHOR

Fig. 96-5

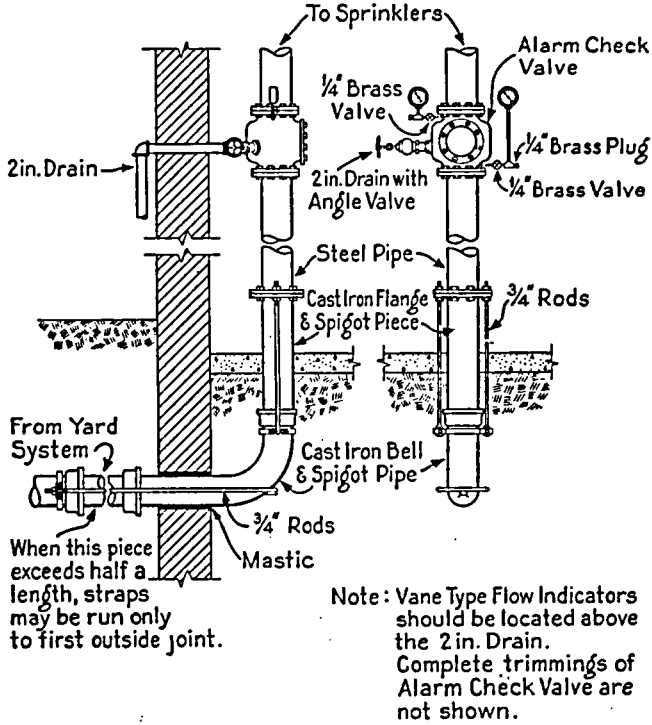


Fig. 96–6

movement, and shall contain no ashes, cinders or other corrosive materials.

9702. Rocks shall not be rolled into trenches and allowed to drop on pipes.

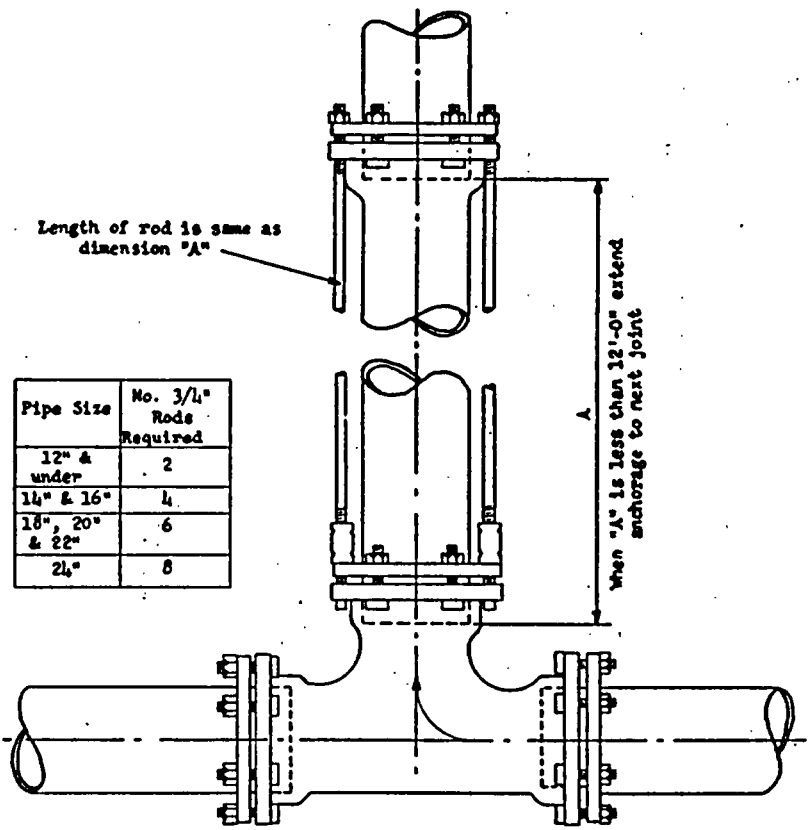
9703. In trenches cut through rock, back filling shall preferably be entirely of earth. In any case earth shall be used under and around pipe, and for at least 2 feet above.

98. Flushing.

9801. After a system has been completed and tested and before it is permanently filled with water the entire outside system shall be thoroughly flushed under pressure through

hydrants or other outlets. Leads to inside risers shall be similarly flushed. 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-in. pipe: 500 gals. per min. 10-in pipe: 1500 gals. per min.
8-in. pipe: 1000 gals. per min. 12-in. pipe: 2000 gals. per min.



Pipe Size	No. 3/4" Rods Required
12" & under	2
14" & 16"	4
18", 20" & 22"	6
24"	8

Fig. 96-A