NFPA
24

INSTALLATION OF

# PRIVATE FIRE SERVICE MAINS 1981




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

3M-7-81-FP
Printed in U.S.A.

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SC-AM-81

# Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NFPA 24-1981

## 1981 Edition of NFPA 24

This edition of NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, was prepared by the Technical Committee on Private Water Supply Piping Systems, released by the Correlating Committee on Water Extinguishing Systems and Related Equipment, and acted on by the National Fire Protection Association, Inc. on May 20, 1981, at its Annual Meeting in Dallas, Texas. It was issued by the Standards Council with an effective date of June 29, 1981.

The 1977 edition of this standard was approved by the American National Standards Institute as an American National Standard. This edition has also been submitted for similar approval.

Changes other than editorial are indicated by a vertical rule in the margin of the page on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

## Origin and Development of NFPA 24

In 1903 the NFPA Committee on Hose and Hydrants first presented *Specifications for Mill Yard Hose Houses* taken substantially from a standard published by the Eastern Factory Insurance Association. This text was revised and adopted in 1904. The NFPA Committee on Field Practice amended the Specifications in 1926, published as NFPA No. 25.

In 1925 the Committee on Field Practice prepared a *Standard on Outside Protection, Private Underground Piping Systems Supplying Water for Fire Extinguishment*, which was adopted by NFPA. It was largely taken from the 1920 edition of the NFPA *Automatic Sprinkler Standard*, Section M on Underground Pipes and Fittings. In September 1931, a revision was made with the resulting Standard designated as NFPA No. 24. In this 1981 edition the title was changed from *Standard for Outside Protection* to *Standard for the Installation of Private Fire Service Mains and Their Appurtenances.*

In 1953, on recommendation of the Committee on Standpipes and Outside Protection, the two standards (No. 24 and No. 25) were completely revised and adopted as NFPA No. 24. Amendments were made leading to separate editions in 1955, 1959, 1962, 1963, 1965, 1966, 1968, 1969, 1970, 1973, 1977 and 1981.

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

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

## Contents

# Standard for the Installation of Private Fire Service Mains and Their Appurtenances

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

Information on referenced publications can be found in Appendix C.

## Chapter 1 General Information

**1-1 Scope.** This standard establishes the minimum requirements for installation of private fire service mains and their appurtenances supplying automatic sprinkler systems, open sprinkler systems, water spray fixed systems, foam systems, private hydrants, monitor nozzles or standpipe systems with references to water supplies, private hydrants and also hose houses. This standard also applies to "combined service mains" used to carry water for both fire service and industrial use. The authority having jurisdiction shall always be consulted before installation of, or remodeling, private fire service mains.

**1-2 Purpose.** The purpose of this standard is to provide a reasonable degree of protection for life and property from fire through installation requirements for private fire service main systems based upon sound engineering principles, test data and field experience. Nothing in this standard is intended to restrict new technologies or alternate arrangements, providing the level of safety prescribed by the standard is not lowered.

## 1-3 Definitions.

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

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

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

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

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

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

**Private Fire Service Main.** Private fire service main as used in this standard is that pipe and its appurtenances on private property between a source of water and the base of the riser (flange of flange and spigot piece or base tee) for automatic sprinkler systems, open sprinkler systems, water spray fixed systems, standpipe systems, inlets to foam making systems or the base elbow of private hydrants or

monitor nozzles. When connected to a public water system, the private service main begins at a point designated by the public water utility, usually at a manually operated valve near the property line. When connected to fire pumps, the main begins at the fire protection system side of the pump discharge valve. When to a gravity or pressure tank, the main begins at the inlet side of the tank's check valve.

**Shall.** Indicates a mandatory requirement.

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

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

NOTE: Formerly a standard was a document which contained mandatory and advisory provisions.

1-4 Other NFPA publications that may apply to private fire service main are listed in Appendix C.

1-5* A layout plan shall be approved by the authority having jurisdiction in every case where new private fire service main is contemplated.

1-6 The plan shall be drawn to scale and shall include all essential details such as:

(a) Size and location of all water supplies.

(b) Size and location of all piping, indicating, where possible, the class and type and depth of existing pipe, the class and type of new pipe to be installed and the depth to which it is to be 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. Indicate the size, type and location of meters, regulators and check valves.

(d) Size and location of hydrants, showing size and number of outlets and if outlets are to be equipped with independent gate valves. Indicate if hose houses and equipment are 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 connections, if part of private fire service main system, including detail of connections.

1-7 Installation work shall be done by fully experienced and responsible persons.

1-8 Units. Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI). Two units (liter and bar), outside of but recognized by SI, are commonly used in international fire protection. These units are listed in Table 1-8 with conversion factors.

Table 1-8

| Name of Unit | Unit Symbol | Conversion Factor |
|---|---|---|
| liter | L | 1 gal = 3.785L |
| liter per minute per square meter | $L/min \cdot m^2$ | 1 $gpm/ft^2$ = 40.746$L/min \cdot m^2$ |
| cubic decimeter | $dm^3$ | 1 gal = 3.785 $dm^3$ |
| Pascal | Pa | 1 psi = 6894.757 Pa |
| bar | bar | 1 psi = 0.0689 bar |
| bar | bar | 1 bar = $10^5$ Pa |

For additional conversions and information see ASTM E380-1976, *Standard for Metric Practice.*

1-8.1 If a value for measurement as given in this standard is followed by an equivalent value in other units, the first stated is to be regarded as the requirement. A given equivalent value may be approximate.

1-8.2 The conversion procedure for the SI units has been to multiply the quantity by the conversion factor and then round the result to the appropriate number of significant digits.

## Chapter 2 Water Supplies

**2-1 Nature of Supply.** The choice of water supplies shall be made in cooperation with the authority having jurisdiction.

**2-2 Public Water Systems.** (Applicable also to private supply systems.)

2-2.1 One or more connections from a reliable public water system of good pressure and adequate capacity furnishes a satisfactory supply. A high static water pressure shall not, however, be the criterion by which the efficiency of the supply is determined.

2-2.2 Adequacy of water supply shall be determined by flow tests or other reliable means. Where flow tests are made, the flow in gallons per minute (L/min) together with the static and residual pressures shall be indicated on the plan.

2-2.3 Public mains shall be of ample size, in no case smaller than 6 in. Dead-end mains shall be avoided if possible by arranging for mains supplied from both directions.

2-2.4 No pressure regulating valve shall be used in water supply except by special permission of the authority having jurisdiction. Where meters are used they shall be of an approved type.

2-2.5 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 having jurisdiction shall be determined and followed.

2-2.6 Connections larger than 2 in. to public water systems shall be controlled by post indicator valves of a standard type and located not less than 40 ft (12.2 m) from the buildings protected.

*Exception: If this cannot be done, the post indicator valves shall be placed where they will be readily accessible in case of fire and not liable to injury. (See Section 3-3 for details.) Where post indicator valves cannot readily be used as in a cityblock, underground valves shall conform to these provisions and their locations and direction of turning to open shall be clearly marked.*

**2-3* Pumps.** A fire pump installation consisting of pump, driver and suction supply, when of adequate capacity and reliability, and properly located, makes a good supply. An automatically controlled fire pump taking water from a water main of adequate capacity, or taking draft under a head from a reliable storage of adequate capacity, may under certain conditions be accepted by the authority having jurisdiction as a single supply.

NOTE: For additional information, see NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps.*

**2-4 Tanks.** When gravity, pressure or suction tanks are to be used, the authority having jurisdiction shall be consulted.

NOTE: See NFPA 22, *Standard for Water Tanks for Private Fire Protection.*

**2-5 Penstocks or Flumes, Rivers or Lakes.** Water supply connections from penstocks, flumes, rivers, lakes, or reservoirs shall be arranged to avoid mud and sediment, and shall be provided with approved double removable screens or approved strainers installed in an approved manner.

**2-6* Fire Department Connections.**[1]

**2-6.1** 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 shall be provided.

*Exception: Omission of fire department connections may be allowed by the authority having jurisdiction.*

**2-6.2** Fire department connections shall be properly supported.

**2-6.3** There shall be no shutoff valve in the fire department connection.

**2-6.4** 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.

**2-6.5** 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.

[1]See NFPA 13E, *Recommendations for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems.*

**2-6.6** Hose connections shall be approved type.

**2-6.7** Hose coupling threads shall conform to the American National Fire Hose Connection Screw Thread as specified in NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose.*

*Exception No. 1: Where local hose coupling threads do not conform to the American National Fire Hose Connection Screw Thread, the authority having jurisdiction shall designate the threads to be used.*

*Exception No. 2: Where local hose couplings are of a type without threads, the authority having jurisdiction shall designate the type coupling to be used.*

**2-6.8** Hose connections shall be equipped with standard caps, properly secured and arranged for easy removal by fire departments.

**2-6.9** Hose connections shall be on the street side of buildings and shall be located and arranged so that hose lines can be readily and conveniently attached to the inlets without interference from any nearby objects including buildings, fences, posts, or other fire department connections.

**2-6.10** (a) Hose connections shall be designated by a sign having raised letters at least 1 in. (25.4 mm) in size cast on a plate or fitting, reading for service designated: e.g., "AUTO SPKR." or "OPEN SPKR." or "STANDPIPE," etc.

(b) If hose connection does not serve all of the system an appropriate and durable sign shall be attached.

## Chapter 3 Valves

### 3-1 Types of Valves.

3-1.1 All control valves shall be listed indicating type unless a nonindicating valve, such as an underground gate valve with approved roadway box complete with T-wrench, is accepted by the authority having jurisdiction.

Such valves shall not close in less than 5 seconds when operated at maximum possible speed from the fully open position. This is to avoid damage to piping by water hammer.

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

(a) An underground gate valve of listed type equipped with a listed indicator post.

(b) A listed water control valve assembly which is normally open and requires constant energy application to close and keep closed.

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

3-1.2 Check valves shall be listed.

### 3-2 Valves Controlling Water Supplies.

3-2.1 At least one control valve shall be installed in each source of water supply except fire department connections.

3-2.2 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.

3-2.3 A control valve shall 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 gal (56.78 $m^3$) capacity, no control valve need be installed on the tank side of the check valve.

NOTE: For additional information on controlling valves see NFPA 22, *Standard for Water Tanks for Private Fire Protection.*

3-2.4 Where a gravity tank is located on a tower in the yard, the control valve on the tank side of the check valve shall be an outside screw and yoke or listed indicating valve; the other shall be either an outside screw and yoke, listed indicating or a listed valve having a post type indicator. Where a gravity tank is located on a building, both control valves shall be outside screw and yoke or listed indicating valves; and all fittings inside the building, except the drain tee and heater connections, shall be under the control of a listed valve.

NOTE: For additional information on controlling valves see NFPA 22, *Standard for Water Tanks for Private Fire Protection.*

3-2.5* When a pump is located in a combustible pump house or exposed to danger from fire or falling walls, or when a tank discharges into a private fire service main fed by another supply, either the check valve in the connection shall be located in a pit or the control valve shall be of the post indicator type located a safe distance outside buildings.

3-2.6 All control valves shall be located where readily accessible and free from obstructions.

### 3-3 Post Indicator Valves.

3-3.1* Every connection from the private fire service main to a building shall be provided with a listed indicating valve so located as to control all sources of water supply except fire department connections when arranged as specified in Section 2-6.

*Exception: Omission of the post indicator may be allowed by the authority having jurisdiction in accordance with the provisions of 3-1.1 and 3-4.1.*

3-3.2 Post indicator valves shall be located not less than 40 ft (12.2 m) from buildings. When necessary to place a valve close to a building, the indicator post shall be located at a blank part of the wall if possible.

3-3.3 Post indicator valves shall be set with regard to the final grade line so that the top of the post will be about 36 in. (0.9 m) above the ground.

3-3.4 Post indicator valves shall be properly protected against mechanical damage where needed.

**3-4 Valves in Pits.**

**3-4.1** Where it is impracticable to provide a post indicator valve, valves may be placed in pits through permission of the authority having jurisdiction. Valve pits, except those located at or near the base of the riser of an elevated tank, shall satisfy the objectives of 3-4.2.

NOTE: For valve pits located at or near the base of a tank riser, refer to NFPA 22, *Standard for Water Tanks for Private Fire Protection.*

**3-4.2*** When used, valve pits shall be of adequate size and readily accessible for inspection, operation, testing, maintenance, and removal of equipment contained therein. They shall be constructed and arranged to properly protect the installed equipment from movement of earth, freezing, and accumulation of water. Poured-in-place or precast concrete, with or without reinforcement, or brick (all depending upon soil conditions and size of pit) are appropriate materials for construction of valve pits. Other approved materials may be used. Where the water table is low and the soil is porous, crushed stone or gravel may be used for the floor of the pit. See Figures A-2-6b and A-2-6c for suggested arrangements.

**3-4.3** The location of the valve shall be clearly marked and the cover of the pit shall be kept free of obstructions.

**3-5 Sectional Valves.**

**3-5.1** Large private fire service main systems shall have sectional controlling valves at appropriate points, in order to permit sectionalizing the system in the event of a break, or for the making of repairs or extensions.

**3-5.2** A valve shall be provided on each bank where a main crosses water; it is also recommended that valves be installed to shut off sections of pipe under buildings. (*See 8-3.1.*)

**3-6 Identifying and Securing.** Identification signs shall be provided at each valve to indicate its function and what it controls. To assure that valves are kept open see Chapter 6 of NFPA 26, *Recommended Practice for the Supervision of Valves Controlling Water Supplies for Fire Protection.*

# Chapter 4 Hydrants

## 4-1 General.

4-1.1 Hydrants shall be of approved type and have not less than a 6-in. connection with the mains. A valve shall be installed in the hydrant connection. The number, size and arrangement of outlets, the size of main valve opening, and the size of barrel shall be suitable for the protection to be provided and shall be approved by the authority having jurisdiction. Independent gate valves on 2½-in. outlets may be used. (*See Chapter 5.*)

4-1.2 Hydrant outlet threads shall conform to the American National Fire Hose Connection Screw Thread, as specified in NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections.*

*Exception No. 1: Where local hose coupling threads do not conform to the American National Fire Hose Connection Screw Thread, the authority having jurisdiction shall designate the threads to be used.*

*Exception No. 2: Where local hose couplings are of a type without threads, the authority having jurisdiction shall designate the type of outlet to be used.*

## 4-2 Number and Location.

4-2.1 A sufficient number of hydrants shall be installed to provide two streams for 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. There shall be sufficient hydrants to concentrate the required fire flow about any important building with no hose line exceeding 500 ft (152.5 m) in length.

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

4-2.2* For average conditions, hydrants shall be placed at least 40 ft (12.2 m) from the buildings protected.

*Exception: When hydrants cannot be placed at this distance, they may be located closer, or wall hydrants used (see Figure A-4-4.2) provided they are set in locations by blank walls where the possibility of injury by falling walls is small and from which people are not likely to be driven by smoke or heat. Usually, in crowded plant 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.*

4-2.3 Hydrants shall not be placed near retaining walls where there is danger of frost through the walls.

**4-3 Installation and Maintenance.**

4-3.1 Hydrants shall be set on flat stones or concrete slabs and, if necessary, shall be provided with sufficient small stones (or equivalent) placed about the drain to ensure quick drainage.

4-3.2 Where soil is of such a nature that the hydrants will not drain properly with the arrangement specified in 4-3.1 or ground water stands at levels above that of the drain, the hydrant drain shall be plugged at the time of installation. If drain is plugged, hydrants in service in cold climates shall be pumped out after usage. Such hydrants shall be marked to indicate the need for pumping out after usage.

4-3.3 In setting hydrants, due regard should be given to final grade line. The center of a hose outlet shall be not less than 12 in. (305 mm) above the floor of a hose house or above grade.

4-3.4 Hydrants shall be fastened to piping by standard clamps or be properly anchored. [*See Fig. A-8-6.2(g).*]

4-3.5 Hydrants shall be protected if subject to mechanical damage. The means of protection shall be arranged in a manner which will not interfere with the connection to or operation of hydrants.

4-3.6 Hydrants shall be tested at least annually for proper functioning in accordance with the requirements of the authority having jurisdiction.

## Chapter 5 Hose Houses and Equipment

NOTE: See NFPA 1962, *Standard for the Care, Use and Maintenance of Fire Hose Including Connections and Nozzles.*

### 5-1 General.

**5-1.1*** An adequate supply of hose and equipment shall be provided when hydrants are intended for use by plant personnel or a fire brigade. The quantity and type of hose and equipment will depend upon the number and location of hydrants relative to the protected property, the extent of the hazard, and the fire fighting capabilities of the potential users. The authority having jurisdiction shall be consulted.

**5-1.2*** Hose shall conform to NFPA 1961, *Standard for Fire Hose.*

**5-1.3*** Hose shall be stored so it is readily accessible and is protected from the weather. This may be done by storing hose in hose houses or by locating hose reels or hose carriers in weatherproof enclosures.

**5-1.4 Hose Couplings.** Hose coupling threads shall conform to the American National Fire Hose Connection Screw Thread, as specified in NFPA 1963, *Standard for Screw Threads and Gaskets for Fire Hose Connections.*

*Exception No. 1: Where local hose coupling threads do not conform to the American National Fire Hose Connection Screw Thread, the authority having jurisdiction shall designate the threads to be used.*

*Exception No. 2: Where local hose couplings are of a type without threads, the authority having jurisdiction shall designate the type of coupling to be used.*

### 5-2 Location.

**5-2.1** When hose houses are used, they shall either be located over the hydrant or immediately nearby. Hydrants within hose houses shall 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 the attached hose.

**5-2.2** When hose reels or hose carriers are used, they shall be located so that the hose may be brought quickly into use at a hydrant.

**5-3 Construction.** 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. Clearance shall be provided for proper operation of the hydrant wrench. Proper ventilation shall be provided. The exterior shall be painted or otherwise suitably protected against deterioration.

**5-4* Size and Arrangement.** Hose houses shall be of a size and arrangement to provide shelves or racks for the hose and equipment. For equipment details of hose houses, see Section 5-6 and 5-1.4.

**5-5 Marking.** Hose houses shall be plainly identified.

**5-6 Equipment—General.**

**5-6.1*** When hose houses are used in addition to the hose, each shall be equipped with:

2-Approved adjustable spray-solid stream nozzles equipped with shutoffs for each size of hose provided.
1-Fire axe with brackets.
1-Hydrant wrench (in addition to wrench on hydrant).
4-Coupling spanners for each size hose provided.
2-Hose coupling gaskets for each size hose.

**5-6.1.1** Where two sizes of hose and nozzles are provided, reducers or gated wyes shall be included in the hose house equipment.

**5-7 Domestic Service Use Prohibited.** The use of hydrants and hose for purposes other than fire related services shall be prohibited.

## Chapter 6 Master Streams

**6-1* General.** Master streams are delivered by monitor nozzles, hydrant mounted monitor nozzles or portable deluge sets capable of delivering more than 250 gpm (946 L/min).

6-2 Master streams shall be provided as protection for large amounts of combustible materials located in yards, average amounts of combustible materials in inaccessible locations or occupancies presenting special hazards as required by the authority having jurisdiction.

6-3 The location of this apparatus, the size of piping supplying it, the arrangement of control valves, and the necessary water supplies all demand special considerations in each individual case, and the authority having jurisdiction shall be consulted.

## Chapter 7* Pipe and Fittings

### 7-1 Selection of Pipe.

**7-1.1* Piping.** Piping shall be listed or meet AWWA standards and shall be asbestos cement, cast iron, ductile iron, fiberglass filament wound epoxy, polyethylene, polyvinyl chloride (PVC), reinforced concrete, steel or other listed material.

**7-1.2*** The type and class of pipe for a particular installation shall be determined through consideration of its fire resistance, the maximum working pressure, the laying conditions under which the pipe is to be installed, soil conditions, corrosion, and susceptibility of pipe to other external loads, including earth loads installation beneath buildings and traffic or vehicle loads.

**7-2* Coating and Lining of Pipe.** All ferrous metal pipe shall be lined, and steel pipe shall be coated and wrapped with joints field-coated and wrapped after assembly.

**7-3* Joints.** Joints shall be of an approved type.

**7-4* Fittings.** Fittings shall be of an approved type with joints and pressure class ratings compatible with the pipe used. Steel pipe fittings shall be coated, wrapped and lined.

### 7-5 Sizes of Pipe.

**7-5.1*** No pipe smaller than 6 in. in diameter shall be installed as a private service main.

*Exception: For mains that do not supply hydrants, sizes smaller than 6 in. may be used subject to the following restrictions:*

*1. The main supplies only automatic sprinkler systems, open sprinkler systems, water spray fixed systems, foam systems or Class II standpipe systems.*

*2. Hydraulic calculations show that the main will supply the total demand at the appropriate pressure.*

*3. Main size shall be at least as large as the riser but not less than 4 in. in diameter where unlined cast iron pipe is used.*

**7-5.2** The size of the private fire service mains supplying fire protection systems shall be approved by the authority having jurisdiction, due consideration being given to the construction and occupancy of the plant, to the fire flow and pressure of water required and to the adequacy of the supply.

**7-5.3*** For purposes of estimating friction loss, see A-7-5.3.

# Chapter 8 Rules for Laying Pipe

## 8-1 Depth of Cover.

**8-1.1*** The depth of cover over water pipes shall be determined by the maximum depth of frost penetration in the locality where the pipe is laid. The top of the pipe shall be buried not less than 1 ft (0.3 m) below the frost line for the locality. In those locations where frost is not a factor, the depth of cover shall be not less than 2½ ft (0.8 m) to prevent mechanical injury. Pipe under driveways shall be buried a minimum of 3 ft (0.9 m) and under railroad tracks a minimum of 4 ft (1.2 m). (*See A-8-1.1.*)

**8-1.2** Depth of covering shall be measured from top of pipe to finished grade, and due consideration shall always be given to future or final grade and nature of soil.

## 8-2 Protection Against Freezing.

**8-2.1** 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.

**8-2.2** Pipes shall not be placed over water raceways or near embankment walls without special attention being given to protection against frost.

**8-2.3** Where pipe is laid in water 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.

## 8-3 Protection Against Damage.

**8-3.1** Pipe shall not be run under buildings.

*Exception: When absolutely necessary to run pipe under buildings, special precautions shall be taken which include arching the foundation walls over the pipe, running pipe in covered trenches and providing valves to isolate sections of pipe under buildings. (See 3-5.2.)*

8-3.2 Where a riser is close to building foundations, underground fittings of proper design and type shall be used to avoid pipe joints being located in or under the foundations.

8-3.3 Mains running under railroads carrying heavy trucking, under large piles of heavy commodities or in areas subjecting the main to heavy shock and vibrations shall be subjected to an evaluation of the specific loading conditions and suitably protected, if necessary. (*See 7-1.2*)

8-3.4* When it is necessary to join metal pipe with pipe of dissimilar metal, the joint shall be insulated, by an approved method, against the passage of an electric current.

8-3.5 In no case shall the pipe be used for grounding of electrical services.

## 8-4 Care in Laying.

8-4.1 Pipes, valves, hydrants and fittings shall be inspected for damage when received and shall be inspected prior to installation. Bolted joints shall be checked for proper torquing of bolts. Pipe, valves, hydrants, and fittings shall be clean inside. When work is stopped, open ends shall be plugged to prevent stones and foreign materials from entering.

8-4.2 All pipe, fittings, valves and hydrants shall be carefully lowered into the trench with suitable equipment. They shall be carefully examined for cracks or other defects while suspended above the trench immediately before installation. Plain ends shall be inspected with special attention as these ends are the most susceptible to damage. Under no circumstances shall water main materials be dropped or dumped. Pipe shall not be rolled or skidded against other pipe materials.

8-4.3 Pipes shall bear throughout their full length and shall not be supported by the bell ends only or by blocks.

*Exception: If ground is soft, or of a quicksand nature, special provisions shall be made for supporting pipe. For ordinary conditions of soft ground, longitudinal wooden stringers with cross ties will give good results.*

## 8-5 Pipe Joint Assembly.

8-5.1 Joints shall be assembled by persons familiar with the particular materials being used and in accordance with the manufacturer's instructions and specifications.

8-5.2 All bolted joint accessories shall be cleaned and thoroughly coated with asphalt or other corrosion retarding material after installation.

## 8-6 Anchoring Fire Mains.

8-6.1 Except for the case of welded joints and approved special restrained joints, such as provided by approved mechanical joint retainer glands or locked mechanical and push-on joints, the usual joints for underground pipe and fittings are expected to be held in place by the soil in which the pipe is buried. Gasketed push-on and mechanical joints without special locking devices have limited ability to resist separation due to movement of the pipe. All tees, plugs, caps, bends and hydrant branches on pipe installed underground shall be restrained against movement.

### 8-6.2* Methods of Anchoring Fire Mains.

8-6.2.1 Pipe clamps and tie-rods, thrust blocks, locked mechanical or push-on joints mechanical joints utilizing set screw retainer glands or other approved methods or devices shall be used. The type of pipe, soil conditions and available space determine the method.

8-6.2.2 Details of typical pipe clamps, tie rods and restrained joints are shown in Figures A-8-6.2(a) to A-8-6.2(l).

8-6.2.3 In underground piping systems, to determine the length to be restrained, see Appendix B.

#### 8-6.2.4 Sizing the Clamps, Rods, Bolts and Washers.

(a) Clamps shall be ½ by 2 in. (12.7 by 50.8 mm) for pipe 4 to 6 in.; ⅝ by 2½ in. (15.9 by 63.5 mm) for pipe 8 and 10 in.; ⅝ by 3 in. (15.9 by 76.2 mm) for pipe 12 in. Bolt holes shall be 1/16 in. (1.6 mm) diameter larger than bolts.

(b) Minimum rod size shall be ⅝-in. (15.9-mm) diameter. Table 8-6.2.4(b) gives numbers of various diameter rods required for a given pipe size. When using bolting rods, the diameter of mechanical joint bolts limits the size of rods to ¾-in. (19.1-mm).

When using clamps, rods shall be used in pairs, two to a clamp.

*Exception: Assemblies in which an anchor is made by means of two clamps canted on the barrel of the pipe may use one rod per clamp if approved for the specific installation by the authority having jurisdiction.*

*When using combinations of rods greater in number than two, the rods shall be symetrically spaced.*

Table 8-6.2.4(b)
Rod Number — Diameter Combinations

| Pipe Size inches | Number of Rods | | | |
|---|---|---|---|---|
| | ⅝ in. (15.9 mm) | ¾ in. (19.1 mm) | ⅞in. (22.2 mm) | 1 in. (25.4 mm) |
| 4 | 2 | - | - | - |
| 6 | 2 | - | - | - |
| 8 | 3 | 2 | - | - |
| 10 | 4 | 3 | 2 | - |
| 12 | 6 | 4 | 3 | 2 |
| 14 | 8 | 5 | 4 | 3 |
| 16 | 10 | 7 | 5 | 4 |

Table has been derived using pressure of 225 psi (15.5 bars) and design stress of 25,000 psi (172.4 MPa).

(c) Clamp bolts shall be ⅝-in. (15.9-mm) diameter for pipe 4, 6, and 8 in.; ¾-in. (19.1-mm) diameter for pipe 10 in. and ⅞-in. (22.2-mm) diameter for pipe 12 in.

(d) Washers may be cast iron or steel, round or square. Dimensions for cast iron washers shall be ⅝ by 3 in. (15.9 by 76.2 mm) for pipe 4, 6, 8 and 10 in. and ¾ by 3½ in. (19.1 by 88.9 mm) for pipe 12 in. Dimensions for steel washers shall be ½ by 3 in. (12.7 by 76.2 mm) for pipe 4, 6, 8 and 10 in. and ½ by 3½ in. (12.7 by 88.9 mm) for 12 in. Holes shall be ⅛ in. (3.2 mm) larger than rods.

**8-6.2.5 Sizes of Anchor Straps for Tees.** Straps shall be ⅝ in. (15.9 mm) thick and 2½ in. (63.5 mm) wide for pipe 4, 6, 8, and 10 in.; ⅝ in. (15.9 mm) thick and 3 in. (76.2 mm) wide for pipe 12 in. Rod holes shall be 1/16 in. (1.6 mm) larger than rods. Dimensions in inches (mm) for straps are suitable either for mechanical or push-on joint tee fittings.

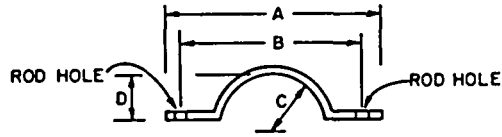



**Figure 8-6.2.5. Anchor Straps for Tees.**

[*See Figure A-8-6.2(d).*]

Table 8-6.2.5 Anchor Straps For Tees

| Pipe Size | A | | B | | C | | D | |
|---|---|---|---|---|---|---|---|---|
| In. | In. | mm | In. | mm | In. | mm | In. | mm |
| 4 | 12½ | 318 | 10⅛ | 257 | 2½ | 64 | 1¾ | 44 |
| 6 | 14½ | 368 | 12⅛ | 308 | 3⅜16 | 90 | 2 13/16 | 71 |
| 8 | 16¾ | 425 | 14⅜ | 365 | 4 21/32 | 118 | 3 29/32 | 99 |
| 10 | 19 1/16 | 484 | 16 1/16 | 424 | 5¾ | 146 | 5 | 127 |
| 12 | 22 5/16 | 567 | 19 3/16 | 487 | 6¾ | 171 | 5⅞ | 149 |

**8-6.2.6 Sizes of Plug Strap for Bell End of Pipe.** Strap shall be ¾ in. (19.1 mm) thick, 2½ in. (63.5 mm) wide. Strap length is the same as dimension A for tee straps given in Figure 8-6.2.5; distance between centers of rod holes is the same as dimension B for tee straps. [*See Figure A-8-6.2(h).*]

**8-6.2.7** Material used for clamps, rods, rod couplings or turnbuckles, bolts, washers, anchor straps and plug straps shall be of material having physical and chemical characteristics such that its deterioration under stress can be predicted with reliability. Examples of materials and the standards covering these materials are:

| | |
|---|---|
| (a) Clamps. | Steel (see Note). |
| (b) Rods. | Steel (see Note). |
| (c) Bolts. | Steel (ASTM A307-78). |
| (d) Washers. | Steel (see Note 1). Cast Iron (Class A cast iron as defined by ASTM A126-73). |
| (e) Anchor Straps and Plug Straps. | Steel (See Note). |
| (f) Rod Couplings or Turnbuckles. | Malleable iron (ASTM A197-78). |

NOTE: Steel of modified range merchant quality as defined in *Standard for Steel Chemical Composition and Harden Ability*, U.S. Federal Standard No. 66C, April 18, 1967, change notice No. 2, April 16, 1970, as promulgated by the U.S. Federal Government General Services Administration.

The above-listed materials do not preclude the use of other materials which will also satisfy the requirements of this section.

**8-6.2.8** After installation, rods, nuts, bolts, washers, clamps and other restraining devices except thrust blocks shall be cleaned and thoroughly coated with a bituminous or other acceptable corrosion-retarding material.

**8-6.2.9** Thrust blocks are satisfactory where soil is suitable. Table 8-6.2.9 gives bearing areas against undisturbed vertical wall of a trench in soil equivalent to sand and gravel cemented with clay. For other soils, the values in the table shall be multiplied by an appropriate factor. (*See Table A-8-6.2.10.*) For a more complete method of treating thrust restraint for underground piping systems, see Appendix B.

**Table 8-6.2.9**
**Area of Bearing Face of Concrete Thrust Blocks**

| Pipe Size Inches | ¼ Bend Square Feet | $m^2$ | ⅛ Bend Square Feet | $m^2$ | Tees, Plugs, Caps and Hydrants Square Feet | $m^2$ |
|---|---|---|---|---|---|---|
| 4 | 2 | 0.19 | 2 | 0.19 | 2 | 0.19 |
| 6 | 5 | 0.46 | 3 | 0.28 | 4 | 0.37 |
| 8 | 8 | 0.74 | 5 | 0.46 | 6 | 0.56 |
| 10 | 13 | 1.21 | 7 | 0.65 | 9 | 0.84 |
| 12 | 18 | 1.67 | 10 | 0.93 | 13 | 1.21 |
| 14 | 25 | 2.32 | 14 | 1.30 | 18 | 1.67 |
| 16 | 32 | 2.97 | 18 | 1.67 | 23 | 2.14 |

Areas in table have been derived using a water pressure of 225 pounds per square inch (15.5 bars) and a soil resistance of 2000 pounds per square foot (1.0 bars).

**8-6.2.10*** Thrust blocks or other suitable means of thrust restraint shall be provided at each change in the direction of a pipeline and at all tees, plugs, caps, and bends. The thrust blocks shall be of concrete of a mix not leaner than one part cement, two and one-half parts sand, and five parts stone. Backing shall be placed between undisturbed earth 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. Thrust blocks are not suitable for vertical pipe.

**8-6.2.11** On steep grades mains shall be properly anchored to prevent slipping. The pipe shall be anchored at the bottom of a hill and at any turns (lateral or vertical). The anchoring shall be done either to natural rock or by means of suitable piers built on the downhill side of the bell. Bell ends shall be installed facing uphill. Straight runs on hills shall be anchored as determined by the design engineer.

## 8-7 Backfilling.

**8-7.1** Backfill shall be well tamped in layers under and around pipes (and puddled where possible) to prevent settlement or lateral movement, and shall contain no ashes, cinders, refuse, organic matter or other corrosive materials.

8-7.2 Rocks shall not be placed in trenches. Frozen earth shall not be used for backfilling.

8-7.3 In trenches cut through rock, tamped backfill shall be used for at least 6 in. (152 mm) under and around the pipe and for at least 2 ft (0.6 m) above the pipe.

8-8 Flushing.

8-8.1 Underground mains and lead-in connections to system risers shall be flushed thoroughly before connection is made to sprinkler, standpipe or other fire protection system piping in order to remove foreign materials which may have entered the pipe during the course of the installation.

8-8.2 Underground mains and lead-in connections supplying wet pipe, dry pipe, pre-action, deluge, or standpipe systems shall be flushed at a flow rate not less than indicated in Table 8-8.2 or at the hydraulically calculated water demand rate of the system, whichever is greater.

For all systems the flushing operations shall be continued for a sufficient time to ensure thorough cleaning. When planning the flushing operations, consideration shall be given to disposal of the water issuing from the test outlets.

*Exception No. 1: When the water supply will not produce the stipulated flow rate, connection to a hydraulically designed system may be flushed at the demand rate of the system, including hose streams if hose or hydrants, or both, are supplied from that connection.*

*Exception No. 2: For pipe schedule systems or noncalculated systems, when the water supply will not produce the stipulated flow rate, the maximum flow rate available shall be used.*

Table 8-8.2

| Pipe Size | Flow Rate | |
|---|---|---|
| | gpm | L/min |
| *4 inch | 400 | 1514 |
| 6 inch | 750 | 2839 |
| 8 inch | 1000 | 3785 |
| 10 inch | 1500 | 5678 |
| 12 inch | 2000 | 7570 |

*Lead-in connections only.

### 8-9 Testing Underground System.

8-9.1* Before asking final approval of an installation by the authority having jurisdiction, the installing company shall furnish a Contractor's Material and Test Certificate countersigned by the property owner or representative. For a typical Contractor's Material and Test Certificate for Underground Piping, see Figure A-8-9.1.

8-9.2* The trench shall be backfilled between joints before testing to prevent movement of pipe. (*see A-8-9.2.*)

### 8-9.3 Hydrostatic Test Requirements.

8-9.3.1* All new private fire service mains shall be tested hydrostatically at not less than 200 psi (13.8 bars) pressure for two hours or at 50 psi (3.4 bars) in excess of the maximum static pressure when the maximum static pressure is in excess of 150 psi (10.3 bars). (*See A-8-9.3.1.*)

8-9.3.2* The amount of leakage in piping shall be measured at the specified test pressure by pumping from a calibrated container. For new pipe, the amount of leakage at the joints shall not exceed two quarts per hour (1.89 L/h) per 100 gaskets or joints irrespective of pipe diameter.

8-9.3.3 The amount of allowable leakage specified in 8-9.3.2 may be increased by one fluid ounce per inch valve diameter per hour (30 ml/25 mm/h) for each metal seated valve isolating the test section. If dry barrel hydrants are tested with the main valve open, so the hydrants are under pressure, an additional five ounces per minute (150 ml/min) leakage is permitted for each hydrant.

8-9.3.4 Tests shall be made by the contractor in the presence of the authority having jurisdiction or the representative of the owner. The certificate shown in Figure A-8-9.1 is to be completed.

### 8-9.4 Operating Test.

8-9.4.1 Each hydrant shall be fully opened and closed under system water pressure and dry barrel hydrants checked for proper drainage. Where fire pumps are available, this shall be done with the pumps running.

8-9.4.2 All control valves shall be fully closed and opened under system water pressure to ensure proper operation.

# Appendix A

*This Appendix is not a part of this NFPA Standard for the Installation of Private Fire Service Mains and Their Appurtenances, but is included for information purposes only.*

**A-1-5** Piping should be laid so that the system can be extended with a minimum of expense. Possible future plant expansion should also be considered and the piping laid so that it will not be covered by buildings. One or more framed plans of the complete system (kept corrected up to date) should be conspicuously posted for ready reference.

**A-2-3** See sections dealing with sprinkler equipment supervisory and water flow alarm services in NFPA 71, *Standard for the Installation, Maintenance and Use of Central Station Signaling Systems for Guard, Fire Alarm and Supervisory Service*; NFPA 72A, *Standard for the Installation, Maintenance and Use of Local Protective Signaling Systems for Watchman, Fire Alarm and Supervisory Service*; NFPA 72B, *Standard for the Installation, Maintenance and Use of Auxiliary Protective Signaling Systems for Fire Alarm Service*; NFPA 72C, *Standard for the Installation, Maintenance and Use of Remote Station Protective Signaling Systems for Fire Alarm and Supervisory Service*; and NFPA 72D, *Standard for the Installation, Maintenance and Use of Proprietary Protective Signating Systems for Watchman, Fire Alarm and Supervisory Service*. See separately published NFPA 20, *Standard for the Installation of Centrifugal Fire Pumps*, and NFPA 13, *Standard for the Installation of Sprinkler Systems*.

**A-2.6** Typical fire department connections are shown in Figures A-2-6a, A-2-6b, and A-2-6c.

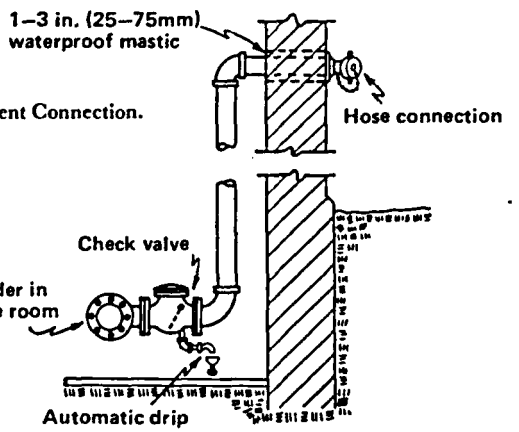
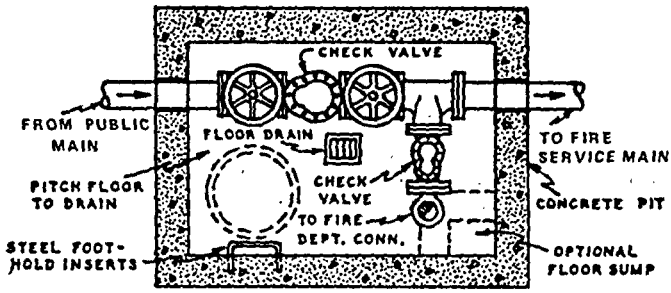
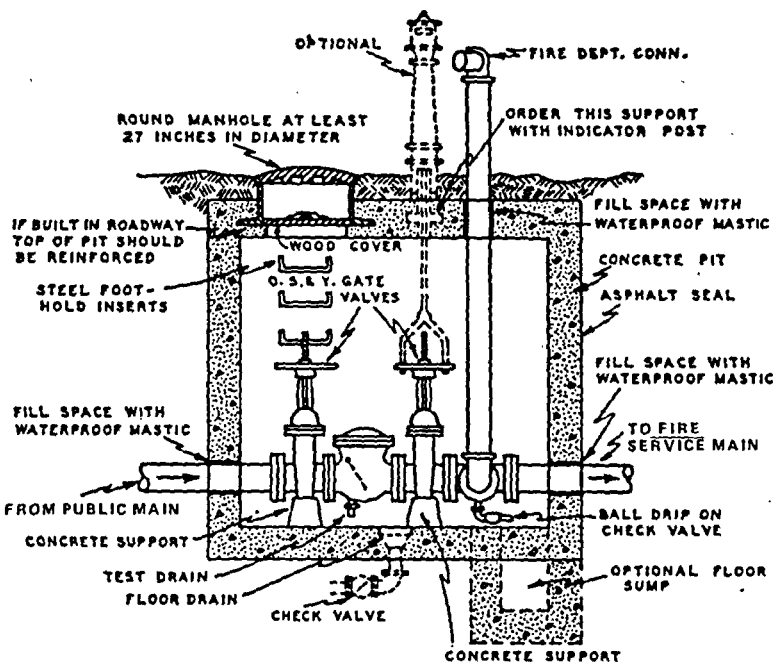



Figure A-2-6a. Fire Department Connection.




PLAN
NO SCALE




SECTION
NO SCALE

Figure A-2-6b. Typical City Water Pit – Single Check Valve Arrangement.

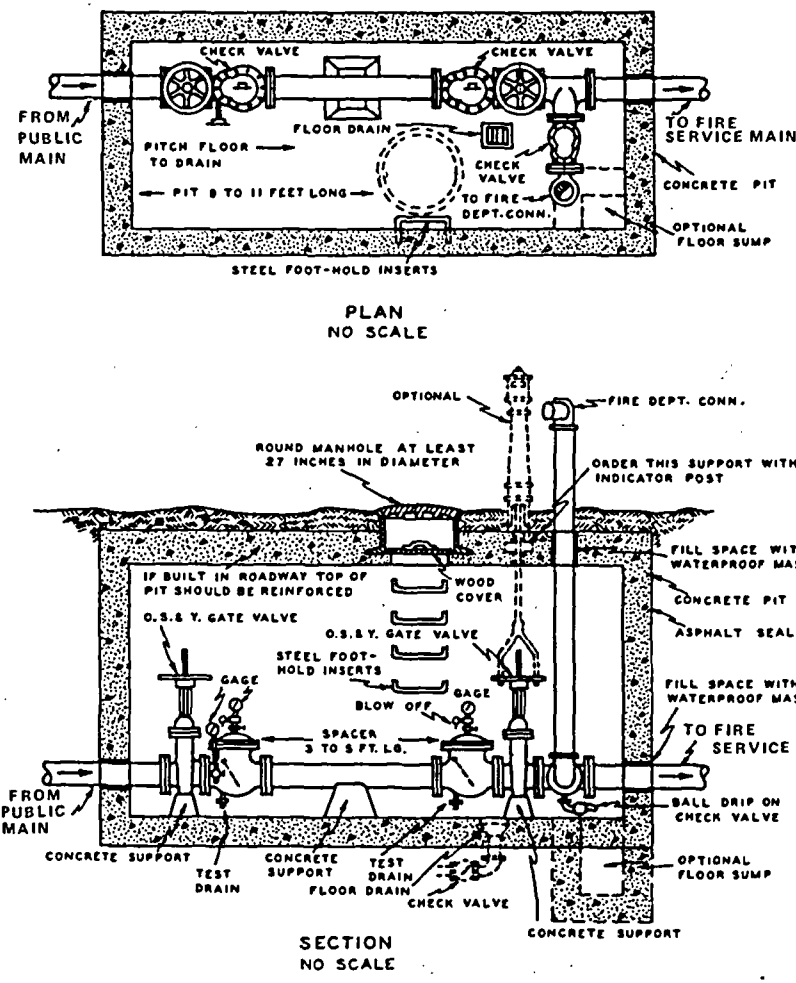



Figure A-2-6c. Typical City Water Pit – Double Check Valve Arrangement.

A-3-2.5 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.

A-3-3.1 Outside control valves are suggested in the following order of preference:

(a) Listed indicating valves at each connection into the building at least 40 ft (12.2 m) from buildings if space permits.

(b) Control valves installed in a cut-off stair tower or valve room accessible from outside.

(c) Valves located in risers with indicating posts arranged for outside operation.

(d) Key operated valves in each connection into the building.

A-3-4.2 A valve wrench with a long handle should be provided at a convenient location on the premises.

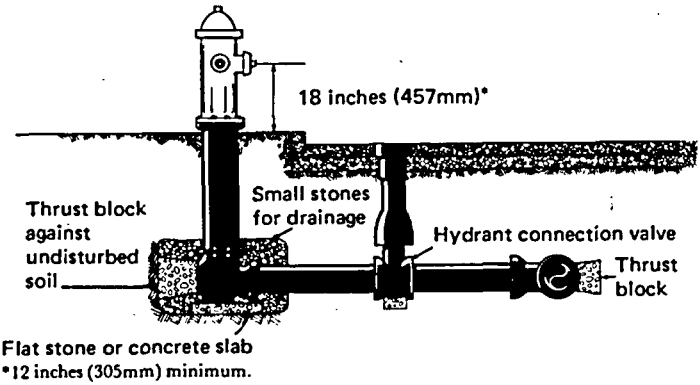



Figure A-4-1. Typical Hydrant Connection.

A-4-2.2 With use of wall hydrants, the authority having jurisdiction should be consulted regarding the necessary water supply and arrangement of control valves at the point of supply demand in each individual case.

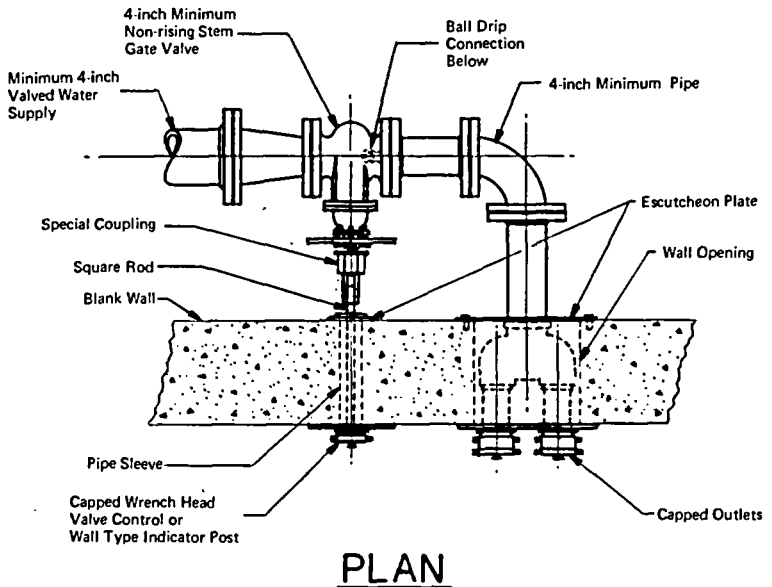



**Figure A-4-2.2. Typical Wall Fire Hydrant Installation.**

A-5-1.1 All hose should not be removed from a hose house for testing at the same time because the time lost in returning it in case of fire might allow the fire to spread beyond control.

A.5-1.2 Where hose may be subjected to acids, acid fumes, or other corrosive materials, as in chemical plants, the purchase of approved rubber-covered rubber-lined hose is advised. For plant yards containing rough surfaces that will cause heavy wear or where working pressures are above 150 psi (10.3 bars), double jacketed should be considered.

A-5-1.3 When hose houses are located over hydrants it is good practice to have two or three lengths of hose connected together and attached to the hydrant ready for use.

A-5-4 Typical hose houses are shown in Figures A-5-4a through A-5-4d. Materials used to construct hose houses are wood, steel and aluminum.

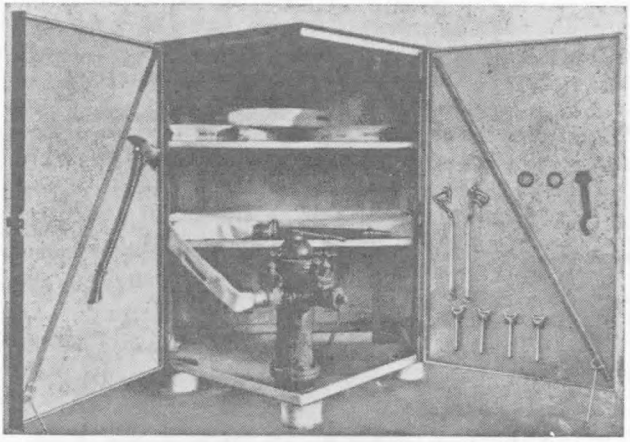


Figure A-5-4a. House of five-sided design for installation over a private hydrant. Such houses may be of wood, steel, or aluminum with a tight floor installed after erection.

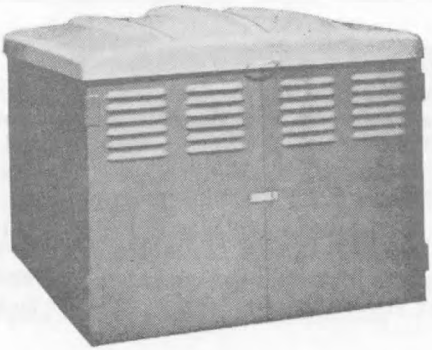


Figure A-5-4b. Steel house of compact dimensions for installation over a private hydrant. House is shown closed. Top lifts up and doors on front side open for complete accessibility.

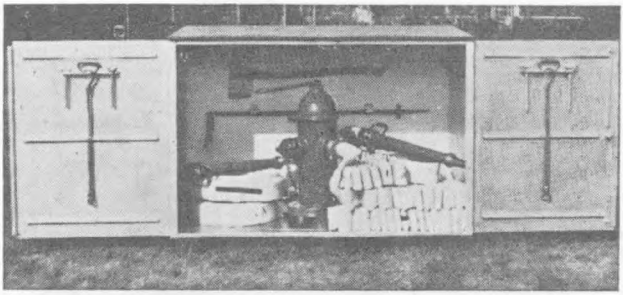


Figure A-5-4c. Hose house of compact dimensions for installation over a private hydrant. Construction may be steel or aluminum.

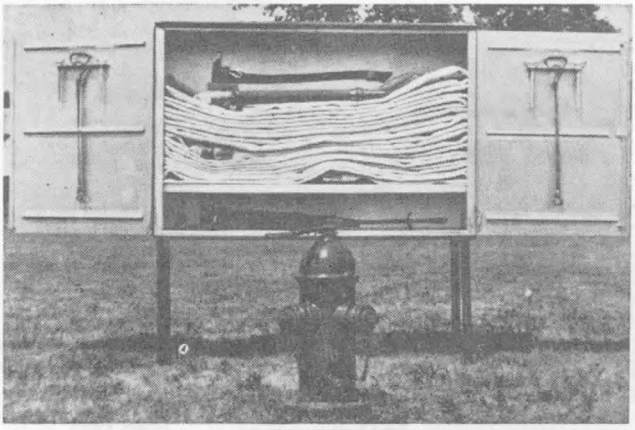


Figure A-5-4d. Hose house of steel or aluminum construction. This type can be installed on legs as illustrated or installed on a wall near, but not directly over, a private hydrant.

**A-5-6.1** Desirable optional equipment to be included in hose house equipment is as follows:

1-Crow bar with brackets

2-Hose and ladder straps

2-Electrical battery or kerosene hand lights.

## A-6-1 Typical Monitor Nozzles.

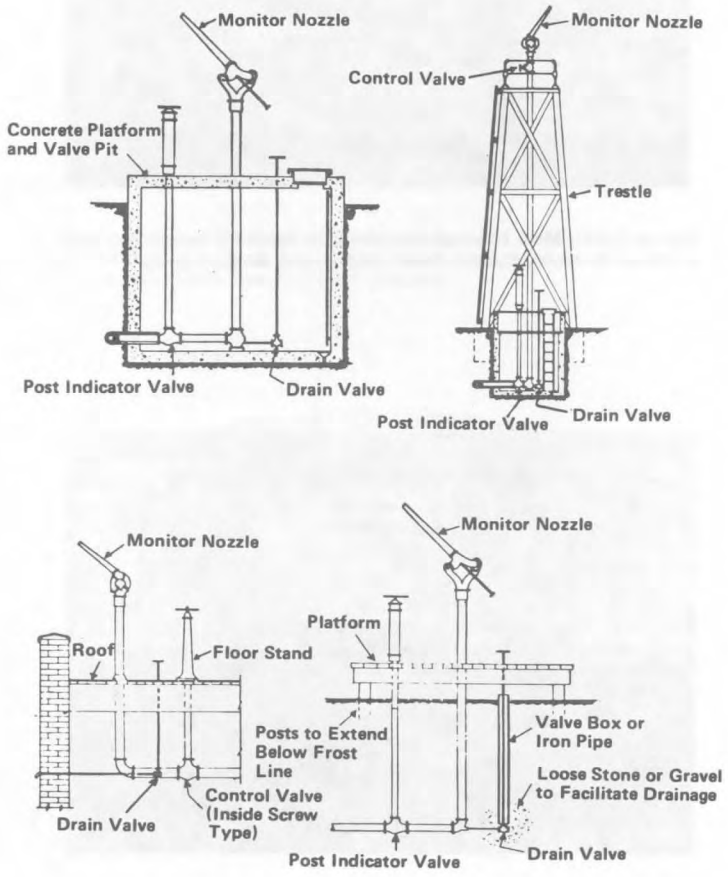



Figure A-6-1a. Standard Monitor Nozzles. Gear control nozzles are also satisfactory.

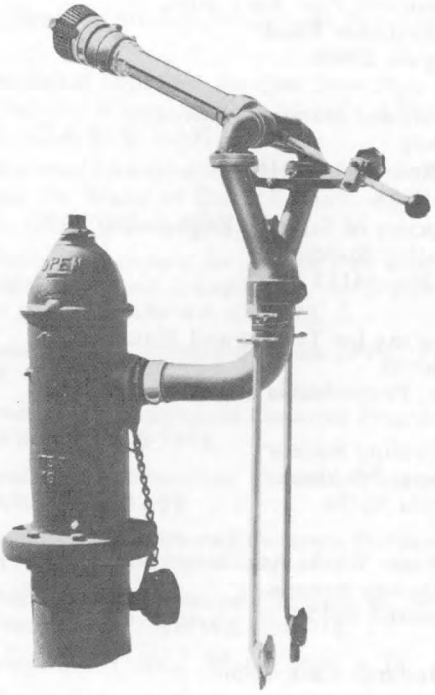



**Figure A-6-1b. Typical hydrant mounted monitor nozzle.**

A-7 This standard makes reference to codes and standards published by other organizations. The addresses are as follows:

ACPA
American Concrete Pipe Association
8320 Old Courthouse Road
Vienna, Virginia 20005

ANSI
American National Standards Institute
1430 Broadway
New York, New York 10018

ASSE
American Society of Sanitary Engineering
960 Illuminating Building
Cleveland, Ohio 44113

ASTM
American Society for Testing and Materials
1916 Race Street
Philadelphia, Pennsylvania 19103

AWS
American Welding Society
2501 Northwest 7th Street
Miami, Florida 33125

AWWA
American Water Works Association Inc.
6666 West Quincy Avenue
Denver, Colorado 80235

CSA
Candian Standards Association
178 Rexdale Boulevard
Rexdale, Ontario, Canada M9W 1R3

DIPRA
Ductile Iron Pipe Research Association
Executive Plaza West, Suite 509
1301 West 22nd Street
Oak Brook, Illinois 60521

A-7-1.1

(a)Testing laboratories list or label cast iron and ductile iron pipe (cement-lined and unlined, coated and uncoated), asbestos-cement pipe and couplings, steel pipe, fiberglass filament wound epoxy pipe and couplings, polyethylene pipe and polyvinyl chloride (PVC) pipe and couplings. Underwriters Laboratories Inc. lists under re-examination service reinforced concrete pipe (cylinder pipe, non-prestressed and prestressed).

(b) *Pipe Standards.* The various types of pipe are usually manufactured to one of the following standards:

AWWA *Standard for Asbestos-Cement Pressure Pipe*, AWWA C400-77.

ASTM *Specifications for Asbetos-Cement Pressure Pipe*, ASTM C-296-78.

*American National Standard for Cast Iron Pipe Centrifugally Cast in Metal Molds, for Water or Other Liquids*, ANSI A21.6-1975, AWWA C106-75, CSA B131.5-1973.

*American National Standard for Cast Iron Centrifugally Cast in Sand-Lined Molds, for Water or Other Liquids*, ANSI A21.8-1970, AWWA C108-75, CSA B131.7-1973.

*American National Standard for Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids*, ANSI A21.51-1976, AWWA C151-76.

AWWA *Standard for Polyvinyl Chloride (PVC) Pressure Pipe*, AWWA C900-75.

AWWA *Standard for Reinforced Concrete Pressure Pipe, Steel Cylinder Type*, AWWA C300-1974.

AWWA *Standard for Prestressed Concrete Pressure Pipe, Steel Cylinder Type*, AWWA C301-79.

AWWA *Standard for Reinforced Concrete Pressure Pipe, Non-Cylinder Type*, AWWA C302-74.

AWWA *Standard for Reinforced Concrete Water Pipe, Steel-Cylinder Type, Pretensioned*, AWWA C303-78.

AWWA *Standard for Steel Water Pipe 6 In. and Larger*, AWWA C200-75.

(c) *Installation Standards.* The following apply to the installation of pipe and fittings:

AWWA *Standard for the Installation of Asbetos-Cement Water Pipe*, AWWA C603-78.

AWWA *Standard for the Installation of Cast Iron Water Mains*, AWWA C600-77.

*Concrete Pipe Handbook*, American Concrete Pipe Association.

*Steel Pipe Design and Installation*, AWWA M11, Steel Pipe Manual.

*A Guide for the Installation of Gray Cast Iron Water Mains*, Ductile Iron Pipe Research Association.

*A Guide for the Installation of Ductile Iron Pipe*, Ductile Iron Pipe Research Association.

**A-7-1.2 Pipe Design Manuals.** The following pipe design manuals may be used as guides:

*Standard Practice for the Selection of Asbestos-Cement Water Pipe*, AWWA C401-77.

*American National Standard for Thickness Design of Cast Iron Pipe*, ANSI A21.1-1967 (R 1972), AWWA C101-67, CSA B131.1-1969.

*Concrete Pipe Handbook*, American Concrete Pipe Association.

*American National Standard for the Thickness Design of Ductile Iron Pipe*, ANSI A21.50-1976, AWWA C150-76.

*Steel Pipe Design and Installation*, AWWA M11.

**A-7-2 Coating and Lining Standards.** The following apply to the application of coating and linings:

*American National Standard for Cement Mortar Lining for Cast Iron Pipe and Fittings for Water*, ANSI A21.4-1974, AWWA C104-74.

*American National Standard for Polyethylene Encasement for Gray and Ductile Cast Iron Piping for Water and Other Liquids*, ANSI A21.5-1972, AWWA C105-72.

AWWA *Standard for Coal-Tar Enamel Protective Coatings for Steel Water Pipelines*, AWWA C203-78.

AWWA *Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe*, AWWA C205-71.

AWWA *Standard for Cement-Mortar Lining of Water Pipe Lines in Place*, AWWA C602-76.

**A-7-3 Joint Standards.** The following apply to joints used with the various types of pipe:

*American National Standard for Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings*, ANSI A21.11-79, AWWA C111-79.

AWWA *Standard for Field Welding of Steel Water Pipe Joints*, AWWA C206-75.

AWWA *Standard for Steel Pipe Flanges*, AWWA C207-78.

*American National Standard for Cast Iron Pipe Flanges and Flanged Fittings for 25, 125, 250 and 800 lb*, ANSI B16.1-75.

*American National Standard for Flanged Cast Iron and Ductile Iron Pipe with Threaded Flanges*, ANSI A21.15-75, AWWA C115-75.

**A-7-4 Fittings Standards.** Fittings generally used are cast iron with joints to specifications of the manufacturer of the particular type of pipe. See *Joint Standards* listed following A-7-3. Steel fittings also have some applications. There are the following standards on fittings:

*American National Standard for Gray Iron and Ductile Iron Fittings, 2-in. through 48-in., for Water and Other Liquids,* AWWA C110-77.

AWWA *Standard for Dimensions for Steel Water Pipe Fittings,* AWWA C208-59.

*American National Standard for Cast Iron Pipe Flanges and Flanged Fittings for 25, 125, 250 and 800 lb,* ANSI B16.1-75.

**A-7-5.1** Loop systems for yard piping are recommended for increased reliability and improved hydraulics. Loop systems should be sectionalized by placing valves at branches and at strategic locations to minimize the extent of impairments.

**A-7-5.3** Pipe friction losses should be determined on the basis of Hazen and Williams formula.

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

$P$ = Pressure in psi
$Q$ = Flow in gpm
$C$ = Hazen and Williams Coefficient
$d$ = Actual pipe diameter, in inches

**Table A-7-5.3**

| Pipe or Tube | Hazen-Williams "C" Value[1] |
|---|---|
| Unlined Cast or Ductile Iron | 100 |
| Asbestos Cement, Cement Lined Cast or Ductile Iron, and Steel | 140 |
| Fiberglass Filament Wound Epoxy, Polyethylene and Polyvinyl Chloride (PVC) | 150 |

[1]These values may be reduced by the authority having jurisdiction to be consistent with design procedures.

A-8-1.1 As there is normally no circulation of water in private fire mains, they require greater depth of covering than do public mains. Greater depth is required in a loose gravelly soil (or in rock) than in compact, clayey soil. Recommended depth of cover above the top of underground yard mains is shown in Figure A-8-1.1.

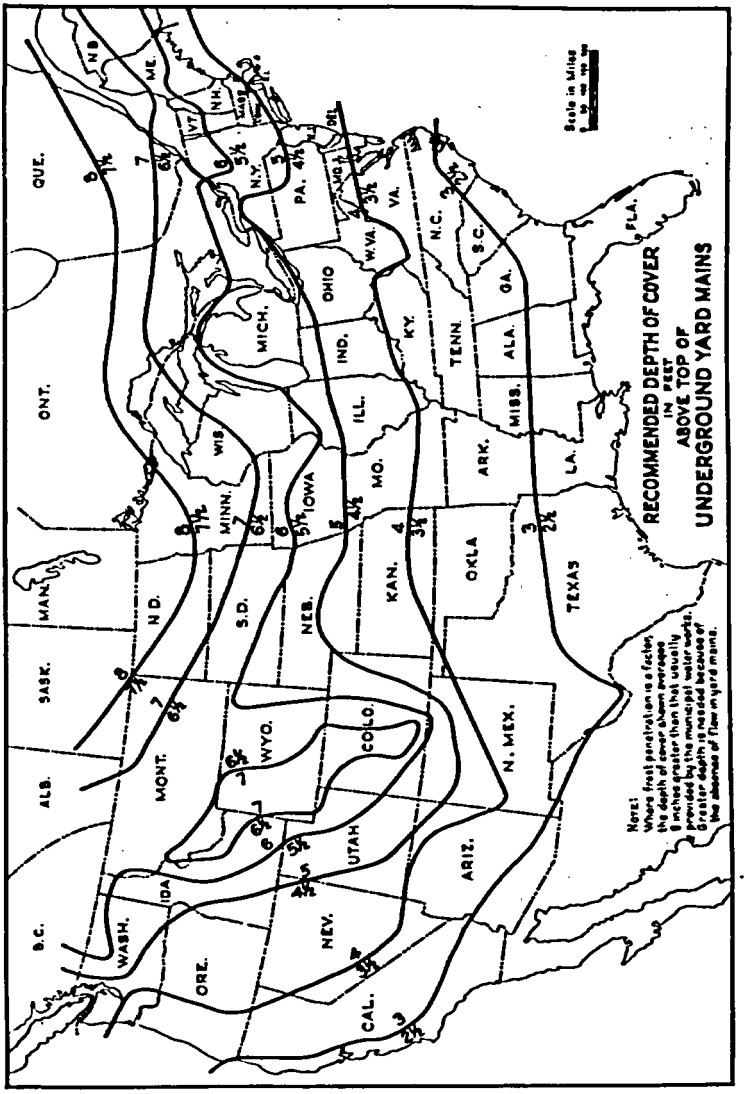



Figure A-8-1.1.

A-8-3.4 Gray cast iron is not considered galvanically dissimilar to ductile iron. Rubber gasket joints (unrestrained push-on or mechanical joints) are not considered connected electrically. Metal thickness should not be considered a protection against corrosive environments. In the case of cast iron or ductile iron pipe for soil evaluation and external protection systems, see Appendix, Section A-7-2—ANSI A21.5-1972.

A-8-6.2 There is no particular significance to be attached to whether the sketch shows push-on or a standard mechanical joint. The anchoring procedure illustrated applies in most cases to either type of joint. In some cases dimensions of the particular pipe or fitting hubs and space available for working around the particular joint will influence the choice of methods used.

The following Figures A-8-6.2(a) through A-8-6.2(i) illustrate acceptable methods for the use of tie rods and clamps.

NOTE 1: In certain of the assemblies of rods and clamps shown, rods run from a lug on the fitting (or a clamp behind the hub of a bell) to a clamp against the face of a bell. Note that this arrangement anchors only one joint. The stability of the joint where the clamp is against the face of the bell depends on having soil surrounding a relatively long piece of pipe on both sides of the joint.

NOTE 2: In the assemblies shown for rods to flanged fittings, note that the flanged fitting is not to be buried in soil.

NOTE 3: The assemblies shown in which an anchor is made by means of two clamps canted on the long spigot end of a fitting may be used if approved for the specific installation by the authority having jurisdiction.

NOTE 4: Whenever rods or yokes are used, sufficient torque should be applied to the nuts to allow the rods to orient themselves as they would under full test pressure, and thus eliminate deflection during the test.

NOTE 5: In the event of fire test pressures in excess of 250 psi (17.2 bars) stock sizes of the rods and strapping materials should be reviewed and approved by the authority having jurisdiction.

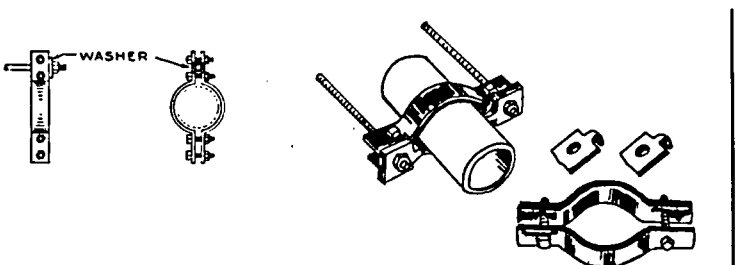



Figure A-8-6.2(a) Pipe Clamp

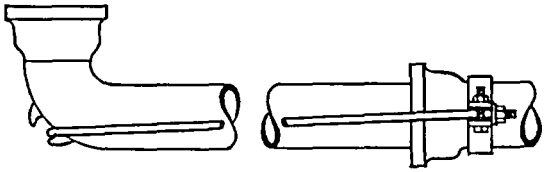


Figure A-8-6.2(b). Anchor for Long Spigot ¼ Bend.

Short hairpin bend and rod couplings may be used in this assembly.

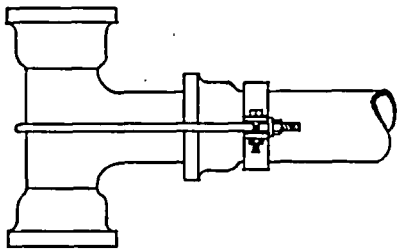


Figure A-8-6.2(c). Tee Anchor.

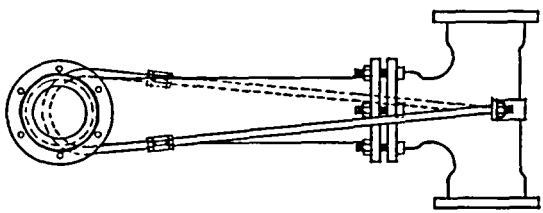


Figure A-8-6.2(d). Anchor for Bell End Tee and ¼ Bend Spigot End.

Shows use of short hairpin bend and rod.

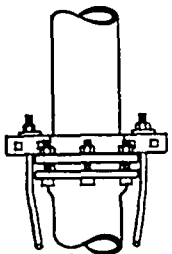


Figure A-8-6.2(e). Anchors at ¼ Bend.

See Note 1.

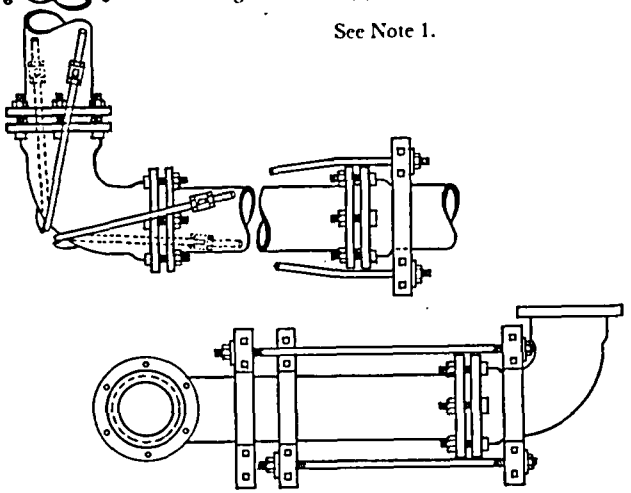


Figure A-8-6.2(f). Anchor to Long Spigot of Bend.

See Note 3.

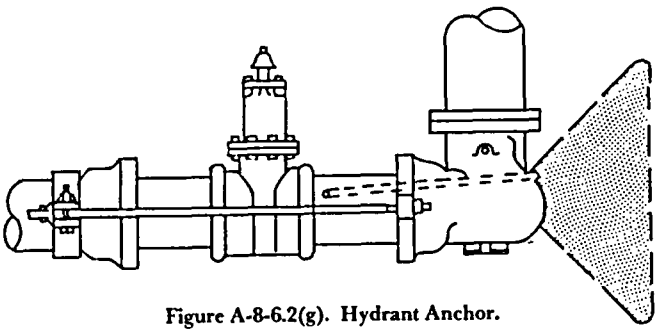


Figure A-8-6.2(g). Hydrant Anchor.

Rods are attached to lugs cast on bell of hydrants. If hydrant is not fitted with lugs, rods are attached as shown by the dotted lines. NOTE: Thrust block required where rods are not used.

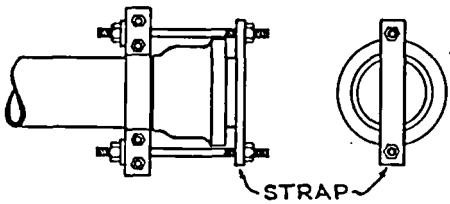



Figure A-8-6.2(h). Plug Strap for Bell End of Pipe.

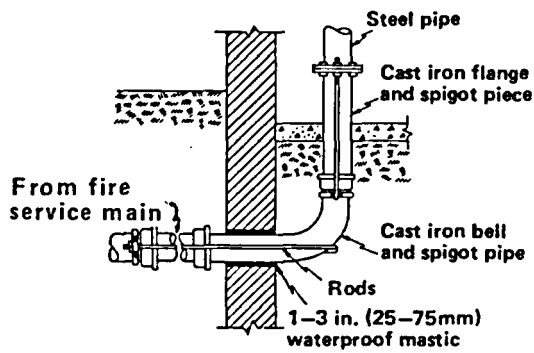



Figure A-8-6.2(i). Typical Connection to Standpipe Riser.

This shows a common arrangement of pipe through a foundation to feed a standpipe riser and illustrates use of certain of the anchoring methods.

Figures A-8-6.2(j) through A-8-6.2(l) illustrate typical available restrained joints suitable for underground or aboveground use in place of rods to restrain unbalanced forces on a piping system. Other approved variations are available.

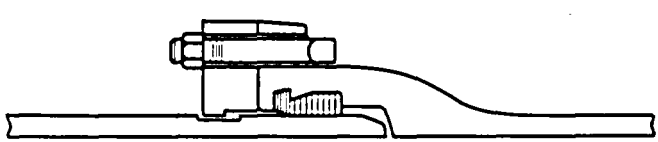


Figure A-8-6.2(j). Restrained Push-on Joints.

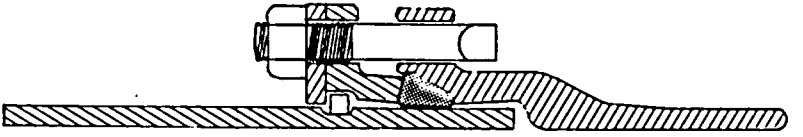


Figure A-8-6.2(k). Restrained Mechanical Joint.

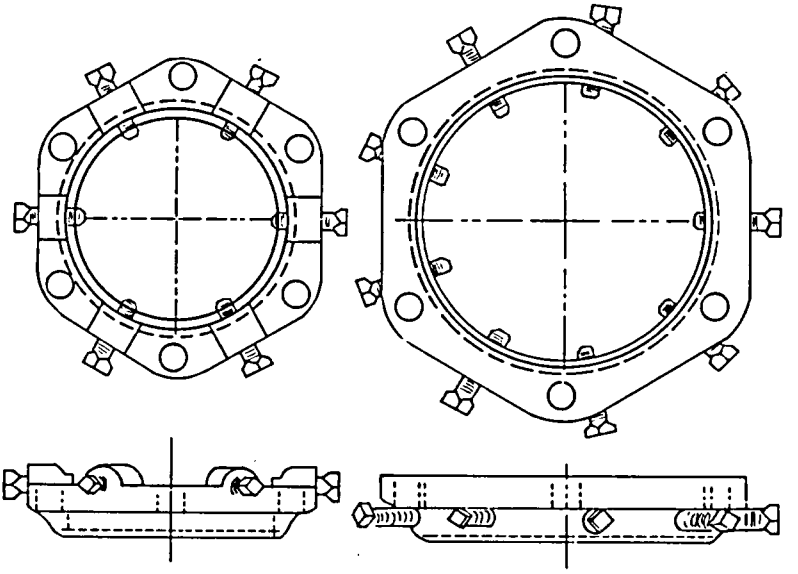


Figure A-8-6.2(l). Mechanical Joint Ductile Iron Retainer Gland 4-24 Inch.

NOTE: Such devices should be torqued to the manufacturer's recommendations.

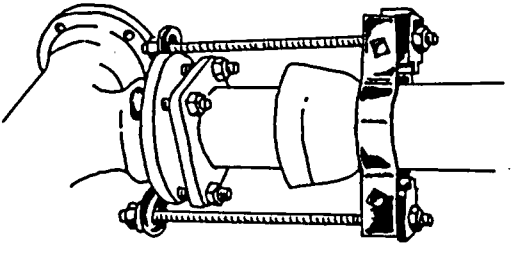


Figure A-8-6.2(m) Tie Bolt Anchor