

NFPA

24

# OUTSIDE PROTECTION 1977



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**See Inside Back Cover for Official NFPA Definitions**

## **Standard for Outside Protection**

**NFPA 24—1977**

### **1977 Edition of NFPA 24**

This edition of the Standard for Outside Protection incorporates revisions adopted by the National Fire Protection Association at its 1977 Annual Meeting, in Washington, D.C., May 19, 1977, on recommendation of the Committee on Standpipes and Outside Protection. It supersedes the edition of 1973 and all prior editions. Changes, other than editorial, are denoted by a vertical line in the margin of the pages in which they appear.

### **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 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, and 1973. This 1977 edition contains the latest recommendations of the Association.

## Committee on Standpipes and Outside Protection

**Kenneth J. Carl, Chairman**

Public Protection Grading, Insurance Services Office,  
160 Water Street, New York, NY 10038

**Richard H. Chamberlain, Secretary**

Rowell & Associates, North Star Building, Northern Lights Circle, North Syracuse, NY 13212

**Willis C. Beard**, National Association of Fire  
Equipment Distributors, Inc.

**G. Clarke**, Factory Mutual Research Corporation

**Joseph G. Coutu**, Industrial Risk Insurers

**Chief Robert Ely**, California Fire Chiefs  
Association

**E. E. Hinderer**, Caterpillar Tractor Co.

**T. C. Jester**, Manufacturers Standardization  
Society of the Valve & Fitting Industry

**Kerry B. Koen**, Memphis Fire Department

**Bruno Joseph Lukes**, Canadian Automatic  
Sprinkler Association

**Alan R. Marshall**, Badger-Powhatan Company

**Richard Martineau**, National Automatic Sprinkler  
& Fire Control Association

**Murvan M. Maxwell**, American Institute of  
Architects

**Guido Moccio**, Fire Marshals Association of North  
America

**James W. Nolan**, James W. Nolan Company

**Commissioner John O'Hagen**, New York City Fire  
Department

**John E. Plantinga**, Meyer, Strong & Jones

**David O. Rogers**, Alexander & Alexander

**Peter K. Schontag**, NFPA Industrial Section

**Willard R. Seipt**, Certain-teed Products  
Corporation, P&PG

**Ray Simpson**, International Association of Fire  
Chiefs

**W. Harry Smith**, Cast Iron Pipe Research  
Association

**Miles Suchomel**, Underwriters Laboratories Inc.

**William Stanley Thompson**, Fire Equipment  
Manufacturers Association

**William T. Trinker**, The Mill Mutual Fire  
Prevention Bureau

**Fred S. Winters**, American Mutual Insurance  
Alliance

**J. Milton Wright**, Naples, FL 33940

**Peter Yurkonis**, Rolf Jensen & Associates, Inc.

**Joseph A. Zott**, Johnson & Higgins

### Alternates

**Russell P. Fleming**, National Automatic Sprinkler  
and Fire Control Association (Alternate to  
Richard Martineau)

**Robert J. Madden**, Fire Equipment Manufacturers  
Association, Inc. (Alternate to William S.  
Thompson)

**Stanley W. Muller**, American Institute of  
Architects (Alternate to Murvan M. Maxwell)

**A. P. Scitline**, NFPA Industrial Section (Alternate  
to P. K. Schontag)

**Eldon A. Steen**, Industrial Risk Insurers (Alternate  
to J. G. Coutu)

**Harry Westhaus**, Insurance Services Office  
(Alternate to Kenneth J. Carl)

*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*

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## **Standard for Outside Protection**

**NFPA 24—1977**

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

### **Chapter 1 General Information**

**1-1 Scope.** This standard covers 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. The authority having jurisdiction shall always be consulted before installation of, or remodeling of, yard piping.

**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 yard piping systems based upon sound engineering principles, test data and field experience.

**1-3 Definition of Outside Protection.** Outside protection as used in this standard means underground piping systems on private property together with the hydrants and other appurtenances thereto used for fire protection purposes.

**1-4** Other NFPA publications that may apply to yard piping are listed in Appendix C.

**1-5\*** A layout plan shall be approved by the authority having jurisdiction in every case where new yard piping 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 yard 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 (litre 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
litre	<i>l</i>	1 gal. = 3.785 <i>l</i>
litre per minute per square metre	<i>l</i> /min•m <sup>2</sup>	1 gpm/ft <sup>2</sup> = 40.746 <i>l</i> /min•m <sup>2</sup>
cubic decimetre	dm <sup>3</sup>	1 gal. = 3.785 dm <sup>3</sup>
Pascal	Pa	1 psi = 6894.757 Pa
bar	bar	1 psi = 0.0689 bar
bar	bar	1 bar = 10 <sup>5</sup> 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 System.** (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** Street mains shall be of ample size, in no case smaller than six inches. 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 to public waterworks systems shall be controlled by post indicator valves of a standard type and located not less than 40 feet (12.2m) 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 city block, underground valves shall conform to these provisions and their locations and direction of turning to open shall be clearly marked.*

**2-2.7** Connections for domestic or standpipe use over two inches in size shall conform to 2-2.6.

**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.

## **2-4 Tanks.**

**2-4.1 Gravity Tanks.** The capacity and elevation shall be determined by the authority having jurisdiction.

NOTE: See *Standard for Water Tanks for Private Fire Protection*, NFPA 22 (see Appendix C).

**2-4.2 Pressure Tanks.** When pressure tanks are to be used the authority having jurisdiction shall be consulted.

NOTE: See *Standard for Water Tanks for Private Fire Protection*, NFPA 22 (see Appendix C).

**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.<sup>1</sup>**

**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.

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<sup>1</sup>See *Recommendations for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems*, NFPA 13E (see Appendix C).

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.

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 194, *Screw Threads and Gaskets for Fire Hose Connections*. (See Appendix C.)

*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.*

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 one inch 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.

*Exception No. 1: Inside screw-type gate valves may be used with the approval of the authority having jurisdiction when required by special local conditions.*

*Exception No. 2: Inside screw-type gate valves may be used in hydrant connections.*

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 gallons (56.78m<sup>3</sup>) capacity, no control valve need be installed on the tank side of the check valve.

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.

3-2.5\* When a pump is 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 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 controlling water supplies for sprinklers shall be located where readily accessible and free from obstructions.

### **3-3 Post Indicator Valves.**

**3-3.1** Every connection from the yard main to a building shall be provided with a post indicator valve.

*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 feet (12.2m) 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 inches (0.9m) above the ground and 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 Standard for Water Tanks for Private Fire Protection, NFPA 22 (see Appendix C).*

**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 yard 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*. (*See Appendix C.*)

## Chapter 4 Hydrants

### 4-1\* General.

4-1.1 Hydrants shall be of approved type and have not less than a six-inch 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-inch 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 194, *Screw Threads and Gaskets for Fire Hose Connections*. (*See Appendix C.*)

*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 feet (152.5m) 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 feet (12.2m) from the buildings protected.

*Exception: Where it is impossible to place them at this distance, they may be located nearer, provided they are set in locations where the possibility 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.*

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 inches 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-8-6.2-7.)

4-3.5 Hydrants shall be protected if subject to mechanical damage.

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 198, *Care of Fire Hose (Appendix C)*.

### 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 196, *Standard for Fire Hose*. (See *Appendix C*.)

**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 194, *Screw Threads and Gaskets for Fire Hose Connections*. (See *Appendix C*.)

*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 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\* Underground 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 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 six inches in diameter shall be installed underground in yard systems for mains or hydrant branches.

**7-5.2** The size of the pipe supplying sprinkler systems and yard 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 one foot (0.3m) 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 two-and-a-half feet (0.8m) to prevent mechanical injury. Pipe under driveways shall be buried a minimum of three feet (0.9m) and under railroad tracks a minimum of four feet (1.2m). (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** Special care is necessary in running pipes under railroad tracks, under roads carrying heavy trucking, and under large piles of heavy commodities or in areas subjecting the buried pipes to shock and vibration. Where subject to such conditions, pipes shall be run in a covered pipe trench or be otherwise properly guarded. (See 7-1.)

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

**8-3.5** In no case shall the pipe be used for grounding of electrical services. It is especially important that no direct current be grounded to the pipe.

#### **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 provision 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 Joints.**

**8-5.1** Flexible joints (mechanical or push-on) are the present-day standard. Lead or other special joints shall be used only with approval by the authority having jurisdiction; such joints, if employed, shall be made by persons familiar with the particular material used.

**8-5.2** When using flexible joint pipe or fittings, deflection shall not exceed that recommended by the manufacturer.

**8-5.3** 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 re-tainer 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 re-tainer 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 of Clamps, Rods, Bolts and Washers.**

(a) Clamps shall be  $\frac{1}{2}$  by 2 inches (12.7 by 50.8mm) for pipe 4 to 6 inches;  $\frac{5}{8}$  by  $2\frac{1}{2}$  inches (15.9 by 63.5mm) for pipe 8 and 10 inches;  $\frac{5}{8}$  by 3 inches (15.9 by 76.2mm) for pipe 12 inches. Bolt holes shall be  $\frac{1}{16}$  inch (1.6mm) diameter larger than bolts.

(b) Rods shall be two  $\frac{3}{4}$ -inch (19.1mm) diameter for pipes 4, 6 and 8 inches; two  $\frac{7}{8}$ -inch (22.2mm) diameter for pipe 10 inches; and two 1-inch (25.4mm) diameter for pipe 12 inches. Rods shall be threaded at ends only. When using bolted rods the diameter of mechanical joint bolts limits the size of rods to  $\frac{3}{4}$  inch (19.1mm).

*Exception: A greater number of rods symmetrically spaced, and equal in total cross-sectional area required for the joint may be used; however, the minimum rod size shall be  $\frac{3}{4}$  inch (19.1mm).*

(c) Clamp bolts shall be  $\frac{5}{8}$ -inch (15.9mm) diameter for pipe 4, 6, and 8 inches;  $\frac{3}{4}$ -inch (19.1mm) diameter for pipe 10 inches and  $\frac{7}{8}$ -inch (22.2mm) diameter for pipe 12 inches.

(d) Washers may be cast iron or steel, round or square. Dimensions for cast iron washers shall be  $\frac{5}{8}$  by 3 inches (15.9 by 76.2mm) for pipe 4, 6, 8 and 10 inches and  $\frac{3}{4}$  by  $3\frac{1}{2}$  inches (19.1 by 88.9mm) for pipe 12 inches. Dimensions for steel washers shall be  $\frac{1}{2}$  by 3 inches (12.7 by 76.2mm) for pipe 4, 6, 8 and 10 inches and  $\frac{1}{2}$  by  $3\frac{1}{2}$  inches (12.7 by 88.9mm) for 12 inches. Holes shall be  $\frac{1}{8}$  inch (3.2mm) larger than rods.

**8-6.2.5 Sizes of Anchor Straps for Tees.** Straps shall be  $\frac{5}{8}$  inch (15.9mm) thick and  $2\frac{1}{2}$  inches (63.5mm) wide for pipe 4, 6, 8, and 10 inches;  $\frac{3}{8}$  inch (15.9mm) thick and 3 inches (76.2mm) wide for pipe 12 inches. Rod holes shall be  $\frac{1}{16}$  inch (1.6mm) larger than rods. Dimensions in inches (mm) for straps are suitable either for mechanical or push-on joint tee fittings.

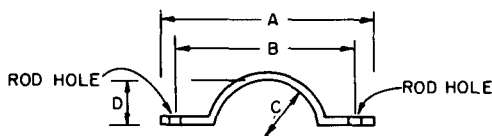


Figure 8-6.2.5. Anchor Straps for Tees.

[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	$12\frac{1}{2}$	318	$10\frac{1}{8}$	257	$2\frac{1}{2}$	64	$1\frac{3}{4}$	44
6	$14\frac{1}{2}$	368	$12\frac{1}{8}$	308	$3\frac{9}{16}$	90	$2\frac{13}{16}$	71
8	$16\frac{3}{4}$	425	$14\frac{3}{8}$	365	$4\frac{21}{32}$	118	$3\frac{29}{32}$	99
10	$19\frac{1}{16}$	484	$16\frac{1}{16}$	424	$5\frac{3}{4}$	146	5	127
12	$22\frac{5}{16}$	567	$19\frac{3}{16}$	487	$6\frac{3}{4}$	171	$5\frac{7}{8}$	149

**8-6.2.6 Sizes of Plug Strap for Bell End of Pipe.** Strap shall be  $\frac{3}{4}$  inches (19.1mm) thick,  $2\frac{1}{2}$  inches (63.5mm) 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 A307-76b).
(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 A197-47-reapproved 1976).

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	$\frac{1}{4}$ Bend Square Feet	m <sup>2</sup>	$\frac{1}{8}$ Bend Square Feet	m <sup>2</sup>	Tees, Plugs, Caps and Hydrants Square Feet	m <sup>2</sup>
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 six inches (152mm) under and around the pipe and for at least 2 feet (0.6m) 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 written statement, countersigned by the property owner or representative, to the effect that the work has been completed in accordance with approved specifications and plans.

NOTE: The Contractor's Material and Test Certificate, shown in NFPA 13, *Standard for the Installation of Sprinkler Systems*, is to be used to the extent it applies. (See Appendix C.)

**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 yard piping shall be tested hydrostatically at not less than 200 pounds per square inch (13.8 bars) pressure for two hours, or at 50 pounds per square inch (3.4 bars) in excess of the maximum static pressure when the maximum static pressure is in excess of 150 pounds per square inch (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 (30ml/25mm/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 (150ml/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 in the Note of 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

The following notes, bearing the same number as the text of the *Standard for Outside Protection* to which they apply, contain useful explanatory material and references to standards.

*This Appendix is not a part of this NFPA Standard for Outside Protection 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 *Standard for the Installation, Maintenance and Use of Central Station Signaling Systems for Guard, Fire Alarm and Supervisory Service*, NFPA 71, *Standard for the Installation, Maintenance and Use of Local Protective Signaling Systems for Watchman, Fire Alarm and Supervisory Service*, NFPA 72A, *Standard for the Installation, Maintenance and Use of Auxiliary Protective Signaling Systems for Fire Alarm Service*, NFPA 72B, *Standard for the Installation, Maintenance and Use of Remote Station Protective Signaling Systems for Fire Alarm and Supervisory Service*, NFPA 72C, and *Standard for the Installation, Maintenance and Use of Proprietary Protective Signaling Systems for Watchman, Fire Alarm and Supervisory Service*, NFPA 72D. See separately published *Standard for the Installation of Centrifugal Fire Pumps*, NFPA 20, and *Standard for the Installation of Sprinkler Systems*, NFPA 13 (see Appendix C).

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

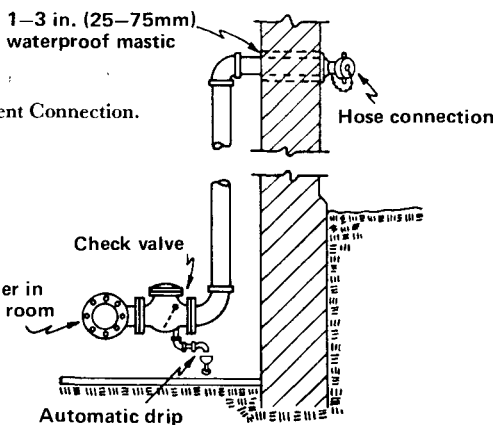


Figure A-2-6a. Fire Department Connection.

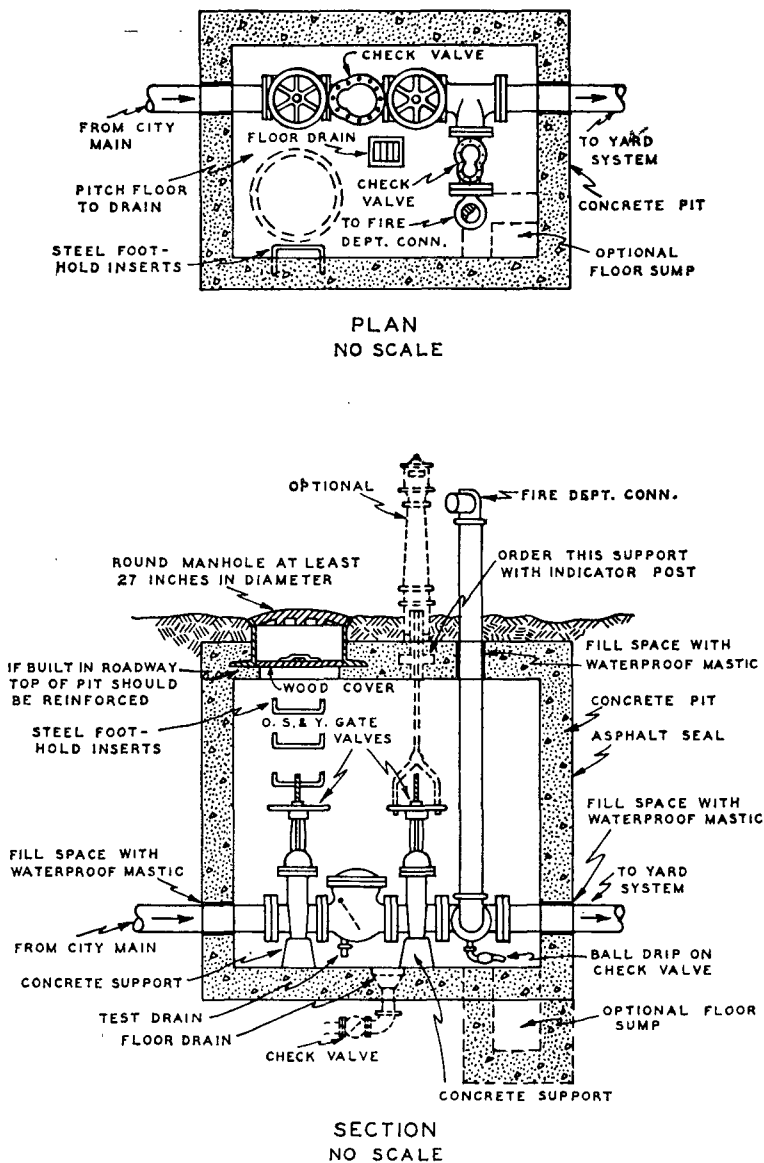


Figure A-2-6b. Typical City Water Pit - Single Check Valve Arrangement.

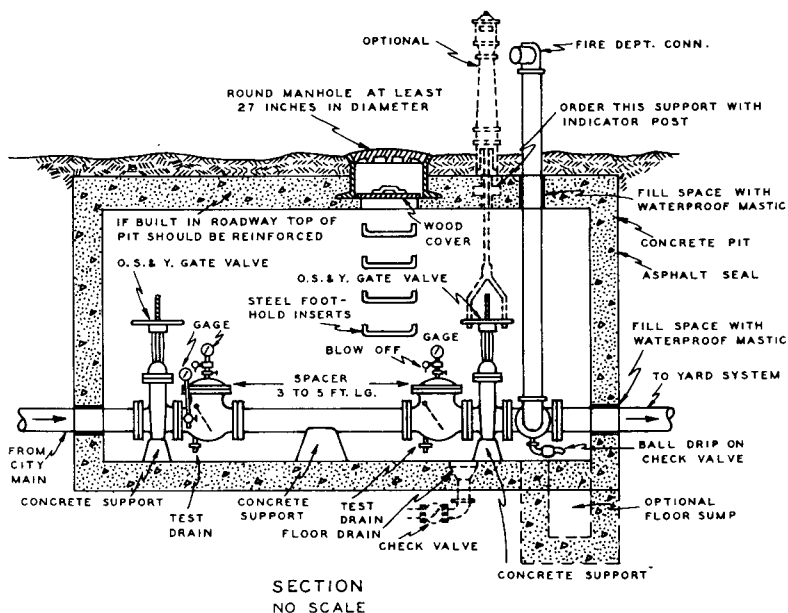
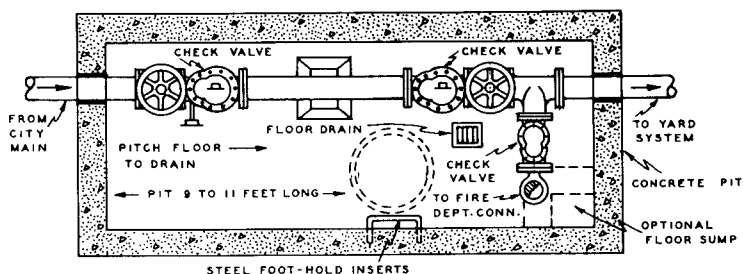


Figure A-2-6c. Typical City Water Pit – Double Check Valve Arrangement.

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

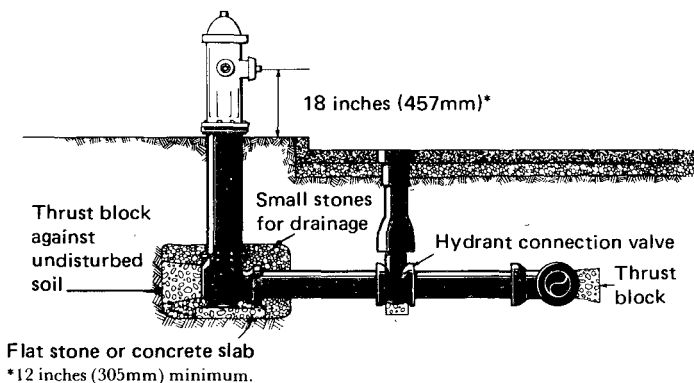


Figure A-4-1. Typical Hydrant Connection.

**A-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 pounds per square inch (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.

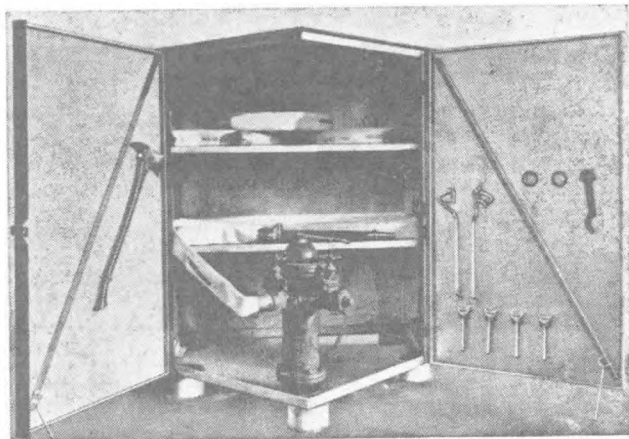


Figure A-5-4a. House of five-sided design for installation over a yard hydrant. Such houses may be of wood, steel, or aluminum with a tight floor installed after erection.

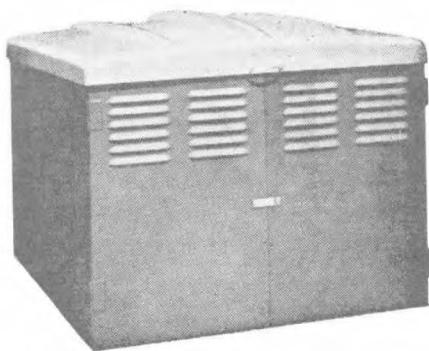


Figure A-5-4b. Steel house of compact dimensions for installation over a yard hydrant. House is shown closed. Top lifts up and doors on front side open for complete accessibility.

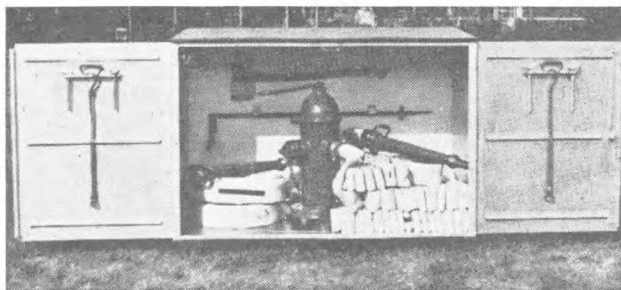


Figure A-5-4c. Hose house of compact dimensions for installation over a yard hydrant. Construction may be steel or aluminum.

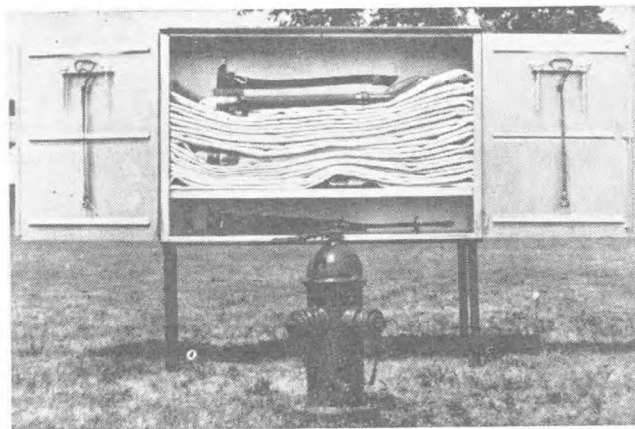


Figure A-5-4d. Hose house of steel or aluminum construction. This type can be installed on legs as illustrated or installed on a wall near, but not directly over, a yard hydrant.

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.

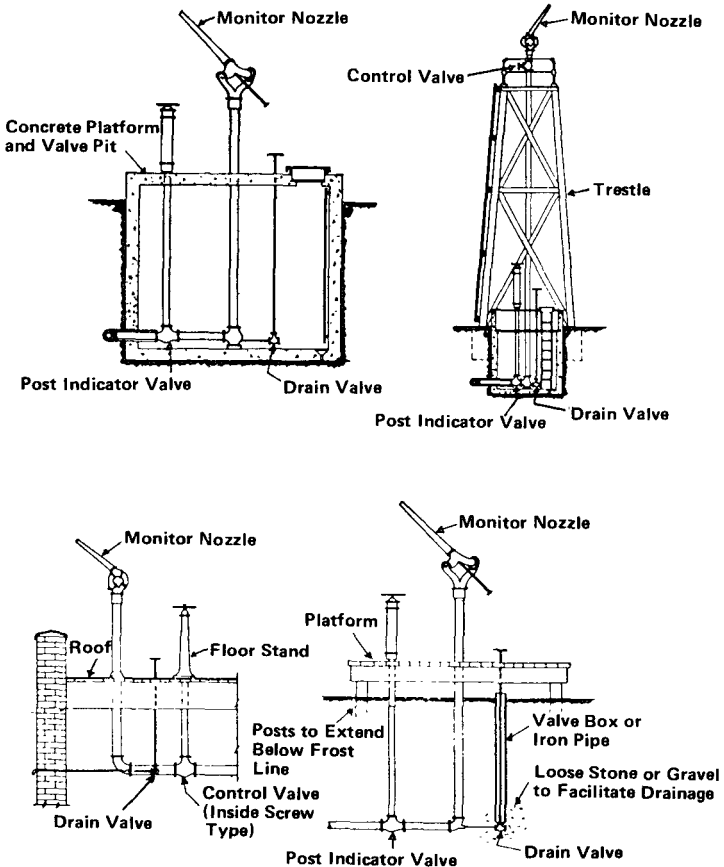


Figure A-6-1a. Standard Monitor Nozzles.  
Gear control nozzles are also satisfactory.

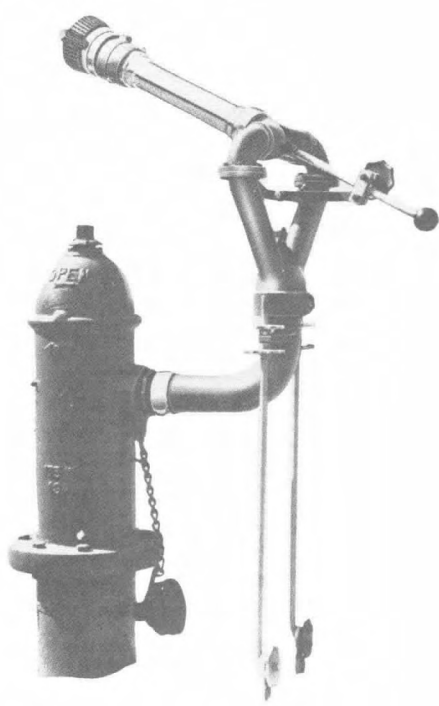


Figure A-6-1b. Typical hydrant mounted monitor nozzle.

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

- (a) AWWA  
American Water Works Association Inc.  
6666 West Quincy Avenue  
Denver, Colorado 80235
- (b) ANSI  
American National Standards Institute  
1430 Broadway  
New York, New York 10018
- (c) CSA  
Canadian Standards Association  
178 Rexdale Boulevard  
Rexdale, Ontario, Canada M9W 1R3
- (d) ASTM  
American Society for Testing and Materials  
1916 Race Street  
Philadelphia, Pennsylvania 19103
- (e) AWS  
American Welding Society  
2501 Northwest 7th Street  
Miami, Florida 33125
- (f) ACPA  
American Concrete Pipe Association  
1501 Wilson Boulevard  
Arlington, Virginia 22209
- (g) CIPRA  
Cast Iron Pipe Research Association  
Executive Plaza West, Suite 509  
1301 West 22nd Street  
Oak Brook, Illinois 60521

**A-7-1.1(a)** Internationally recognized 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, nonprestressed 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 C400-75.
- ASTM Specifications for Asbestos-Cement Pressure Pipe*, ASTM C-296-76.
- 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 C301-72.
- 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 C303-70.
- AWWA Standard for Steel Water Pipe 6 Inches and Larger*, AWWA C200-75.

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

- AWWA Standard for the Installation of Asbestos-Cement Water Pipe*, AWWA C603-65.
- AWWA Standard for the Installation of Cast Iron Water Mains*, AWWA C600-64.
- 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*, Cast Iron Pipe Research Association.
- A Guide for the Installation of Ductile Iron Pipe*, Cast 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 C401-64.
- 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, Steel Pipe Manual.

**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 Pipe 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 C203-73.
- 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 A21.11-72, AWWA C111-72.

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

*AWWA Standard for Steel Pipe Flanges*, AWWA C207-55.

*American National Standard for Cast Iron Pipe Flanges and Flanged Fittings for 25, 125, 250 and 800 lb.*, ANSI B16.1-67.

*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-inch through 48-inch, for Water and Other Liquids*, ANSI A21.10-71, AWWA C110-71.

*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 B16.1-67.

**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.

$$P = \frac{4.54 Q^{1.85}}{C^{1.85} d^{4.87}}$$

$P$  = Pressure in psi

$Q$  = Flow in gpm

$C$  = Hazen and Williams Coefficient

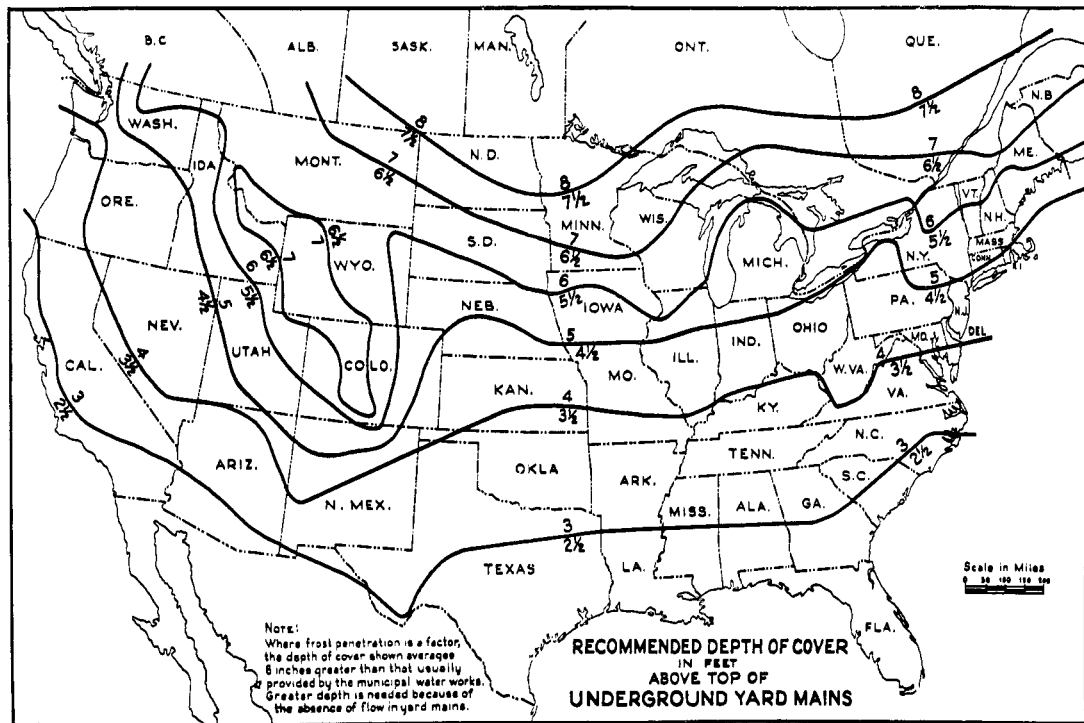
$d$  = Actual pipe diameter, in inches

**Table A-7-5.3**

Pipe or Tube	Hazen-Williams "C" Value <sup>1</sup>
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

<sup>1</sup>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 pounds per square inch (17.2 bars) stock sizes of the rods and strapping materials should be reviewed and approved by the authority having jurisdiction.

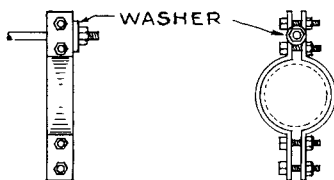
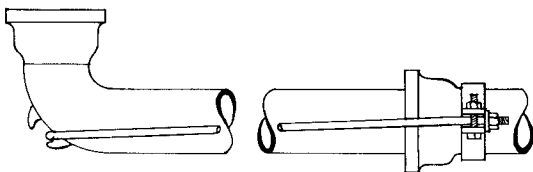
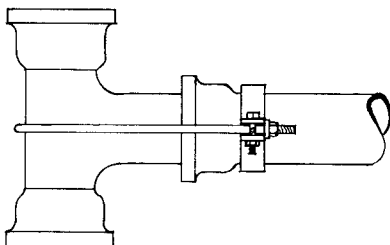


Figure A-8-6.2(a). Pipe Clamp.

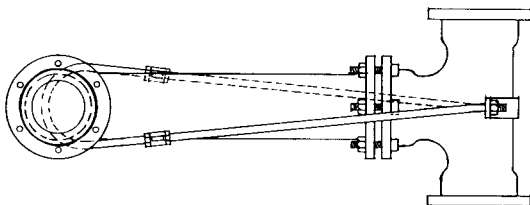


**Figure A-8-6.2(b). Anchor for Long Spigot  $\frac{1}{4}$  Bend.**

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  $\frac{1}{4}$  Bend Spigot End.**

Shows use of short hairpin bend and rod.

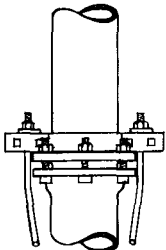


Figure A-8-6.2(e). Anchors at  $\frac{1}{4}$  Bend.

See Note 1.

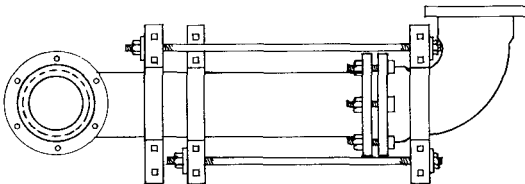
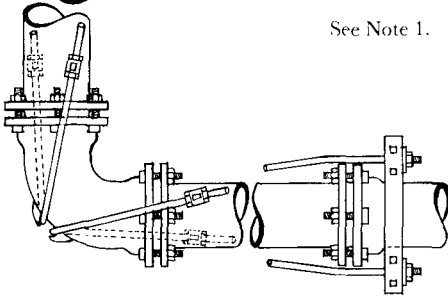


Figure A-8-6.2(f). Anchor to Long Spigot of Bend.

See Note 3.

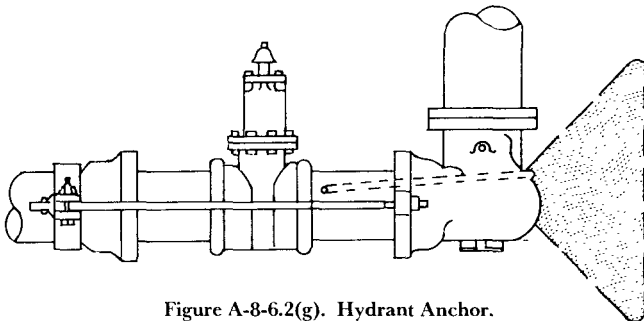


Figure A-8-6.2(g). Hydrant Anchor.

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.

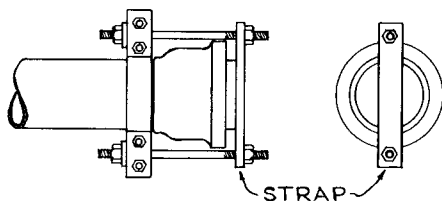


Figure A-8-6.2(h). Plug Strap for Bell End of Pipe.

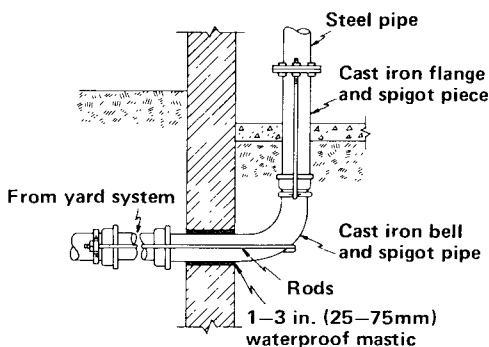


Figure A-8-6.2(i). Typical Connection to Standpipe Riser.

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.

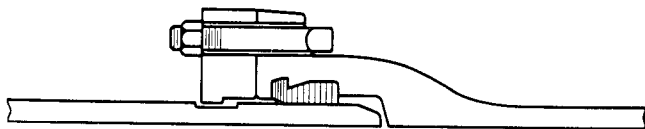


Figure A-8-6.2(j). Restrained Push-on Joints.

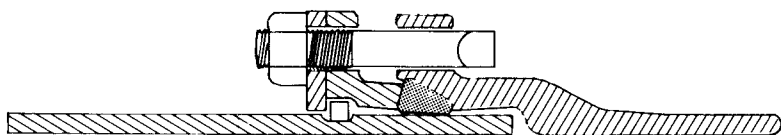


Figure A-8-6.2(k). Restrained Mechanical Joint.

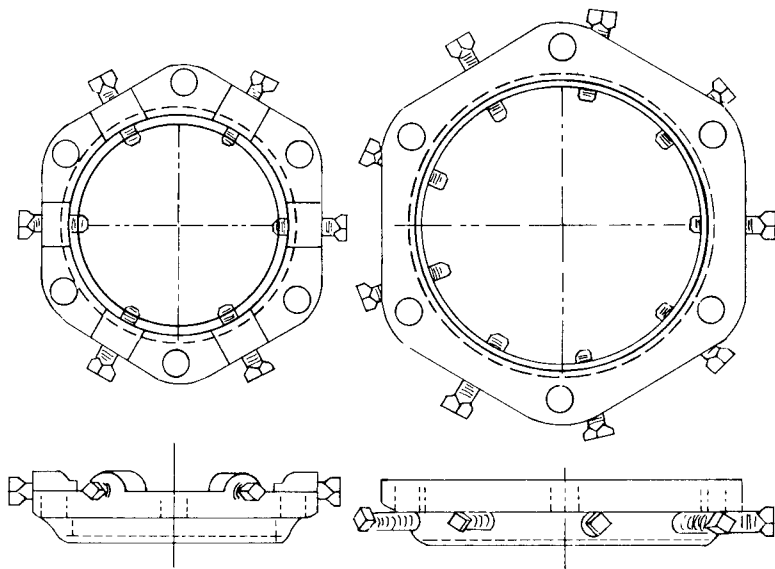
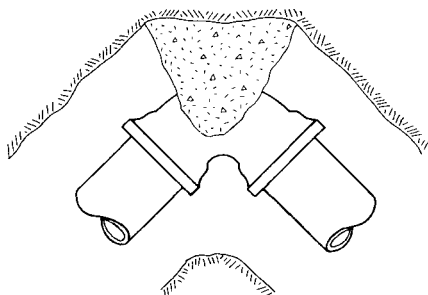


Figure A-8-6.2(l). Mechanical Joint Ductile Iron Retainer Gland 4-24 Inch.

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

## BEARING AGAINST TRENCH WALL



## BEARINGS AGAINST TRENCH WALLS

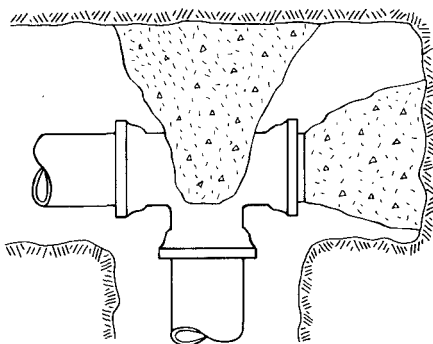


Figure A-8-6.2.10. Typical Thrust Blocks.

Illustrations of the use of thrust blocks: above at one-quarter bend; below at tee and plug. Publications of pipe and fitting manufacturers show methods for installing thrust blocks at other fittings. In each case, the trench is cut to provide a bearing surface on undisturbed soil, and concrete is poured to fit snugly against as much of the fitting as possible without interfering with access to fitting joints. In some cases anchor rods may be used to hold the fitting against the blocks.

**Table A-8-6.2.10 Suggested factors to be used in determining size of thrust blocks are:**

Soft Clay	4
Sand	2
Sand and Gravel	1.33
Shale	0.4.