

Manual of Water Supply Practices

M17

Fire Hydrants:

Installation, Field Testing, and Maintenance

Fifth Edition



American Water Works
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MANUAL OF WATER SUPPLY PRACTICES—M17, Fifth Edition

Fire Hydrants: Installation, Field Testing, and Maintenance

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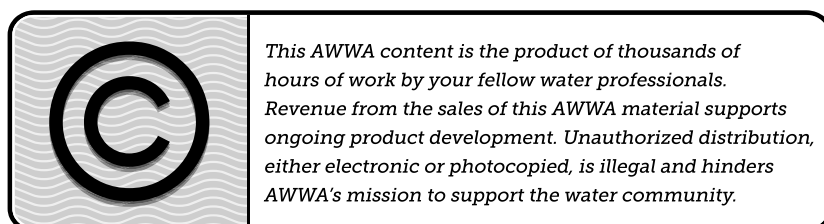
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Technical Editor: Jenifer Walker
Production: TIPS Technical Publishing, Inc.
Manuals Coordinator: Mindy Burke

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Foreword



This manual was prepared by the AWWA Standards Committee on Fire Hydrants. It is intended for use by persons responsible for the installation, operation, and maintenance of dry-barrel and wet-barrel fire hydrants. It is the fifth revision of the original manual, which was published in 1970.

The diversity of hydrants and the detailed maintenance procedures recommended by specific manufacturers make it difficult to develop a text that is both comprehensive and concise. Therefore, this manual is intended for use as a supplement to detailed information available from specific hydrant manufacturers.

It is the judgment of the committee that the major purpose and function of a fire hydrant is public fire protection. Usually, the hydrant is the property or responsibility of the water utility. However, during fire emergencies the hydrant is operated by members of a fire department rather than by water utility personnel.

The use of a fire hydrant as a source of water for street cleaning, construction projects, or for any purpose other than firefighting is outside the primary purpose for which a hydrant is installed. Such uses should be rigidly restricted and controlled in the interest of keeping the fire hydrant in good working order for firefighting.

Those using fire hydrants for purposes other than firefighting are reminded that there are other water quality issues that should be considered. For example, fire hydrants have been exempted from the 0.25% lead provisions and should take appropriate precautions.

The water utility, unless expressly relieved of its responsibility by the fire department in accordance with a written agreement, public ordinance, or other ownership, should schedule regular and sufficiently frequent inspections of hydrants to ensure they are in good working condition.

Additional AWWA publications on hydrants include ANSI/AWWA C502, Standard for Dry-Barrel Fire Hydrants, and ANSI/AWWA C503, Standard for Wet-Barrel Fire Hydrants. The bulk of the material in this manual refers to hydrants claimed by the respective manufacturers to be manufactured in accordance with ANSI/AWWA C502 and ANSI/AWWA C503; however, information is also included on hydrants that are not intended to comply with these standards, such as high-pressure and flush-type hydrants. Installation practices described are consistent with ANSI/AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.

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Todd Martin Alcott, Chair

T.M. Alcott, Waterous Company, South St. Paul, Minn.

T.C. Harbour, Clow Valve Company, Oskaloosa, Iowa

R. Looney, American AVK Company, Minden, Nev.

S.D. Osborne, OSD, LLC, Lexington, Mass.

D.W. Qualls, Dallas Water Utilities, Dallas, Texas

K.J. Wright, EJ USA, Inc., East Jordan, Mich.

This manual was reviewed and approved by the AWWA Standards Committee on Fire Hydrants. Members of that committee, at the time of approval, were as follows:

Sean D. Osborne, Chair

General Interest Members

E.E. Arasmith, ACR Publications, Inc., Albany, Ore.

R. L. Larkin, Gardendale, Ala.

M.D. Tennenbaum, Underwriters Laboratory, Los Angeles, Calif.

J. Maun, Insurance Services Office Inc., Jersey City, N.J.

S.D. Osborne, OSD, LLC, Lexington, Mass.

D. M. Flancher, Standards Liaison, American Water Works Association, Denver, Colo.*

M.P. Yoke, Anniston, Ala.

S. Ziobro, FM Approvals, West Gloucester, R.I.

Producer Members

T.M. Alcott,[†] Waterous Company, South St. Paul, Minn.

D.E. Burczynski,[†] Kennedy Valve, Elmira, N.Y.

T.C. Harbour, Clow Valve Company, Oskaloosa, Iowa

L.W. Fleury Jr., Mueller Group, Smithfield, R.I.

T.R. Ingalls,[†] EJ USA, Inc., East Jordan, Mich.

R.L. Larkin, Gardendale, Ala.

R. Looney, American AVK Company, Minden, NV.

T.J. Mettler, Waterous, South St. Paul, Minn.

J.H. Wilber,[†] American AVK, Littleton, Colo.

K.J. Wright, EJ USA, Inc., East Jordan, Mich.

** Liaison*

[†] Alternate

User Members

T. Corrigan, Des Moines Water Works, Des Moines, Iowa
E. Hernandez, Denver Water, Denver, Colo.
K.S. Jeng-Bullock, PWE City of Houston, Houston, Texas
B. Kellsey, Epcor Water Services Inc., Edmonton, Alta.
J.W. Kingsbury III, Fairfax Water, Fairfax, Va.
B.A. Shelton, Montgomery Water Works and Sanitary Board, Montgomery, Ala.
M.K. Stankovich, City of Haverhill, Haverhill, Mass.
D.W. Qualls, Dallas Water Utilities, Dallas, Texas
L.G. Thomas, East Bay Municipal Utility District, Oakland, Calif.

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Chapter **1**

A Brief History of Fire Hydrants

This chapter is based, in part, on an article that appeared in the September 1944 *Journal AWWA* (36:9:928). The drawings in this chapter are also taken from that article.

ORIGINS

Before there were water distribution systems, water for fighting fires was available only from natural sources, such as rivers, lakes, and ponds, or from cisterns or barrels filled with water.

The first large water distribution systems were built during the seventeenth century in cities such as London and Boston. Over the course of many years, as the needs of growing populations became more sophisticated and complex, distribution systems were improved. Pipe materials improved, portable standpipes and valves were incorporated, and, eventually, the forerunners of modern fire hydrants were used.

London's first water distribution system was built sometime in the early seventeenth century. In the United States, several water systems were built before or about the time of the American Revolution. Boston's water system was built around 1652, and others were built in the latter part of the eighteenth century. The earliest water mains were made by boring out logs; the mains were then buried. When water was needed for fighting fires, a hole was dug to expose the pipe, and a hole was bored into the pipe wall. Water collected around the pipe and was conducted by buckets or through a hose directly to the fire or to a pump. After use, the hole in the pipe was plugged with a tapered piece of wood—hence the

term fire plug, which has persisted to this day. The location of the pipe hole was marked so that if necessary, the plug could be found and removed quickly.

IRON PIPE AND PERMANENT ACCESS POINTS

When cast-iron pipe replaced bored logs as water mains in the early part of the nineteenth century, it became impractical to bore random holes in pipes to gain access to water. Instead, fittings with openings, or tees, were installed at intervals along the pipe. Wooden plugs were still used to close the openings, but firefighters no longer had to dig to find them. An iron shield with a removable cover that extended from the tee to the ground's surface provided ready access to the plug. At first, portable canvas tanks or cisterns were commonly used to collect the water that spewed out when a plug was removed (Figure 1-1). Soon, however, portable standpipes came into use. After the plug was removed, one end of the standpipe was inserted into the tee; a hose connected to the other end of the standpipe carried water to the pump.

Further development of this system in England resulted in a ball hydrant, in which a ball in an iron chamber was attached to the water-main opening (Figure 1-2). Water

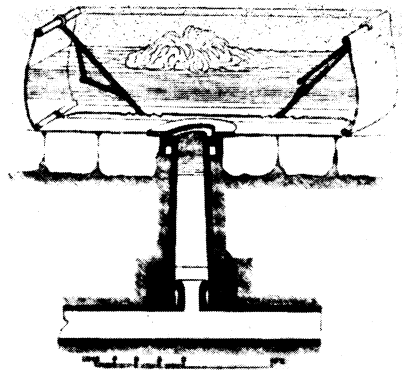


Figure 1-1 Fire-plug arrangement with canvas cistern

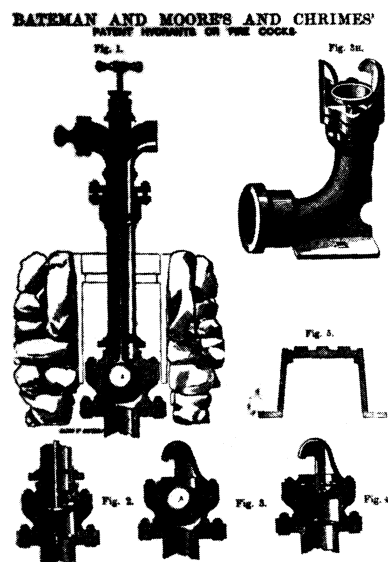


Figure 1-2 Ball hydrant, patented about 1849

pressure held the ball against a seat; after the portable standpipe had been attached, a rod could be used to force the ball down and open the valve. Later, this hydrant was modified by replacing the ball with a spring-loaded valve element, which would remain closed even if water pressure was negligible.

These hydrant designs were the forerunners of the most popular hydrant in North America today: the dry-barrel compression hydrant. With the early style, a portable standpipe was transported to the fire scene and attached to an accessible main connection below the street surface (Figure 1-3). Early dry-barrel compression hydrants were also commonly used in England and certain other countries.

Permanent connections in iron pipe led to other developments as well. One such development consisted of a valve installed belowground, usually in a horizontal branch of the water main. A rod for actuating the valve extended to just below the ground surface, where it was accessible, and an elbow could be attached to the valve outlet. In one version, the elbow terminated in a connection to which a portable standpipe could be attached; in another, it terminated in a hose connection to permit direct hookup of the hose.

DEVELOPMENT OF DRY-BARREL HYDRANTS

In North America, the use of plug-type hydrants and early modifications proved troublesome because of the freezing temperatures to which they were exposed in northern cities. To protect the hydrants from freezing temperatures, but still provide easy access, the

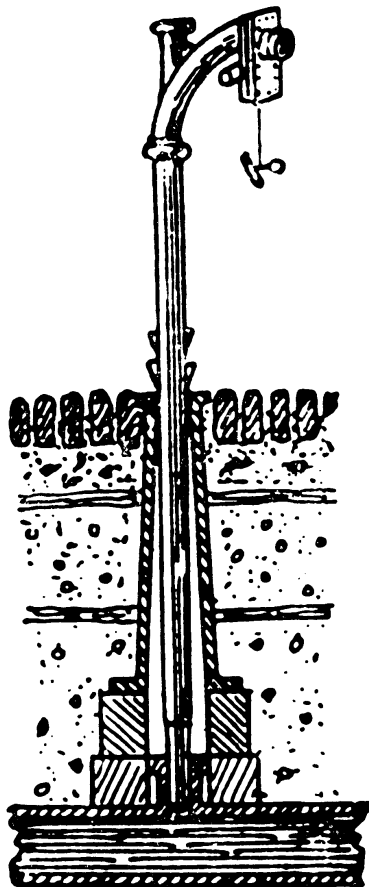


Figure 1-3 Standpipe inserted directly into main socket

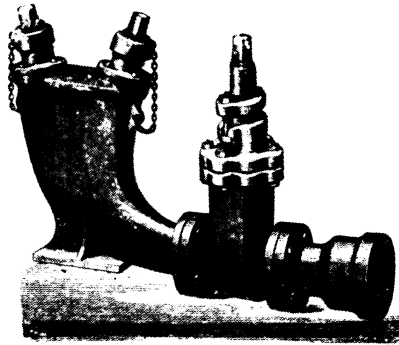


Figure 1-4 Sluiice-valve-type hydrant with two outlets

mains were buried relatively deeply with a pipe extending to the ground surface. This allowed the valve to remain below the frost line but still provided an easy hose connection. To eliminate the need to empty water remaining in the standpipe after use, a drain hole was provided in the standpipe just above the valve. The drain hole was usually controlled by a valve that could be closed when the main valve was opened and vice versa (Figure 1-4).

Two types of dry-barrel hydrants were used during the mid-1800s: flush hydrants, which had the operating mechanism and hose connections in a pit with a cover plate, and post hydrants, which extended above grade. The post hydrant soon became predominant. There were two reasons for this. The obvious reason is that post hydrants were easier to find and to use, particularly in wintry, snowy climates. However, another reason may well have been more persuasive. Early on, professional and volunteer firefighting brigades competed against each other. (Initially, insurance companies paid professional firefighters to protect insured properties.) When a fire alarm sounded, one fireman from each group would race ahead of his company to secure a hydrant for his brigade to the exclusion of its rivals—and it was easier to sit on a post hydrant than to sprawl over the pit of a flush hydrant.

RECENT DEVELOPMENTS

When buckets or hand pumps were used to carry water from a hydrant to a fire, hydrants did not need to be served by high pressure nor did they require very large valve openings. The volume of water available to fight a fire was limited by the capacity of the conveyance rather than the size of the valve opening. Because buckets and hand pumps could carry only limited amounts of water, hydrants with relatively small valve openings were usually more than adequate.

When steam-driven pumps became available, the flows from older hydrants with small valve openings often proved inadequate, so hydrants with larger valve openings came into use. Initially, a 4-in.-(10.2-cm)-diameter valve opening was considered adequate, but eventually 5-in. (12.7-cm) and 6-in. (15.3-cm) sizes were developed. Today, the vast majority of hydrants are connected to the main by 6-in. (15.3-cm) pipe. Most main valves are 4½ in. (11.4 cm) to 5¼ in. (13.3 cm) in diameter. Hydrants may include one or two outlets for connecting large-diameter hoses plus one or two outlets for a 2½-in. (6.4-cm) or 3-in. (7.6-cm) hose.

Dry-barrel hydrants currently produced are post hydrants and are usually furnished with drain valves that are automatically operated by the main valve mechanism. The lower barrels of these hydrants are in direct contact with the ground. The most popular style of the dry-barrel hydrant is the traffic model, which has both a breakable barrel and

operating rod parts located at the ground line. These components are designed to break on impact, thereby protecting the remainder of the hydrant from damage. The design permits quick and inexpensive repairs should the hydrant be struck by a vehicle. Also, after impact, the hydrant is designed to automatically close, thereby preventing any leakage to pass the main valve seat. Because of their popularity, traffic-model hydrants have become the unofficial industry standard. Dry-barrel flush hydrants are generally used only in areas of vehicular traffic, such as parking lots and roadways and airport runways and taxiways.

Where freezing temperatures are rare and never persistent, particularly in the coastal areas of California and Hawaii, wet-barrel hydrants are often used. The wet-barrel hydrant is designed so that the entire interior of the hydrant is pressurized at all times. It is equipped with one or more valved outlets above the ground to which hoses can be connected. Some designs have auxiliary check valves that close if the hydrant is broken, thus preventing local flooding.

Several designs of tamperproof hydrants have been developed in recent years. These have built-in or attached devices that discourage unauthorized use of the hydrant by requiring the use of special equipment for the removal of outlet caps or for operation of the valve-opening mechanism.

Use of nonthreaded-type (also known as Storz) connections on the fire hydrant pumper outlets, which allow the fire department to connect large-diameter supply hose (LDH) directly to the fire hydrant, is being adopted by an increasing number of hydrant users to replace the use of threaded-type pumper outlet connections. The nonthreaded connections used in the United States, either 4 or 5 in. nominal size, are fully engaged with a quarter-turn of one end, and, unlike their threaded counterparts, are “sexless” in that any two ends of the same size can be joined.

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Chapter **2**

Dry-Barrel Hydrants: Definitions and Preferred Nomenclature

A fire hydrant is a valving device connected to a water main. Fire hoses can be attached to outlet nozzles on the hydrant. The hydrant discharges water at a high rate, primarily for fighting fires.

TYPES OF DRY-BARREL HYDRANTS

Dry-barrel hydrants get their name from the fact that water is drained or pumped from the barrel when the hydrant is not in use. In a dry-barrel hydrant, a single main valve is located in the base of the hydrant adjacent to the inlet connection. In addition, the dry-barrel hydrant is equipped with an automatically operated drain valve. When the main valve is closed, the drain valve automatically opens, draining all water from the barrel of the hydrant. When the hydrant is opened, the drain valve automatically closes. The main valve is located below the normal frost line to protect the hydrant from freezing. This allows the dry-barrel hydrant to

be used almost anywhere, but it is especially suited to areas where freezing temperatures occur. Three variations of dry-barrel hydrants include the following types.

Compression Type

In this type of hydrant, the main valve moves reciprocally on a vertical axis against a seat located in the hydrant base. The valve moves against the seat to close and away from the seat to open. It is moved by a vertical stem; the stem moves up or down when the operating nut is rotated. The valve may be located below the seat and open against the pressure (Figure 2-1) or above the seat and open with the pressure (Figure 2-2).

Toggle Type

In this type of hydrant, the main valve moves reciprocally on a horizontal axis against or away from a vertical seat located in the base of the hydrant (Figure 2-3). The main valve is moved using a vertical stem that has left-hand and right-hand threads. Rotation of the stem causes the arms of the toggle mechanism to move the main valve. The valve moves away from the seat to open and against the seat to close. The main valve always opens with the pressure.

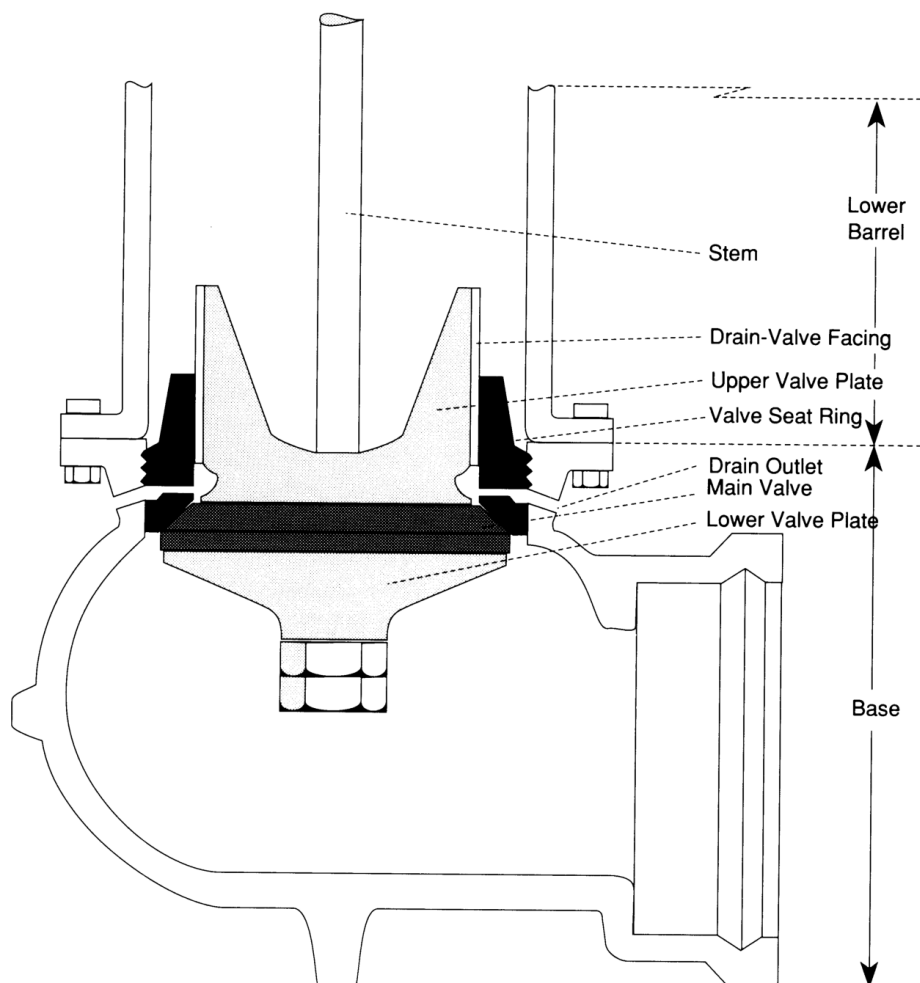


Figure 2-1 Compression-type hydrant, opens against pressure

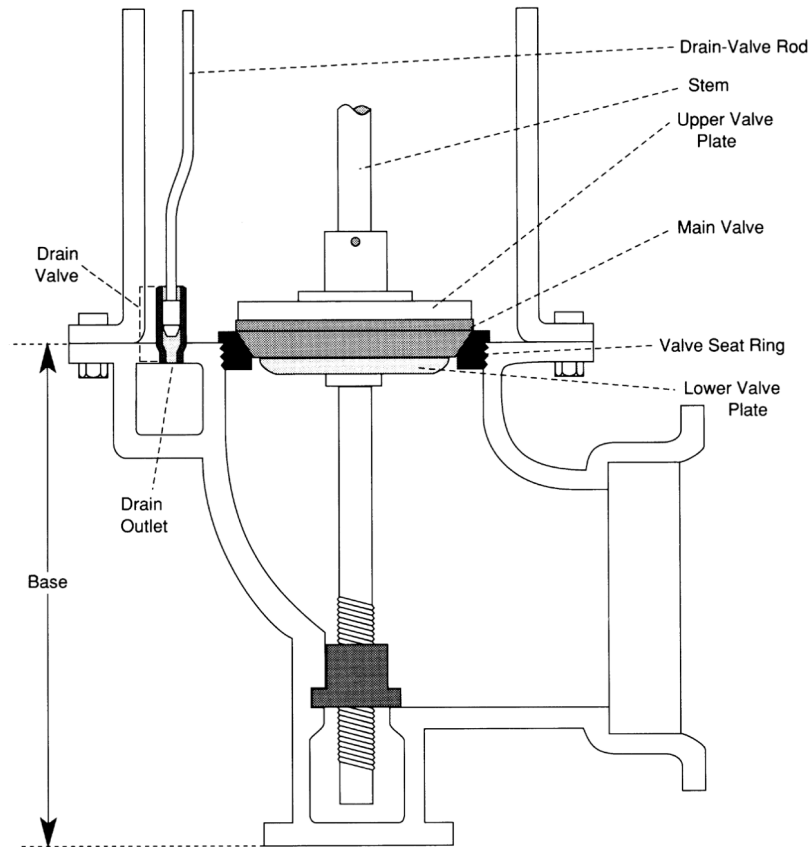


Figure 2-2 Compression-type hydrant, opens with pressure

Slide-Gate Type

In this type of hydrant, the main valve consists of a gate that moves vertically by means of a threaded stem. When the stem is rotated, it causes the internally threaded gate to move. The gate is forced against the valve seat by a wedging mechanism. The valve seat is installed in the base of the hydrant (Figure 2-4).

SPECIAL HYDRANTS

Flush Hydrants

Flush hydrants are designed and constructed for installation completely below the ground line. They are installed in pits, which are usually furnished with removable covers. They are intended for use in areas where post hydrants would interfere with vehicle or aircraft movement (Figure 2-5).

Frost-Jacket Hydrants

Frost-jacket hydrants have a sheath, or frost jacket, attached to the base and surrounding the lower barrel, extending up to the ground line (Figure 2-6). The frost jacket protects the hydrant from the effects of freezing and heaving of the ground by allowing several vertical inches of free movement of the ground, which shields the hydrant from stress and strain. The frost jacket feature simplifies maintenance and repair by holding back

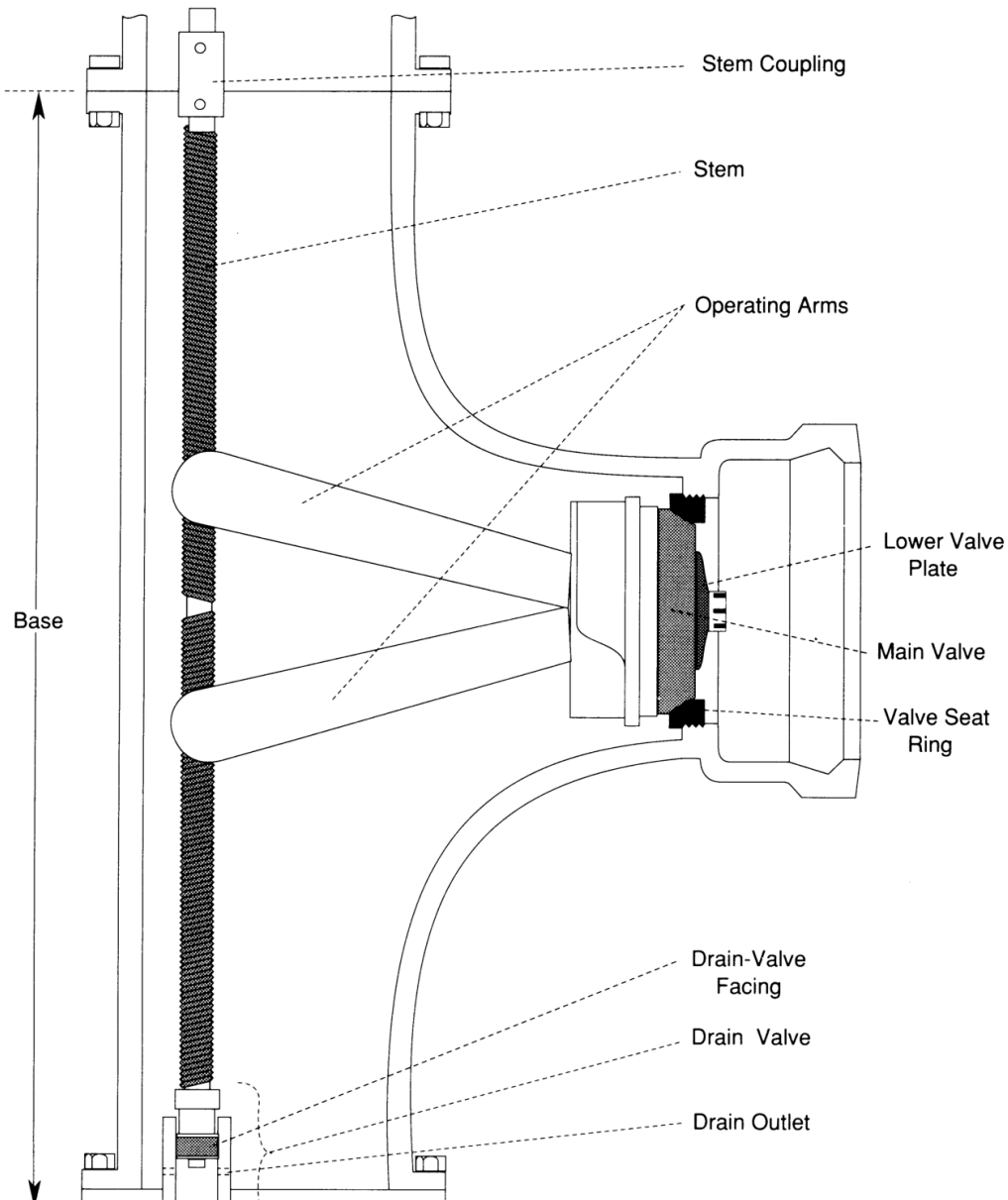


Figure 2-3 Toggle-type hydrant

the surrounding soil to allow the barrel and all of the working parts of the hydrant to be unscrewed, withdrawn as a single unit, repaired elsewhere, and then reinstalled.

High-Pressure Hydrants

High-pressure hydrants are designed and constructed for working pressures above 150 psig (1,034 kPa [gauge]). These hydrants are not within the scope of ANSI/AWWA C502 or ANSI/AWWA C503,* but are produced by several hydrant manufacturers. One design of high-pressure hydrant is the high-pressure pilot-valve hydrant. Other high-pressure hydrants manufactured in the United States and Canada are similar to standard hydrants but are strengthened in materials and design (Figure 2-7).

* ANSI/AWWA C502, *Dry-Barrel Fire Hydrants*; ANSI/AWWA C503, *Wet-Barrel Fire Hydrants*.

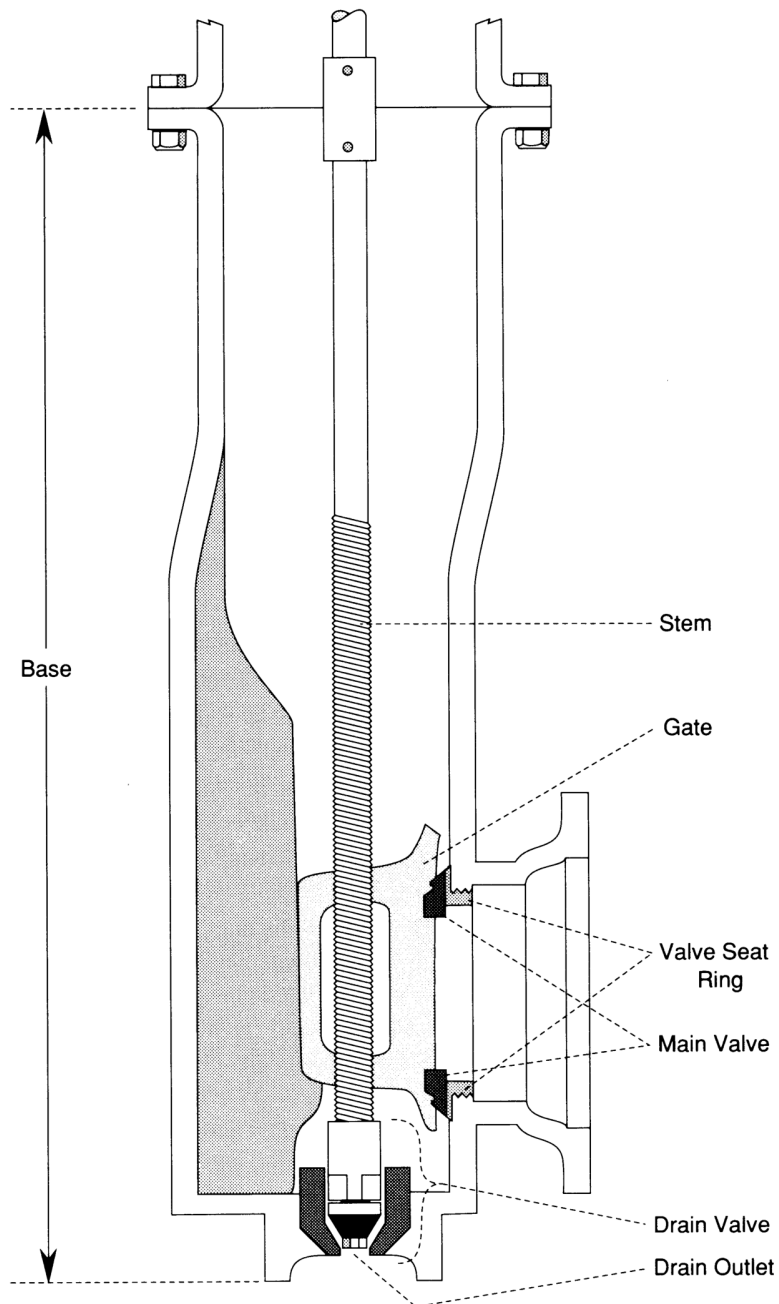


Figure 2-4 Slide-gate hydrant

High-Pressure Pilot-Valve Hydrants

These hydrants differ from other high-pressure hydrants in the design of the main valve. There is a small valve, or pilot valve, in the center of the main valve. The pilot valve opens before and in tandem with the main valve, equalizing pressure on both sides of the main valve with a controlled volume of water. This reduces operating torque in high-pressure applications, which makes the main valve easier to open. The pilot valve also greatly reduces the potential of hydrant vibration or chatter.

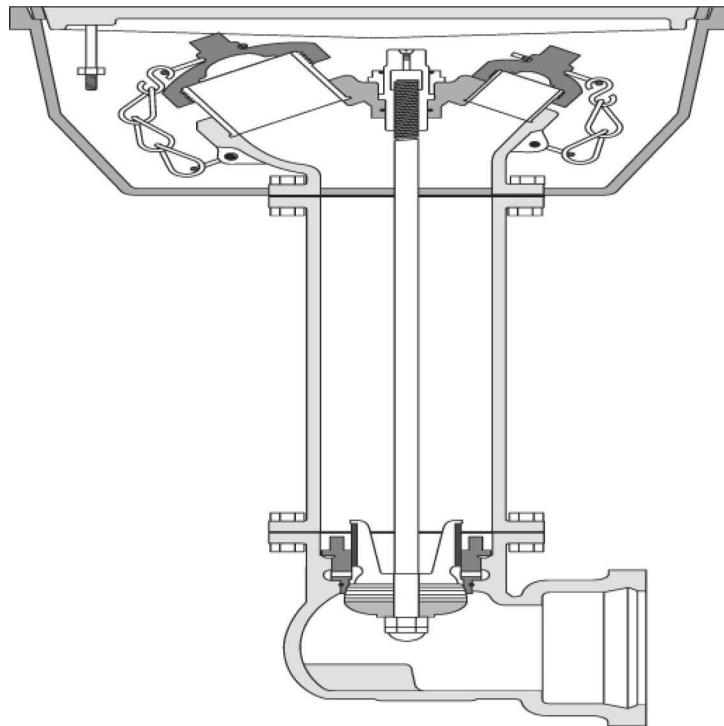


Figure 2-5 Flush hydrant

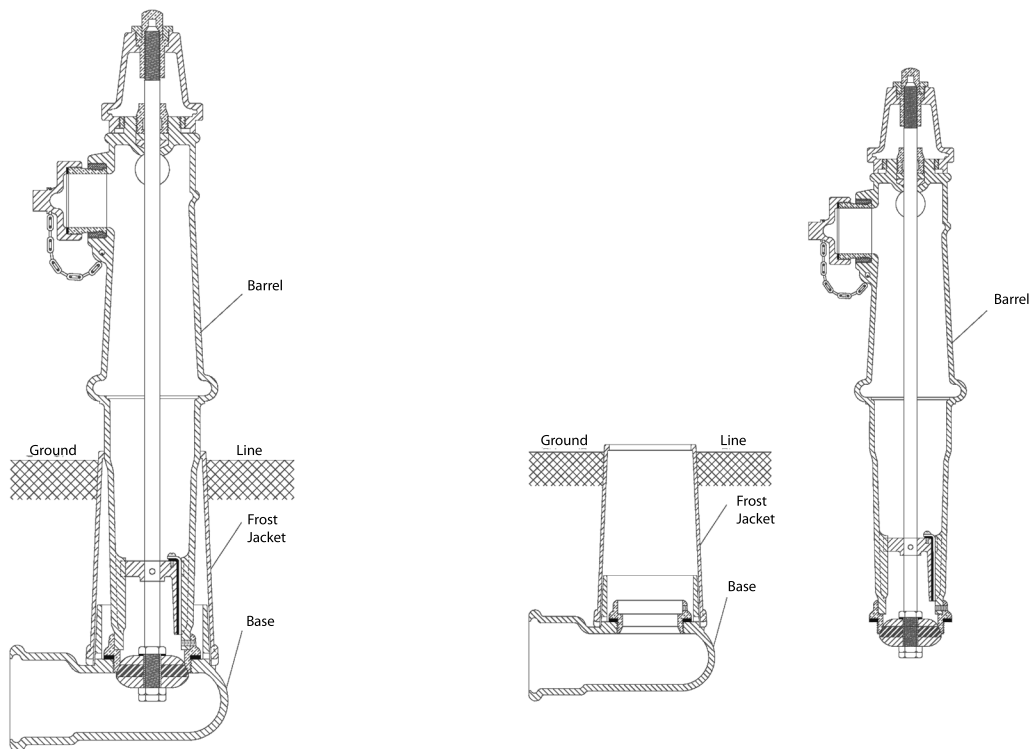


Figure 2-6 Frost-jacket hydrant

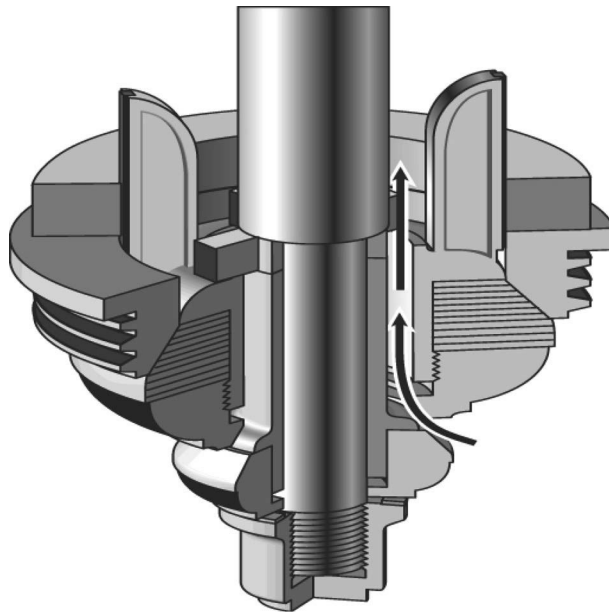


Figure 2-7 High-pressure pilot-valve hydrant

CONSTRUCTION TERMS FOR DRY-BARREL HYDRANTS

Direction to open: The direction in which the operating nut is rotated to open the hydrant: Open left is counterclockwise when viewed from above; open right is clockwise.

Dry-top: A compression-type hydrant in which the operating mechanism at the top of the hydrant is sealed from the barrel so that water does not come into contact with the mechanism during hydrant use.

Frost jacket or protection cover: A sheath that surrounds the barrel and extends from the bottom of the hydrant to the ground line. It is not used in hydrants currently produced.

Hose connection: An outlet to which 3-in. (7.6-cm) or smaller hose can be connected.

Hose gate: A gate valve attached to the hydrant outlet (see definition for *nozzle section* in Sec. Nomenclature for Dry-Barrel Hydrant Components). The attachment may be permanent or temporary. Note: Only gate valves that require several turns of the operating handle to open or close should be used as hose gates.

Main valve opening: The inside diameter of the valve seat ring. Also referred to as the *valve opening*.

No-drain hydrant: A dry-barrel hydrant that is not equipped with a drain valve, or one in which the drain outlets have been plugged. Such hydrants are generally used where the groundwater level may be above the level of the drain outlets to protect against water freezing. No-drain hydrants must be pumped out or otherwise emptied of water after each use.

Pipe connection: The inlet of the hydrant at which connection is made to the hydrant lead.

Post hydrant: Any hydrant that extends above the ground line, with the pumper or hose connection above the ground line. (All hydrants are post hydrants, except flush hydrants. See *flush hydrants* in Sec. Types of Dry-Barrel Hydrants.)

Pumper connection: An outlet to which a hose 3½ in. (8.9 cm) or larger can be connected.

Traffic model: A hydrant designed and constructed so that, if it is struck by a vehicle, certain easily replaceable components will break and allow the upper portion (above the ground line) to become detached from the lower portion (below the ground line). The belowground section will remain intact and undamaged. It is designed so that the main valve remains closed after impact to prevent interruption of the water supply and minimize injury to persons and property.

Wet top: A compression-type hydrant in which the operating mechanism at the top of the hydrant is not sealed from the water when the hydrant is opened.

INSTALLATION TERMS FOR DRY-BARREL HYDRANTS

Auxiliary valve: A gate valve or other type of valve that is installed in the pipe that connects the hydrant to the water main (that is, the hydrant lead). The auxiliary valve can be closed to isolate the hydrant. It is also called the *hydrant gate* or *hydrant control valve*.

Bury: The nominal vertical distance between the ground line and the bottom of the pipe connected to the hydrant inlet, measured to the nearest 6-in. (15.2-cm) increment.

Cover: The nominal vertical distance between the ground line and the top of the pipe connected to the hydrant inlet, measured to the nearest 6 in. (15.2 cm) increment. (Use of this measurement is discouraged in favor of the word *bury*.)

Ground line: The nominal elevation to which the hydrant barrel is buried during installation.

Hydrant gate: See *auxiliary valve*.

Hydrant lead: The pipe connecting the hydrant to the water main. The hydrant lead is also called the *branch* or *lateral*.

Trench: See *bury*.

NOMENCLATURE FOR DRY-BARREL HYDRANT COMPONENTS

The preferred nomenclature for dry-barrel hydrant components was determined by the manufacturers' representatives on the AWWA Standards Committee on Fire Hydrants. This preferred nomenclature was developed to clarify the names of hydrant components for hydrant users. Figures 2-1 through 2-9 indicate the preferred nomenclature for several types of dry-barrel hydrants.* It should be noted that these figures are composites and do not represent a particular manufacturer's product. The following list gives the preferred name for each part and a brief description of each part. Components are listed in numerical order by reference number. Because of differences in each hydrant brand, not all components are identical or comparable by term. Some hydrants contain components that are unique to that hydrant. Therefore, some hydrants have components for which there is no preferred term.

Base: A part that provides a lateral connection to the hydrant lead and directs the flow vertically upward into the lower barrel. Also called *shoe*, *bottom*, *boot*, *elbow*.

* Of course, all hydrants do not include the same components. The diversity of components and the manufacturers' various names for each component can make for confusion. Appendix A consists of a series of drawings and parts lists for dry-barrel and wet-barrel hydrants produced by several manufacturers. Most parts indicated on each drawing are given the part number and name supplied by the manufacturer.

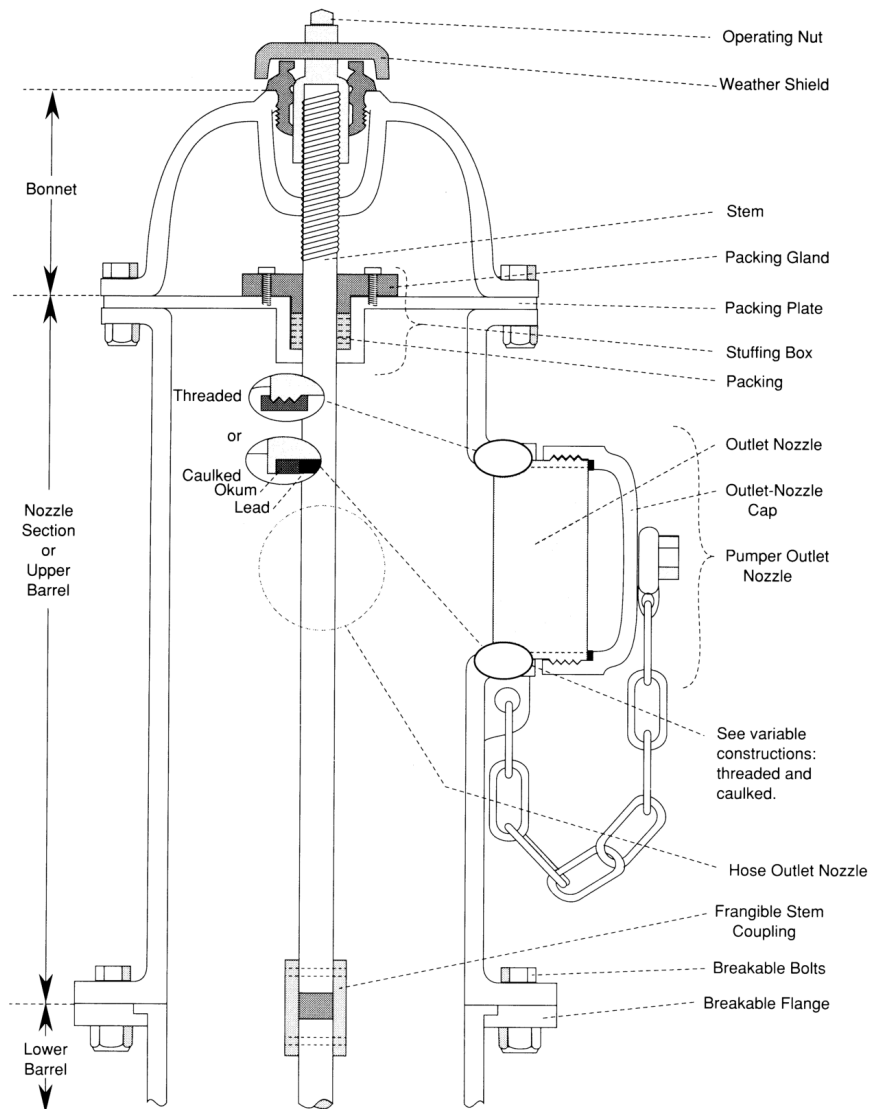


Figure 2-8 Composite dry-barrel breakaway type hydrant upper barrel: compression packing gland type

Bonnet: A part that attaches to the top of the nozzle section and encloses the support portions of the operating mechanism. It may be integral with the nozzle section. Also called *hydrant cap, cover*.

Breakable barrel coupling: A coupling used to fasten the upper barrel to the lower barrel. It is designed to break if stressed severely, such as by a vehicle striking the hydrant. Also called *frangible standpipe coupling*.

Breakable bolt: Bolts used to fasten the upper barrel to the lower barrel. Breakable bolts are designed to break if stressed severely, such as by a vehicle striking the hydrant. Also called *frangible bolt*.

Breakable flange: A part that bolts to a mating flange at a joint between the hydrant upper and lower barrels. The mating flange joint is located immediately above the ground line. It is designed to break if stressed severely, such as by a vehicle striking the hydrant. Also called *breakaway flange, traffic flange*.

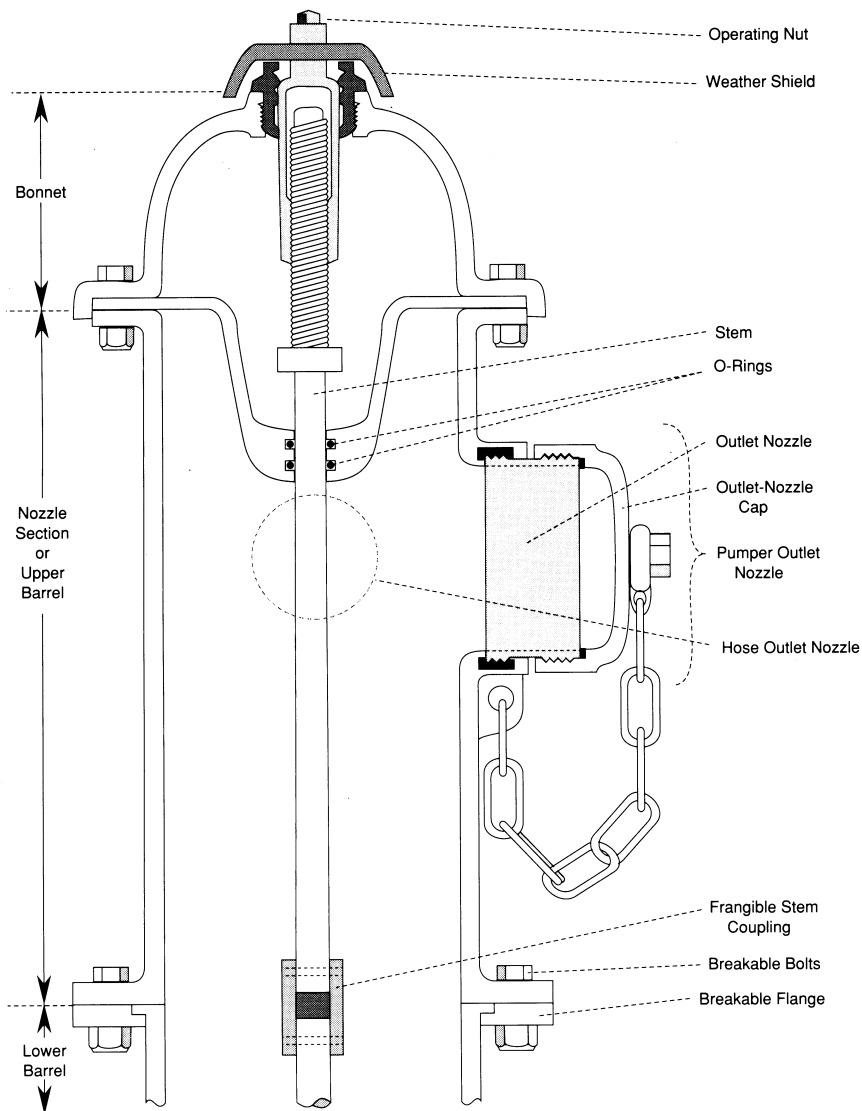


Figure 2-9 Composite dry-barrel hydrant upper barrel; compression O-ring seal type

Drain outlet: The opening in the base (or adjacent part of the base) through which water escapes to the ground when the drain valve is open. Also called *drain bushing*, *drip tubing*, *drain-hole liner*, *drain cup*.

Drain valve: A valve located at or adjacent to the valve seat ring. The drain valve opens automatically when the main valve is closed; this allows water to drain from the barrel into the ground. In like fashion, the drain valve closes automatically when the main valve is opened. The mechanism is usually designed so that, when the main valve is opened, the drain valve closes completely after only one to five turns of the operating nut.

Frangible stem coupling: A stem coupling designed to break if it is stressed severely, such as by a vehicle striking the hydrant. Also called *breakable coupling*, *frangible valve-rod coupling*.

Gate: A part that supports the main valve. It is moved, first horizontally and then vertically, to open or close the main valve opening in a slide-gate hydrant. Also called *main gate*.

Hose gate: A valve that can be attached to a hose outlet nozzle or secured to the nozzle section. The hose gate is furnished with hose threads or is otherwise formed to permit attachment of a fire-hose coupling. The hose gate is normally opened and closed by a rotating valve handle; the hose gate is used to control the flow of water from the hydrant when the main valve is open. (The main valve should never be used to control hydrant flow; such use could damage the hydrant or hydrant installation.) Also called *hose valve*.

Hose outlet nozzle: An outlet nozzle that has an opening that is 3 in. (7.6 cm) or smaller in diameter and is suitable for attachment of a 3-in. (7.6-cm) or smaller fire hose.

Gland bushing: A part that is used to line a gland.

Lower barrel: A part that extends from the base to the ground line, enclosing the stem. The lower barrel conducts water from the base to the upper portion of the hydrant. Also called *standpipe*.

Lower valve plate: A part that is positioned below the main valve and clamps the main valve against the upper valve plate. Also called *lower valve washer*, *valve-ball bottom*, *lower cap nut*, *bottom plate*.

Main valve: A part made of rubber, leather, balata gum, or a similar resilient material; the main valve is forced against a seat to form a watertight seal when the hydrant is closed. Also called *valve*, *valve rubber*, *valve-ball rubber*, *valve seat*, *valve gasket*, *valve disc*.

Nozzle section: A part that extends upward from the barrel and contains the outlet nozzles. It may be integral with the upper barrel. (When the nozzle section is integral with the upper barrel, the part may be referred to as the *upper standpipe* or *upper barrel*. This is not preferred nomenclature.)

Operating nut: An external hydrant part that is turned by a hydrant wrench to rotate the stem nut or stem; it may be integral with the stem nut or stem.

Outlet nozzle: The outlet nozzle is secured in the nozzle section and has an opening through which water can be discharged. The outlet nozzle is threaded or otherwise formed to permit attachment of a fire-hose connection. Also called *nozzle*, *spud*.

Outlet-nozzle cap: A cap that is attached to an outlet nozzle and covers the nozzle opening. The cap is furnished with a nut or other means to permit the application of force adequate to firmly attach it to or remove it from the outlet nozzle.

Packing gland: A part that compresses packing rings in a stuffing box. Also called *packing pusher*.

Packing plate: A part that partitions the interior of the hydrant and contains or supports a stuffing box or other means of sealing one compartment from another. Also called *seal plate*, *support ring*.

Pumper outlet nozzle: An outlet nozzle with an opening at least 3½ in. (8.9 cm) in diameter, suitable for attachment of a 3½-in. (8.9-cm) or larger fire hose. Also called *steamer nozzle*, *steamer connection*, *pumper nozzle*, or *pumper connection*.

Seat-ring insert: A part with internal threads that is secured and sealed to the hydrant base. The internal threads engage with the external threads on the valve seat ring. The seat-ring insert may also serve as a part of the drain system. Also called *drain ring*, *retainer ring*, *upper*.

Stem: A part of the operating mechanism that extends down to the main-valve assembly and moves the main valve to close or open the hydrant. The stem is often in two parts, particularly in a traffic model: the upper stem and the lower stem. Also called *upper rod*, *lower rod*.

Stem nut: A part that internally threaded and engages with threads on the stem so that when the part is rotated, or when the stem is rotated and the stem nut is stationary, the stem is raised or lowered to move the valve. Also called *operating nut*, *operating stem nut*, *revolving nut*.

Stem coupling: A part that joins the portions of a two-part stem. Also called *rod coupling*.

Stop nut: A part that is permanently threaded or otherwise attached to the stem and limits the vertical travel of the stem. Also called *stem stop*, *travel-stop nut*.

Stuffing box: A cylindrical cavity that surrounds the stem and contains a number of packing rings used to prevent leakage along the stem. The stuffing box may be an individual component or a portion of another component. Also called *packing box*.

Upper barrel: A part that extends from the lower barrel at the ground line to the nozzle section, enclosing the stem. It may be integral with the nozzle section. Also called *upper standpipe*. (When the upper barrel is an integral part of the nozzle section, then the term *nozzle section* would incorporate the term *upper barrel*.)

Upper valve plate: A support for the main valve, positioned above the valve. The upper valve plate may also serve as the portion of the drain valve that is moved when the stem rotates. It may also serve as the means to prevent rotation of the valve, stem, and associated parts. Also called *top plate*, *upper valve washer*, *valve-ball top*, *valve top plate*, *valve plate*, *hydrant-valve top*.

Valve seat ring: A part threaded into and sealed to the hydrant base (or associated part adjacent to the base). The main valve is forced against the valve seat ring to close the hydrant. Also called *seat ring*, *valve seat*.

Weather shield: A part that forms a skirt above and surrounding the opening in the hydrant top through which the stem, stem nut, or operating nut protrudes. It may be integral with the operating nut. Also called *weather cap*.

AUXILIARY COMPONENTS FOR DRY-BARREL HYDRANTS

In addition to standard hydrant components and equipment used in the construction and installation of hydrants, the following auxiliary components are sometimes used.

Backflow from standpipe drains: In some instances, local authorities may require a means to prevent backflow of groundwater from hydrant drains into the water system. Where groundwater levels may be above the level of the hydrant lead, no-drain hydrants should be specified and installed. Backflow preventers in the drain connection or the hydrant lead are not considered practical.

Contamination security devices: When hydrants are used to provide water to a nonpotable water container, such as a tank truck that is used for a water source for a high-velocity sewer cleaner, a backflow-prevention device consistent with the degree of hazard must be used. These devices are often coupled with a flowmeter, which may extend the service connection location some distance from the connection of the hardware with the hydrant. Service connection hardware must be adequately and independently supported to avoid creating excessive loads on the outlet nozzle. A check valve located between the water supply system and hydrant inlet may also be used to protect against backflow of contaminants from a hydrant into the supply system.

Hydrant meters: Portable flowmeters that can be attached to a hose nozzle to measure the flow rate or the total flow over a period of time.

Independent hose gates: Hose gate valves include bolt-on and thread types. The bolt-on type joins the nozzle section using a standardized two-bolt flange. The thread-on type joins the hose nozzle using a swivel coupling (Figures 2-10 and 2-11).

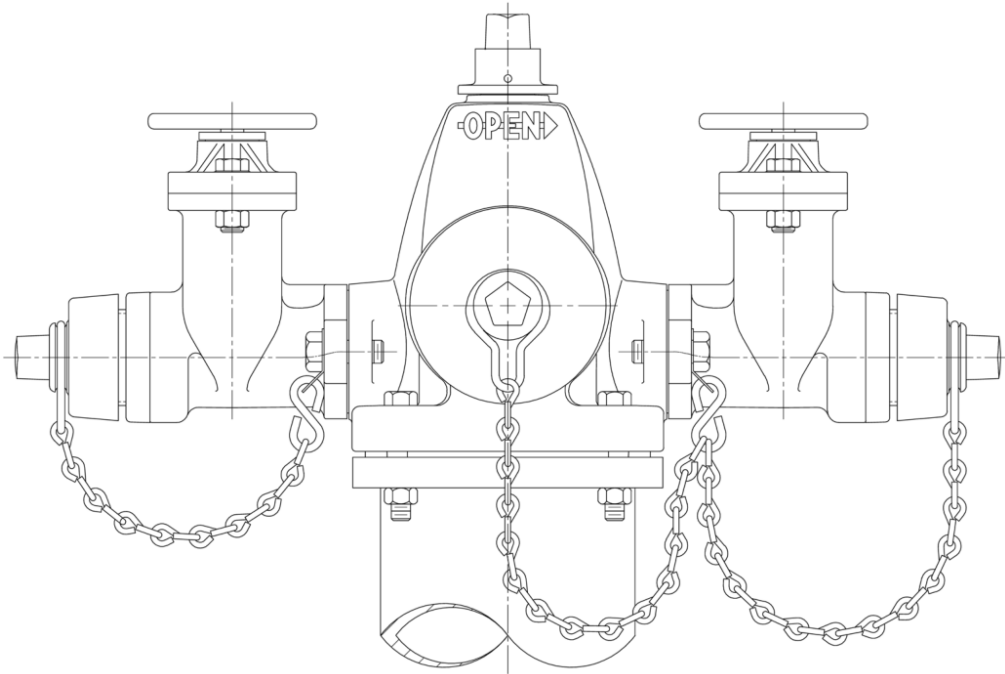


Figure 2-10 Bolt-on independent hose gate valves

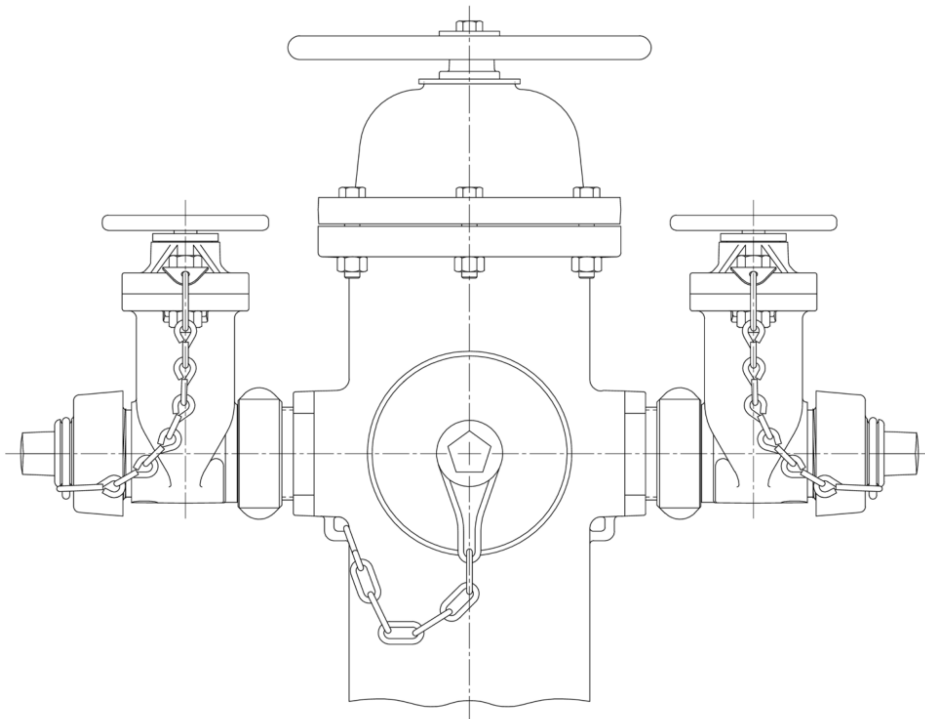


Figure 2-11 Thread-on independent hose gate valves

Service connections: Although fire hydrants are primarily intended to be used to supply water for firefighting, they are also commonly used as a water supply for utilitarian purposes. Note that for utility water supply service that includes use of the hydrant for extended periods of time with the main valve open, plugging the drains may be needed to protect the hydrant drain valve from damage.

MISCELLANEOUS AND OBSOLETE HYDRANT TERMS

Higbee cut: The abrupt termination of the outermost thread on a threaded outlet that reduces the likelihood of cross threading a coupling.

Steamer connection: A term formerly used for *pumper connection*. See *pumper connection* in Sec. Construction Terms for Dry-Barrel Hydrants.

Chapter **3**

Wet-Barrel Hydrants: Definitions and Preferred Nomenclature

WET-BARREL HYDRANTS

Wet-barrel hydrants are used in areas where freezing temperatures are rare and not persistent. Unlike a dry-barrel hydrant, a wet-barrel hydrant does not have a main valve. Instead, the barrel is full of water and pressurized as long as the lateral piping to the hydrant is under pressure and the auxiliary valve ahead of the hydrant is open. In other words, under normal operating conditions, the entire interior of the hydrant is subjected to water pressure at all times. Each outlet nozzle has an independent valve that controls discharge from that particular outlet.

SPECIAL HYDRANTS

High-pressure hydrants: High-pressure hydrants are designed and constructed for a working pressure above 150 psig (1,034 kPa [gauge]). These hydrants are not within the scope of ANSI/AWWA C502 or ANSI/AWWA C503, but they are produced by several hydrant manufacturers and used by several utilities.

CONSTRUCTION TERMS FOR WET-BARREL HYDRANTS

Direction to open: The direction in which the operating nut is rotated to open the valve on a given outlet: Open left is counterclockwise when viewed facing the operating nut; open right is clockwise.

Hose connection: An outlet to which 3-in. (7.6-cm) or smaller hose can be connected.

Hose gate: A gate valve attached to a hydrant outlet. The attachment may be permanent or temporary. Temporary attachments are made with threaded outlets. Note: Only gate valves that require several turns of the operating handle to open or close should be used as hose gates.

Pipe connection: The inlet of the hydrant where the connection is made to the hydrant lead.

Post hydrant: Any hydrant that extends above the ground line with the pumper or hose connection above the ground line. (All hydrants are post hydrants, except flush hydrants. See *flush hydrants* in Sec. Types of Dry-Barrel Hydrants in chapter 2.)

Pumper connection: An outlet to which a hose 3½ in. (8.9 cm) or larger can be connected.

Valve opening: The inside diameter of the valve seat ring.

INSTALLATION TERMS FOR WET-BARREL HYDRANTS

Auxiliary valve: A gate valve or other type of valve that is installed in the pipe that connects the hydrant to the water main (that is, the hydrant lead). The auxiliary valve can be closed to isolate the hydrant. It is also called the *hydrant gate*.

Bury: The nominal vertical distance between the ground line and the bottom of the pipe connected to the hydrant inlet, measured to the nearest 6-in. (15.2-cm) increment.

Cover: The nominal vertical distance between the ground line and the top of the pipe connected to the hydrant inlet, measured to the nearest 6-in. (15.2-cm) increment. (Use of this term is discouraged in favor of the word *bury*.)

Ground line: The nominal elevation to which the hydrant barrel is to be buried during installation.

Hydrant gate: See *auxiliary valve*.

Hydrant lead: The pipe connecting the hydrant to the water main. The hydrant lead is also called the *branch* or *lateral*.

Trench: See *bury*.

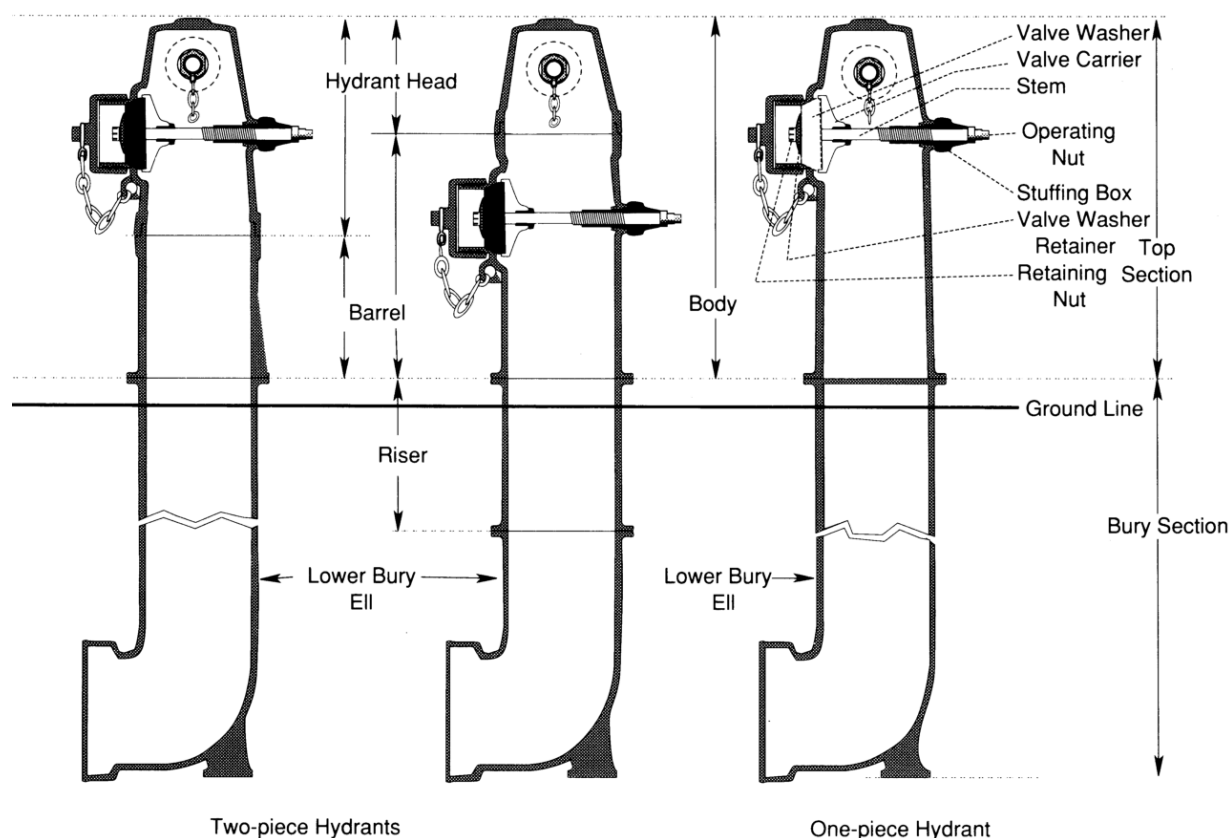


Figure 3-1 Composite wet-barrel hydrants

NOMENCLATURE FOR WET-BARREL HYDRANT COMPONENTS

The preferred nomenclature for wet-barrel hydrant components was determined by the manufacturers' representatives on the AWWA Standards Committee on Fire Hydrants. This preferred nomenclature was developed to clarify the names of hydrant components for hydrant users. Figure 3-1 indicates the preferred nomenclature for three types of wet-barrel hydrants.* It should be noted that these diagrams are composites and do not represent a particular manufacturer's product. The following list gives the preferred name for each part and a brief description of each part. Because of differences in each hydrant brand, not all components are identical or comparable by term. Some hydrants may have unique components for which no preferred term has been assigned.

Barrel: The lower portion of the top section of a two-piece hydrant. Also called *spool*, *lower body*.

Body: The aboveground section of a one-piece hydrant. Also called *body head*.

Bury section: The belowground section of the hydrant, constructed either of a single piece (lower bury ell) or two pieces (lower bury ell and riser).

Hose outlet nozzle: An outlet nozzle that has an opening smaller than 3½ in. (8.9 cm) in diameter and is suitable for attachment of a fire hose. This connection is commonly 2½ in.

* Of course, all hydrants do not include the same components. The diversity of components, and the manufacturers' various names for each component, can make for confusion. Appendix A consists of a series of drawings and parts lists for wet-barrel and dry-barrel hydrants produced by several manufacturers. Most parts indicated on each drawing are given the part number and name supplied by the manufacturer.

(6.4 cm). The inside of the hose outlet nozzle is machined to form a seating surface for the valve washer. Also called *hose valve nozzle, seat, outlet*.

Hydrant head: The upper portion of the top section of a two-piece hydrant. This portion contains valve mechanisms and outlet valves. Also called *body head, top section*.

Lower bury ell: A part that connects the top section or riser of a wet-barrel hydrant to the hydrant lead.

Outlet-nozzle cap: A part that is attached to an outlet nozzle and covers the nozzle opening. The cap is furnished with a nut or other means to permit the application of force to firmly attach it to or remove it from the nozzle. Also called *pro-cap, hose cap*.

Pumper outlet nozzle: An outlet nozzle with an opening at least 3½ in. (8.9 cm) in diameter, suitable for attachment of a 3½-in. (8.9-cm) or larger fire hose. The inside is machined to form a seating surface for the valve washer. Also called *outlet, seat*.

Retaining nut: A threaded hexagonal nut used to secure the parts of the valve assembly together on the stem and to prevent the valve assembly from becoming loose. The retaining nut may contain slots for insertion of a cotter pin or similar device. Also called *disc retaining nut, nut, slotted nut*.

Riser: A section of pipe used to vertically extend a lower bury ell. Also called *midsection, standpipe*.

Stem: The part that extends to the outside of the hydrant top section and is rotated with a hydrant wrench to move the valve washer away from or toward the valve seat. Also called *valve stem*.

Stem bushing: An internally threaded, stationary part that engages the threads on the stem so that when the stem is rotated, the valve assembly is moved to close or open the hydrant.

Stuffing box: A cylindrical cavity that surrounds the stem and contains a number of packing rings or O-rings used to prevent leakage along the stem. The stuffing box may be an individual component or a portion of another component. Also called *stem sleeve, insert, stem guide*.

Top section: The aboveground portion of the hydrant, constructed as a single piece or as a two-piece unit.

Valve carrier: A part that supports the valve washer from the pressure side. The valve carrier is supported by and fits on the stem. Also called *carrier, disc holder*.

Valve seat: A part that is secured and sealed to the nozzle. The valve washer is forced in order to close the hydrant. The valve seat may be integral with the outlet nozzle. Also called *seat ring*.

Valve washer: A part made of rubber, leather, or similar resilient material that is forced against the valve seat to form a watertight seal when the valve is closed. Also called *valve rubber, disc, valve insert*.

Valve-washer retainer: A part carried by the stem that is in front of the valve washer and is used to retain the valve washer against the valve carrier. Also called *retainer*.

AUXILIARY COMPONENTS FOR WET-BARREL HYDRANTS

Break-off check valve: The interior of a wet-barrel fire hydrant is exposed to the distribution system water pressure, which may result in catastrophic leakage if the hydrant is damaged by an impact from a vehicle. A break-off check valve is a device that is designed to close in cases of vehicular impact and provides protection from catastrophic leakage (Figure 3-2).

MISCELLANEOUS AND OBSOLETE HYDRANT TERMS

Higbee cut: The abrupt termination of the outermost thread on a threaded outlet that reduces the likelihood of cross threading a coupling.

Steamer connection: A term formerly used for *pumper connection*. See *pumper connection* in Sec. Construction Terms for Wet-Barrel Hydrants.

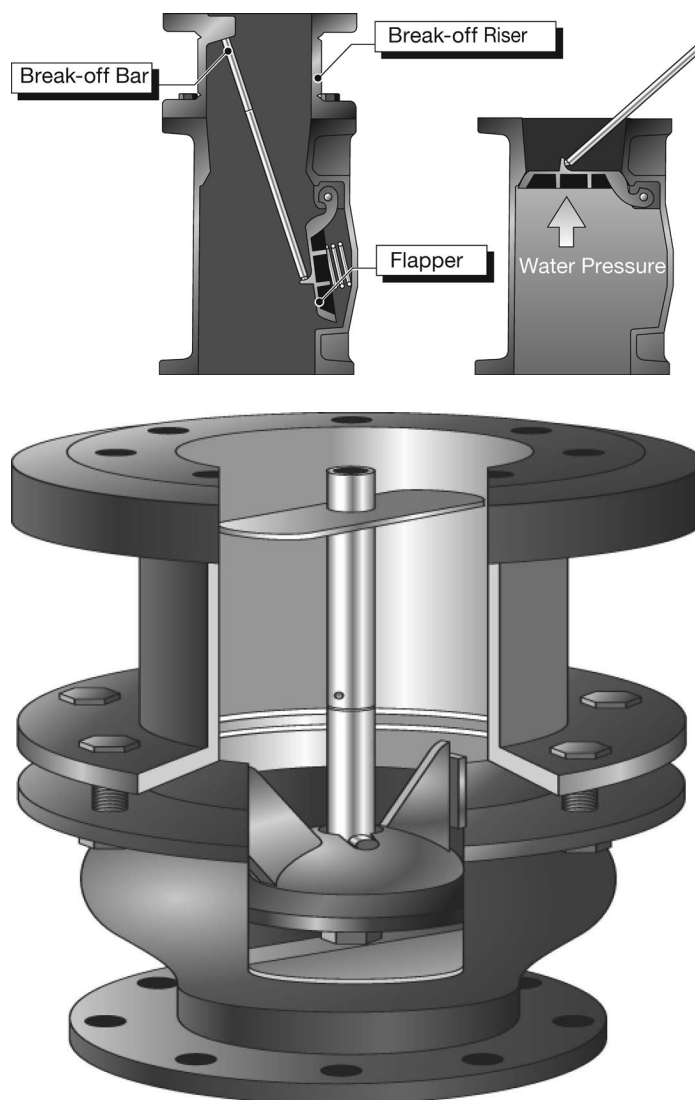


Figure 3-2 Examples of break-off check valves (NOTE: upper left is normal; the device in the upper right is following a vehicular impact)

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Chapter **4**

Inspection, Installation, Testing, and Placing the Hydrant in Service

The fire hydrant is one of the most important parts of a water distribution system but is often one of the most ignored. Hydrants stand idle for long periods and are subject to the effects of weather and the elements and are vulnerable to damage, but they are expected to work well in emergencies. To ensure that hydrants will operate correctly when they are needed, the proper procedures must be followed when they are inspected, installed, tested, and maintained.

WARNING: This manual does not identify health and safety hazards that may be associated with performing tasks described herein. At a minimum, the individuals performing these actions must abide by Occupational Safety and Health Administration (OSHA) regulations as well as any applicable federal and/or safety regulations.

INSPECTION PRIOR TO INSTALLATION

Hydrants should be inspected at the time of delivery to verify compliance with specifications and to check for damage during shipment. Specifications to be checked during the initial inspection include the size and shape of the operating nut and its direction to open, depth of bury, size and type of inlet connection, size of the main valve (for a dry-barrel

hydrant) or valve washer (for a wet-barrel hydrant), outlet-nozzle sizes and configuration, and thread style.

The hydrant should be cycled to full open and full closed positions to ensure that no internal damage or breakage has occurred during shipment and handling. All external bolts should be checked for tightness.

Shortly after delivery, hydrants should be pressure and leak tested on a statistically sampled basis. It is not uncommon for outlet nozzles and pressure bolting to loosen as a result of handling during shipping and storage. Loose nozzles or pressure bolting may cause leakage during a pressure test. Tightening the flange bolting, caulking of leaded-in nozzles, and tightening of threaded-in nozzles will prevent or eliminate minor leaks. In most cases, tightening is all that is needed to achieve a satisfactory pressure test.

After inspection, the hydrant valve should be closed and the outlet-nozzle caps replaced to prevent the entry of foreign matter. Hydrants should be stored with the inlets facing down. Whenever possible, hydrants in storage should be protected from the effects of weather and the elements.

Hydrants should be reinspected just before installation.

INSTALLATION

Following proper procedures ensures correct installation and should result in a lower maintenance cost. Refer to ANSI/AWWA C600, Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances, for a detailed description of proper installation and testing methods. Typical hydrant installations are illustrated in Figures 4-1 and 4-2. The following recommendations are in accordance with ANSI/AWWA C600:

1. Connect fire hydrants only to water mains adequately sized to handle fire flows.
2. Install hydrants as plumb as possible.
3. Locate fire hydrants in accordance with the applicable fire code, the requirements of the local fire authority, or the applicable municipal design standard.
4. Unless otherwise required by item 3, ensure hydrants are installed far enough away from the curb to avoid damage from or to vehicles as they turn. The recommended setback is 2 ft (0.6 m) minimum from the face of the curb to the point on the hydrant nearest to the curb.
5. The pumper outlet nozzle should face the street to enable a quick connection to the fire pumper.
6. Make sure that the outlet nozzles are high enough (at least 18 in. [46 cm]) above the ground line to allow for attachment of hoses and operation of the hydrant wrench. There should be no obstructions that prevent or retard hydrant operation or hinder removal of outlet-nozzle caps.
7. Always install an auxiliary valve between the hydrant and the supply main to permit isolation of the hydrant for maintenance purposes.
8. Provide thrust restraint for the auxiliary valve so that the hydrant may be removed without shutting down the main.
9. Remove foreign matter from the hydrant lead before installing the auxiliary valve and hydrant.
10. Locate the auxiliary valve as close to the main as possible.
11. In setting a hydrant use a firm footing, such as stone slabs or a concrete base on firm ground, to prevent settling and strain on the hydrant lead joints.

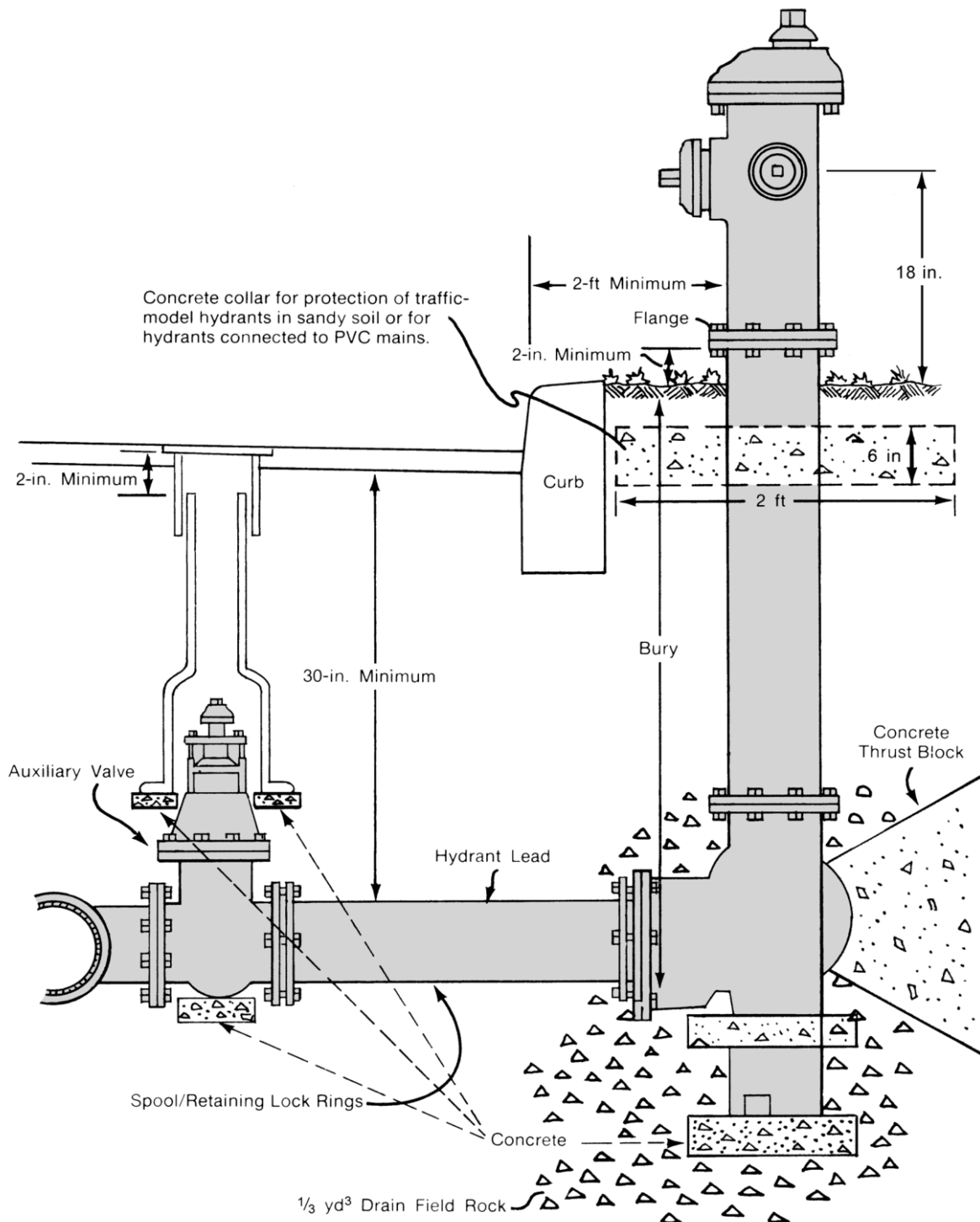


Figure 4-1 Typical dry-barrel hydrant installation. (Thrust blocks and other elements are shown for illustrative purposes only and are not intended to represent details of a properly engineered restraining system.)

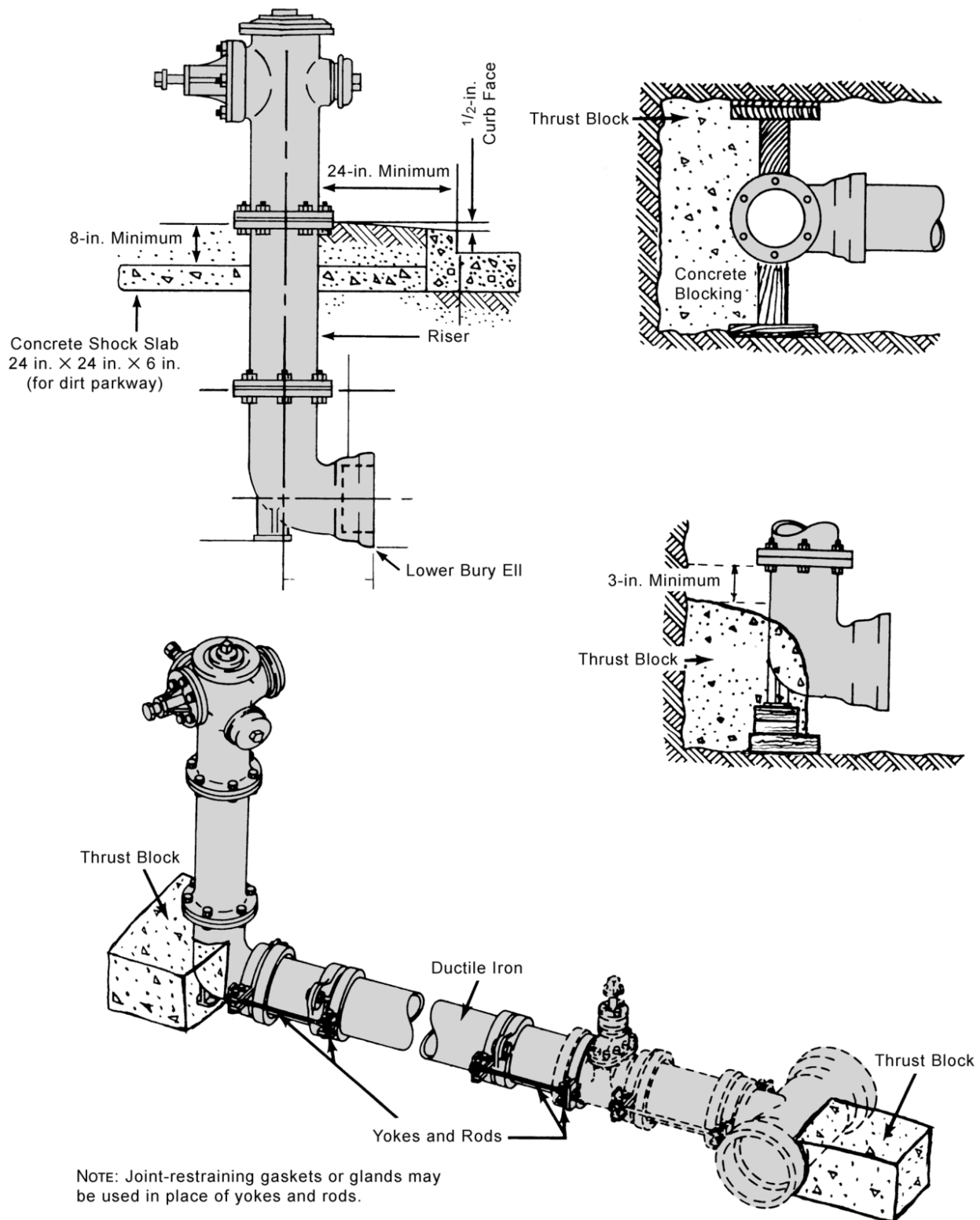


Figure 4-2 Typical wet-barrel hydrant installation. (Thrust blocks and other elements are shown for illustrative purposes only and are not intended to represent details of a properly engineered restraining system.)

12. Provide for thrust restraint of the hydrant by strapping, blocking, or using a restraining type of joint. See Figure 4-3 for examples of restraints.
13. When pouring thrust blocks for dry-barrel hydrants with drains, exercise care not to plug or block the drain holes.
14. Install traffic hydrants with extra care to ensure that there is adequate soil resistance to avoid transmitting shock to the hydrant's lower barrel and hydrant inlet. In loose or poor load-bearing soil, it is suggested that a concrete collar, about 6 in. (150 mm) thick, with a diameter of 2 ft (0.6 m), be installed around the hydrant lower barrel at or near the ground line. When installing hydrants on a PVC main, the concrete collar is of extra importance. In areas of substantial frost penetration, expansion-joint material should be placed between the hydrant and the collar.
15. When installing hydrants on PVC mains, the hydrant lead should be made of the same material as the main. This will help to protect the main from damage if the hydrant is hit during a traffic accident. (If the breakable portion of the hydrant fails to function properly, the hydrant lead could be broken. If the hydrant lead was ductile cast iron and the main line was PVC, the main could be damaged.)
16. Provide for drainage from dry-barrel hydrants. One acceptable method is to excavate the area around the hydrant base, then place about $\frac{1}{3}$ yd³ (0.25 m³) of clean stone to a level 6 in. (150 mm) above the drain outlets. The stone should extend at least 1 ft (0.3 m) on all sides of the hydrant. To keep the drainage pit from clogging, the stone should be covered with 8-mil (0.2-mm) polyethylene or similar waterproof material before backfilling. This practice permits ready hydrant drainage after use.
17. When a hydrant is installed in an area with a high water table, it may be necessary to plug the drain outlets.
18. Hydrants with plugged drain outlets must be marked as such and pumped dry after each use to protect them from freezing.
19. Do not connect hydrant drains to a sanitary sewer or storm sewer.
20. In rural areas where no curb exists, use large setbacks or other means to protect hydrants from traffic, always ensuring that the hydrant is accessible to firefighting equipment.
21. The adoption of a color scheme to indicate flow capacity is optional. However, if such a scheme is used, the uniform color-coding system shown in Table 4-1 is recommended. According to this system, hydrant tops and caps are painted to indicate the hydrant's expected flow rate. This color scheme is consistent with NFPA 291, Recommended Practice for Fire Flow Testing and Marking of Hydrants.*

Table 4-1 Color scheme to indicate flow capacity

Flow		Color
<i>gpm at 20 psig*</i>	<i>L/sec at 140 kPa*</i>	
Greater than 1,500	60	Light blue
1,000–1,499	60	Green
500–999	30–60	Orange
Less than 500	30	Red

* This is the calculated flow at a calculated residual of 20 psi (140 kPa) and with the actual residual on an adjacent nonflowing hydrant being 40 psi (280 kPa) or greater. When the actual observed residual on the adjacent nonflowing hydrant is less than 40 psi (280 kPa), the color scheme should be based on one half of the observed flow. An alternative scheme for color coding may be related to the size of the water main supplying the hydrant.

* National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

22. Hydrants must be highly visible and unobstructed at all times. Therefore, whether or not a color code is used, hydrants should be painted with colors that are easily visible both day and night.
23. Hydrants installed as part of new main construction can be disinfected by opening and closing the main valve during the disinfection of the main. The hydrant should be flushed after disinfection of the main valve to remove the high concentration of chlorine solution.
24. Hydrants installed on an existing main should be disinfected before installation. This may be accomplished by spraying a solution of 300 mg/L chlorine into the hydrant inlet and through the outlet-nozzle openings. The chlorine solution should be flushed from the hydrant immediately after installation.
25. Foreign material may have been left in newly laid lines or hydrant leads. This material can damage valves and valve seats and also affect the results of pressure tests. If this is a concern, after backfilling and before disinfecting the main, remove the valve and valve seat from the hydrant. Then flush the main through the hydrant using an auxiliary valve that is designed to control the flow of water from the line. See Sec. Dechlorination Regulations in chapter 6.

TESTING

ANSI/AWWA C502 permits dry-barrel hydrants with unplugged drain outlets to have an allowable leakage of 5 fluid oz/min (0.25 mL/sec) through the drain valve. Therefore, the main valve should not be opened at the same time that the water main is tested. The auxiliary valve should be closed during water-main tests (see ANSI/AWWA C600). However, if it is possible to temporarily plug the drain outlets, the hydrant and main may be tested at the same time. After the hydrant is installed and, when possible, before backfilling (and after pressure testing the water main), the hydrant should be tested as follows.

Pressure Test at Main Pressure

1. Remove the highest outlet-nozzle cap and open the hydrant valve a few turns. Allow water to reach the bottom of the outlet nozzle. (If the hydrant is furnished with a tapped-plug air vent, it is not necessary to remove the nozzle cap; simply open the air vent.)
2. Replace the outlet-nozzle cap and leave it loose to permit all air to escape, or close the tapped-plug air vent.
3. After all air has escaped, tighten the outlet-nozzle cap.
4. Open the hydrant completely. (Opening the hydrant fully before all the air has escaped will compress the air and cause a safety hazard.)
5. Check for leakage at flanges, outlet nozzles, and the packing or O-rings around the stem.
6. If leakage is noted, repair or replace the faulty components or the entire hydrant.
7. Repeat the test until results are satisfactory.

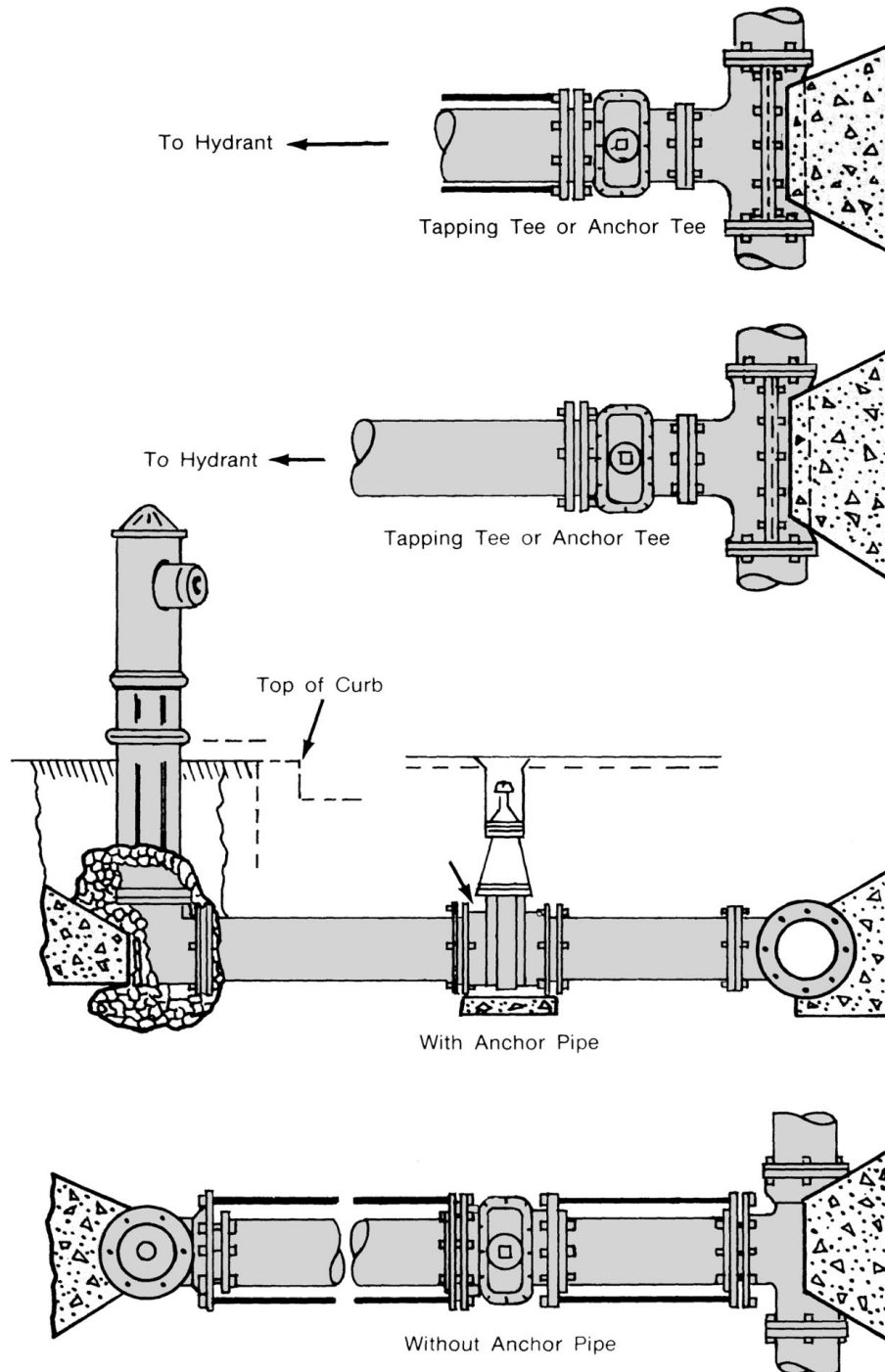


Figure 4-3 Examples of hydrant restraints. (Thrust blocks and other elements are shown for illustrative purposes only and are not intended to represent details of a properly engineered restraining system.)

Pressure Test at Pressures Above Main Pressure

1. Connect a pressure-test pump to one of the hydrant's outlet nozzles.
2. Open the highest outlet-nozzle cap. Open the hydrant valve a few turns. Allow the hydrant to fill until water is at the bottom of the outlet nozzle.
3. After all air has escaped, tighten the outlet-nozzle cap.
4. Open the hydrant completely.
5. Close the auxiliary valve.
6. Pump up to test pressure (usually 150 psi [1,034 kPa]).
7. Check for leakage at flanges, outlet nozzles, and the packing or O-rings around the stem.
8. Repair or replace hydrant, if necessary.
9. Repeat the test until results are satisfactory.
10. Open the auxiliary valve.

Drainage Test for Dry-Barrel Hydrants

1. Following the pressure test, close the hydrant main valve.
2. Remove one outlet-nozzle cap and place the palm of one hand over the outlet-nozzle opening.
3. Drainage should be sufficiently rapid to create a noticeable suction.
4. If the hydrant fails the drainage test, partially open the hydrant with the outlet-nozzle caps on to create a pressure that will clear the drain valve. If this fails, the drain-valve assembly should be removed and inspected. If the drain valve is clear, the problem may be that the drain outlet is plugged from outside the hydrant. Repair will require digging down around the outside of the hydrant and clearing the drain outlet.

PLACING THE HYDRANT IN SERVICE

The following steps are recommended for placing a hydrant in service.

1. After testing and backfilling, the hydrant should be flushed and tested to ensure that it is bacteriologically safe before it is put into service.
2. Tighten the outlet-nozzle caps. Back them off slightly so they will not be excessively tight, but tight enough to prevent their removal by hand.
3. Clean the hydrant exterior to remove dirt accumulated during installation. If necessary for protection or appearance, the exposed portion of the hydrant should be painted with one or more coats of the utility's standard paint.

Chapter **5**

Maintenance

To ensure that a hydrant will work correctly when it is needed, a periodic testing and maintenance program must be followed. Although hydrants are operated by members of the fire department, it is generally the water utility's responsibility to maintain them in working order.

In many small communities, especially where the water purveyor is not the same political entity as the fire department, agreements may have been made with the individual fire departments to maintain and test fire hydrants. Although this practice is worthwhile, it should be remembered that unless there is a verifiable agreement, the owner of the hydrant retains the responsibility for maintenance and inspection of the hydrant.

USES OF HYDRANTS

The primary purpose of a fire hydrant is fire suppression. However, hydrants also serve other useful functions. For example, hydrants provide a method of testing the distribution system's flow capabilities. They also provide a means for flushing the system mains, for street cleaning and sewer cleaning, for street and building construction, and for recreation.

Although each of these functions might be of great importance to certain individuals or groups, the primary purpose—fire suppression—is paramount. Hydrant owners have a moral obligation to see that adequate fire flow can be delivered from every hydrant under their jurisdiction. If adequate flow cannot be delivered by a particular hydrant, that hydrant is not fulfilling the primary purpose. If that is the case, the hydrant should be removed and replaced with a flushing device if needed. A hydrant signifies to the public that water for fighting fires is available.