Plumbing Valves and Accessories

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6.1.0 Gate Valve

The gate valve (*Figure 5-21*) is used in systems where a straight flow with the least amount of restriction is needed. These valves are commonly used in steam lines, waterlines, fuel oil lines, and fire-main cutouts.

The part of a gate valve that opens or closes the valve flow is known as the GATE. The gate is normally wedge-shaped; however, some are uniform in thickness throughout. When the gate is wide open, the opening through the valve is equal to the size of the piping in which the valve is installed; therefore, there is little resistance in the flow of the liquid. Since regulating the flow of liquid is difficult and could cause extensive damage to the valve, the gate valve should NOT be used as a throttling valve. The gate valve should be left in one of two positions: completely open or closed.

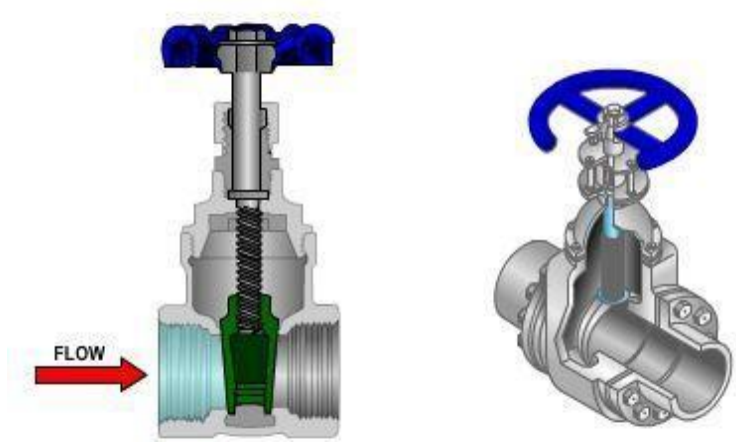


Figure 5-21— Gate valve *Figure*

Figure 5-21 shows a cross-sectional view of a gate valve. The gate is connected to the valve stem. Turning of the handwheel raises or lowers the valve gate. Some gate valves have NONRISING STEMS. On these, the stem is threaded on the lower end, and the gate is threaded on the inside; therefore, the gate travels up the stem when the valve is being opened. This type of valve usually has a pointer or a gauge to indicate whether the valve is in the OPEN or in the CLOSED position. Some gauge valves have RISING STEMS. In these valves, both the gate and the stem move upward when the valve is opened. In some rising stem valves, the stem projects above the handwheel when the valve is opened. The purpose of the rising stem is to allow the operator to see whether the valve is opened or closed.

6.1.1 Globe Valve

The name is derived from the globular shape of the valves; however, other types of valves may also have globe-shaped bodies, so do not jump to the conclusion that a valve with a globe-shaped body is actually a globe valve. The internal structure of a valve, not the external shape, is what distinguishes one type of valve from another.

In a globe type of stop valve, the disk is attached to the valve stem. The disk seats against a seating ring or a seating surface that shuts off the flow of fluid. When the disk is removed from the seating surface, fluid can pass through the valve in either direction. Globe valves may be used partially open as well as fully open or fully closed.

The fluid flow is proportionate to the number of turns of the wheel in opening or closing the globe valve. The purpose of the globe valve is for throttling. Globe valve inlet and outlet openings are arranged in several ways to satisfy different requirements of flow.

Figure 5-22 shows three common types of globe valve bodies. In the straight type, the fluid inlet and outlet openings are in line with each other. In the angle type, the inlet and outlet openings are at an angle to each other. An angle type of globe valve (which is also the UT rate insignia) is commonly used where a stop valve is needed at a 90-degree turn in a line. The cross type of globe valve has three openings, rather than two; it is frequently used in connection with bypass lines.

Globe valves are commonly used in steam, air, oil, and water lines. Globe valves are also used as stop valves on the suction side of many fire room pumps as recirculating

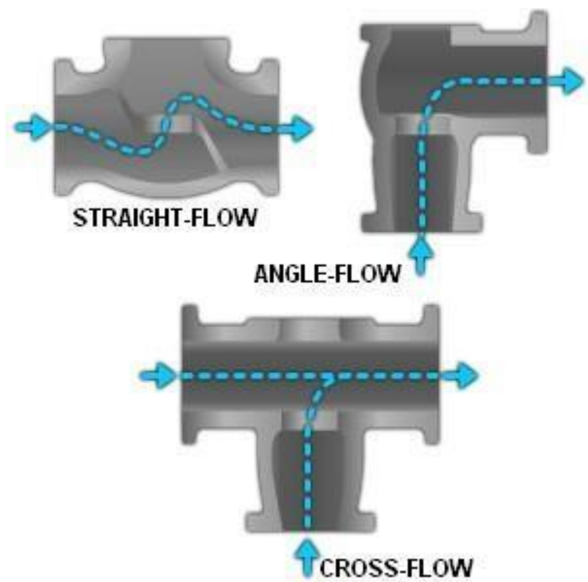


Figure 5-22 – Types of globe valve bodies.

valves in the fuel oil system and as throttle valves on most fire room auxiliary machinery. A cross-sectional view of a globe valve is shown in *Figure 5-23*.

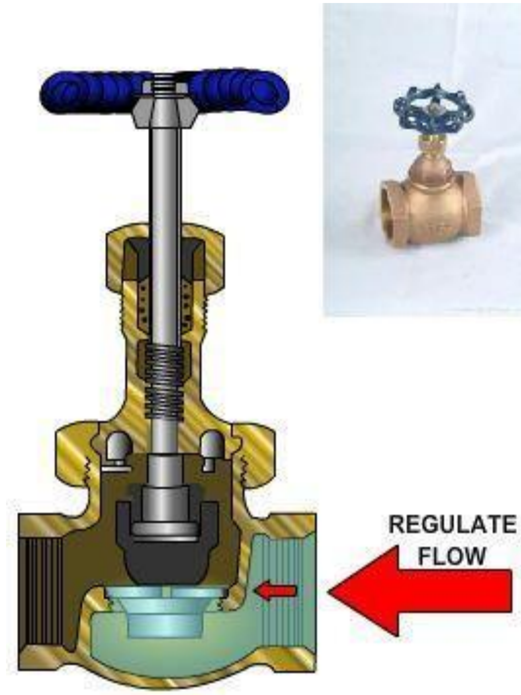


Figure 5-23— Globe valve.

6.1.2 Butterfly Valve

The butterfly valve (*Figure 5-24*) in certain applications has some advantages over gate and globe valves. The butterfly valve is light in weight, takes up less space than a globe valve or gate valve, is easy to overhaul, and can be opened or closed quickly.

The design and construction of butterfly valves may vary, but a butterfly type of disk and some means of sealing are common to all butterfly valves.

The butterfly valve shown in *Figure 5-24* consists of a body, a resilient seat, a butterfly type of disk, a stem, packing, and a notched positioning plate and handle. The resilient seat is under compression when it is mounted in the valve body. The compression causes a seal to form around the edge of the disk and both upper and lower points where the stem passes through the seat. Packing is provided to form a positive seal around the stem if the seal formed by the seat is damaged.

To close the valve, turn the handle a quarter of a turn to rotate the disk 90 degrees.

The resilient seat exerts positive pressure against the disk, which assures a tight shutoff.

Butterfly valves are easy to maintain. The resilient seat is held in place by mechanical means; therefore, neither bonding nor cementing is necessary. Since the resilient seat is replaceable, the valve seat does not require any lapping, grinding, or machine work.

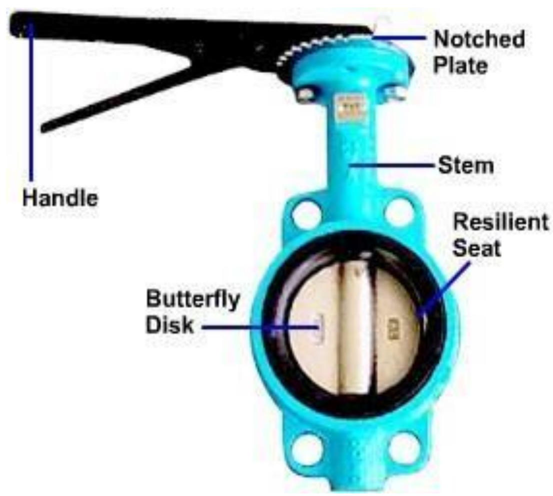


Figure 5-24 – Butterfly valve

Butterfly valves serve a variety of requirements. These valves are now being used in salt water, fresh water, JP-5 fuel, naval distillate fuel oil, diesel oil, lubricating oil systems, air ventilation systems, and set for specific flow.

6.1.3 Altitude Valve

Altitude valves are used primarily on supply lines to elevated storage tanks. These valves are designed to (1) regulate the water level in the water storage tanks to prevent them from overflowing or running dry, and (2) maintain a constant water level as long as water pressure in the distribution system is adequate. *Figure 5-25* illustrates the altitude valve in relation to an elevated storage tank.

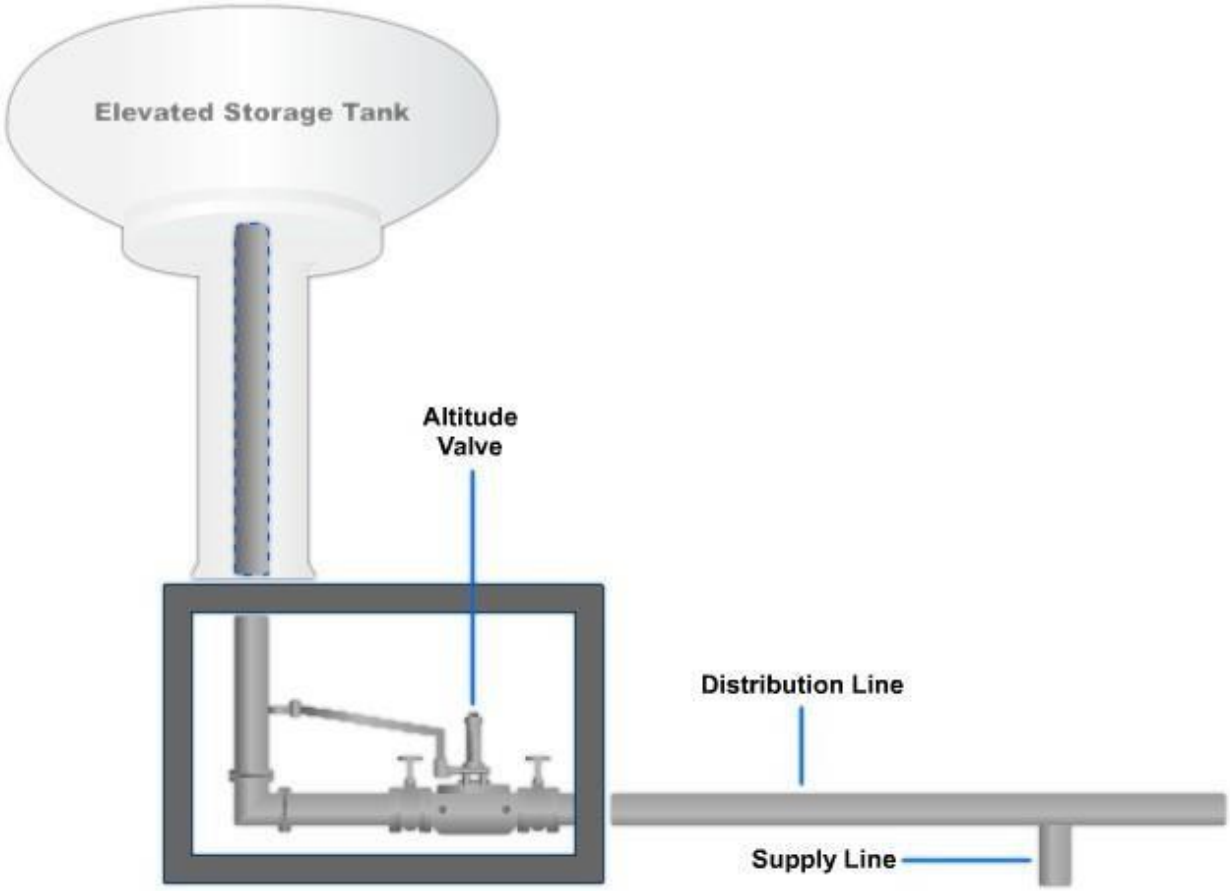


Figure 5-25 — Altitude valve with elevated storage tank.

As stated earlier, altitude valves are used primarily on supply lines to elevated storage tanks. When used on elevated storage tanks, the altitude valve automatically opens when the pressure in the distribution system drops below normal working pressure.

Altitude valves will automatically close or shut off the flow into an elevated tank when the water level in the tank reaches a pre-determined level.

6.1.4 Ball Valve

A ball valve is a quick opening/closing device with a low-pressure drop. Ball valves, like gate valves, are used to start or stop the flow of water through plumbing components or piping systems. They are used on water or other types of supply lines in place of gate valves. Ball valves are not designed for throttling service.

The basic components of the ball valve are the handle, a stem, a disc (ball), and a seat, which are machined into the valve body.

Figure 5-26 illustrates a ball valve. A quarter turn of the handle opens or closes the valve. When the handle is in line with (parallel to) existing piping, the valve is fully open. When the handle is across (perpendicular) to the piping, the valve is fully closed. The disk in a ball valve is a ball with a hole drilled through it. In the open position, the port (opening) in the ball is aligned with the inlet and outlet ports in the valve body.

Before installing a ball valve, you must consider the type of fluid the valve will be servicing. The steel (carbon, forged and stainless) ball valve is used for steam and high-pressure applications. Brass ball valves are used on water services. Finally, you can also use the plastic ball valves on water services, but they are not well adapted for use when a high resistance to acids is required. The type of ball valve and piping will dictate what type of joint that is used to install the valve. The common joints used to install ball valves include the threaded, soldered, mechanical, and solvent- glued. Finally, ball valves can be installed in the vertical or horizontal positions, but again, remember to make certain that the handle is accessible.

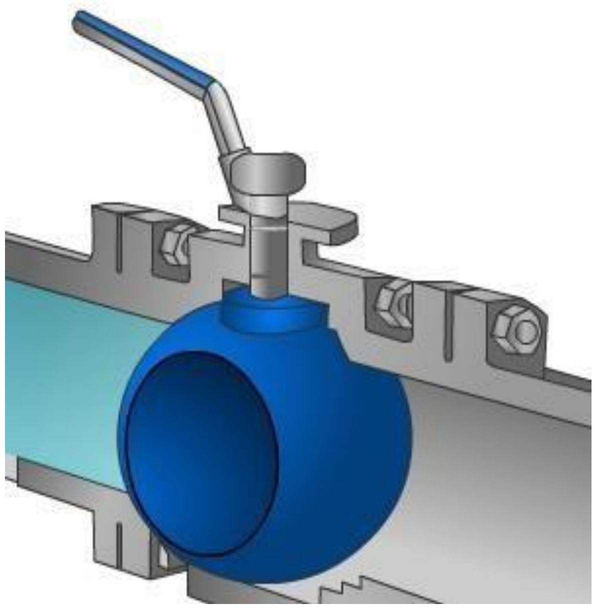


Figure 5-26 – Ball valve.

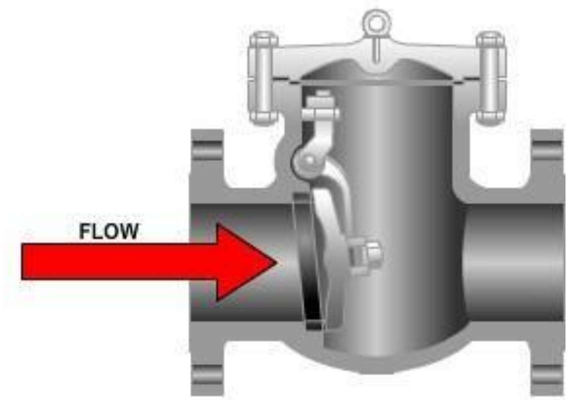
6.1.5 Check Valve

Check valves permit liquids to flow through a line in one direction only; for example, they are used in drain lines where it is important that there is no backflow. Considerable care must be taken to see that valves are installed properly. Most of them have an arrow, or the word "inlet," cast on the valve body to indicate direction of flow. If not, you must check closely to make sure the flow of the liquid in the system operates the valve in the proper manner.

The port in a check valve may be closed by a disk, a ball, or a plunger. The valve opens automatically when the pressure on the inlet side is greater than that on the outlet side. They are made with threaded, flanged, or union faces, with screwed or bolted caps, and for specific pressure ranges.

The disk of a SWING-CHECK valve (*Figure 5-27*) is raised as soon as the pressure in the line below the disk is of sufficient force. While the disk is raised, continuous flow takes place. If for any reason the flow is reversed or if back pressure builds up, this opposing pressure forces the disk to seat, which, in turn, stops the flow. Swing-check valves are used in horizontal lines and have a small amount of resistance to flow.

The operation of a LIFT-CHECK valve (*Figure 5-28*) is basically the same as that of the swing-check valve. The difference is the valve disk moves in an up and down direction instead of through an arc. Lift-check valves are used in lines where reversal of flow and pressures are changing frequently. This valve does not chatter or slam as the swing- check valve does, but it does cause some restriction of flow.



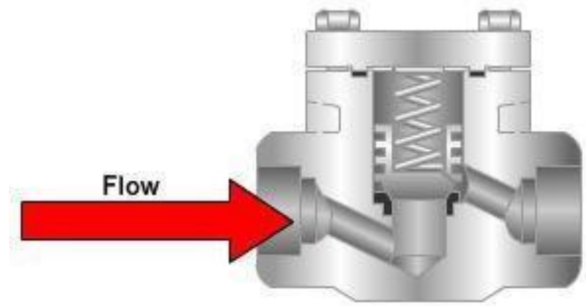
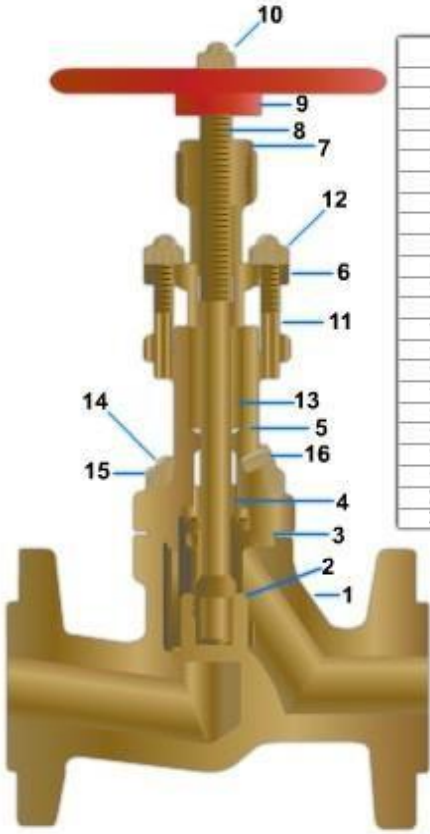


Figure 5-27 – Swing check valve. **Figure 5-28 – Lift check valve.**

6.1.6 Stop Check Valve

As we have seen so far, most valves are classified as either stop valves or check valves; however, some valves function either as a stop valve or as a check valve, depending upon the position of the valve stem. These valves are known as STOP-CHECK VALVES.

The cross section of two stop-check valves is shown in *Figure 5-29*. As you can see, this type of valve looks much like a lift-check valve. The valve stem is long enough so when it is screwed all the way down, it holds the disk firmly against the seat, thereby preventing the flow of any fluid. In this position, the valve acts as a stop valve. When the stem is raised, the disk can then be opened by pressure on the inlet side. In this position, the valve acts as a check valve and allows the flow of fluid in one direction only. The amount of fluid allowed to pass through is regulated by the opening. The opening is adjusted by the stem.



	LIST OF PARTS
1	BODY
2	DISK
3	GASKET
4	STEM BUSHING
5	BONNET
6	GLAND
7	YOKE BUSHING
8	STEM
9	HANDWHEEL
10	HANDWHEEL NUT
11	GLAND BOLT
12	GLAND BOLT NUT
13	PACKING
14	BONNET STUD
15	BONNET STUD NUT
16	RELIEF PLUG
17	SEAT RING
18	SPACER
19	GLAND FLANGE
20	YOKE BUSHING SETSCREW
21	JAMB NUT

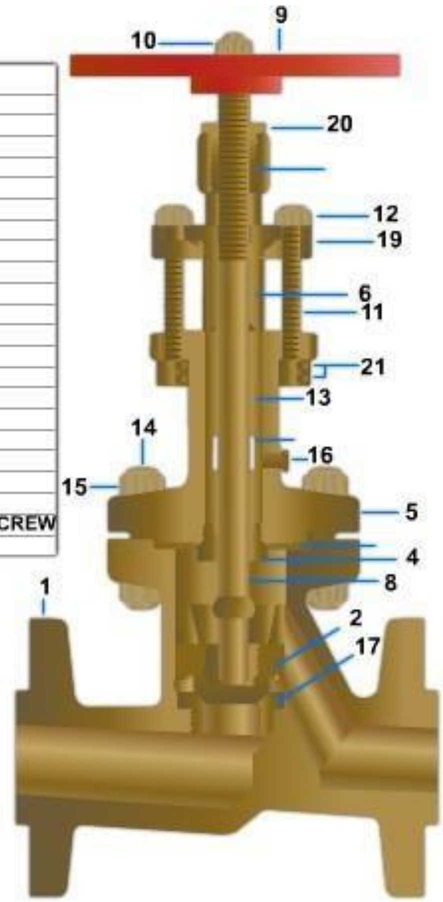


Figure 5-29 — Stop check valve.

6.1.7 Pressure-Reducing Valve

Pressure-reducing valves are automatic valves used to provide a steady pressure lower than that of the supply pressure. Pressure- reducing valves can be set for any desired discharge pressure that is within the limits of the design.

Several types of reducing valves are used in the industry; however, we will be looking at those in the water service system.

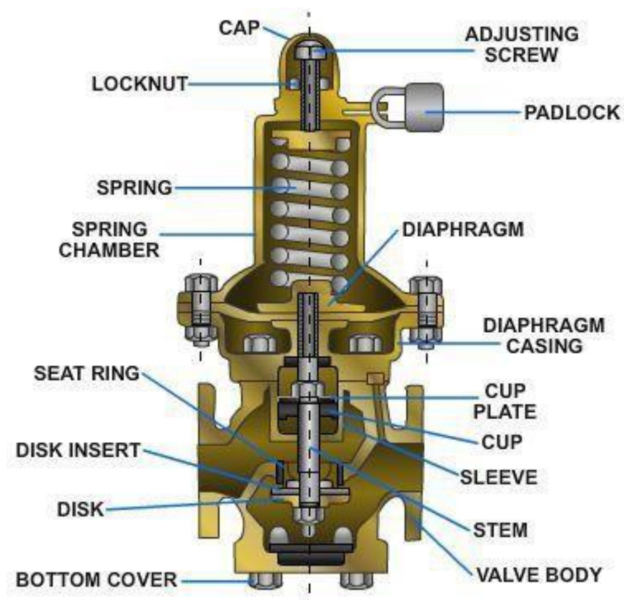


Figure 5-30— Spring-loaded diaphragm type of pressure-reducing valve.

These are normally single-seated, direct-acting, and spring-loaded, as shown in *Figure 5-30*. Water passing through this valve is controlled by means of a pressure difference on both sides of the diaphragm.
The diaphragm is secured to the stem.

Reduced water pressure from the valve outlet is then led through an internal passage to a diaphragm chamber located below the diaphragm. An adjusting spring acts on the upper side of the diaphragm. A leather cup washer or a neoprene O ring makes the water seal between the valve inlet and the diaphragm chamber. This seal is located halfway down the valve stem.

The amount of water pressure applied to the underside of the diaphragm varies according to the discharge pressure. When the discharge pressure is greater than the spring pressure, the diaphragm is forced up. Since this is an upward-seating valve, the upward movement of the stem tends to close the valve or at least to decrease the amount of discharge. When the discharge pressure is less than that of the spring pressure, the diaphragm and the valve stem are forced down, opening the valve wider and increasing the amount of discharge. When the discharge pressure is equal to the spring pressure, the valve stem remains stationary and the flow of water through the valve is not changed.

The amount of pressure applied by the spring to the top of the diaphragm can be adjusted by turning an adjusting screw. Turning the adjusting screw CLOCKWISE increases the pressure applied by the spring to the top of the diaphragm, which, in turn, opens the valve. Turning the adjusting screw COUNTERCLOCKWISE decreases the amount of spring pressure on top of the diaphragm, which, in turn, decreases the amount of discharge. Opening and closing of the valve continues as long as the discharge pressure fluctuates.

Figure 5-31 shows a different type of spring-loaded pressure-reducing valve. In this valve, water enters on the inlet side and acts against the main valve disk, tending to close the main valve; however, water pressure is also led through ports to the auxiliary valve, which controls the admission of water pressure to the top of the main valve piston. This piston has a larger surface than the main disk; therefore, a relatively small amount of

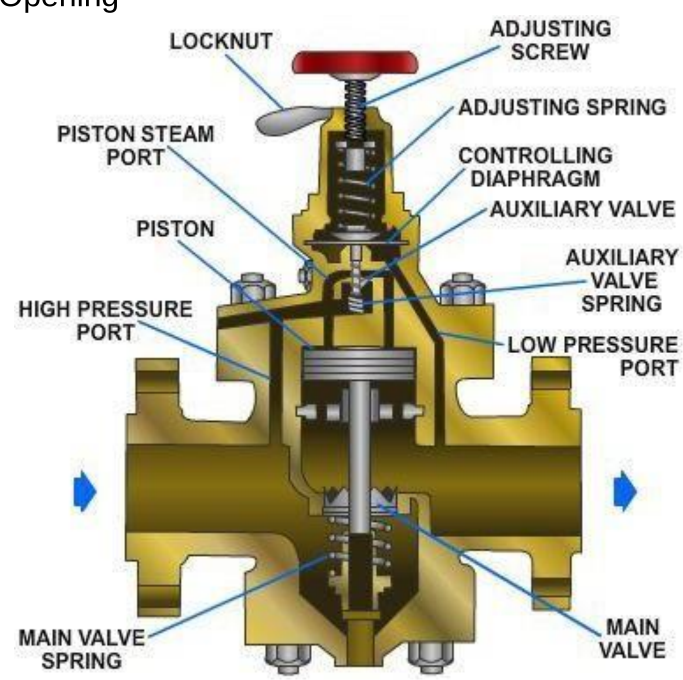


Figure 5-31— Spring-loaded pressure- reducing valve.

pressure acting on the top of the main valve piston tends to open the main valve and also allow water at reduced pressure to flow out the discharge side.

6.1.8 Pressure Relief Valve

This type of valve discharges water from pipes or systems when the maximum desired pressure is exceeded. Normally, the valve starts to open at the set pressure and continues to open gradually until the pressure has reached 20 percent above the set pressure, and then the valve opens completely. Pressure relief valves are installed on low-pressure systems fed through pressure-reducing valves from high-pressure supplies to ensure against damage if the pressure reducing valves fail to operate.

Pressure relief valves are also used on pump headers, discharging into large supply mains to relieve the high-surge pressure that builds up between the time a pump is started and the time required for water in the main to reach full velocity. Relief valves are essentially pressure-reducing valves in which the control mechanism responds to pressure on the inlet, rather than the outlet end.

6.1.9 Hydraulic Control Valve

Hydraulic control valves are used in many sprinkler systems. On some stations, they are installed in the sections of the fire main that supply water to the magazine sprinkling system. This type of valve may be operated from one or more remote control stations by a hydraulic control system.

The hydraulic control valve shown in *Figure 5-32* is a piston-operated globe valve. It is normally held in the CLOSED position by both a spring force and by the fire-main pressure acting against the disk.

When hydraulic pressure is admitted to the underside of the piston, a force is created that overcomes both the spring tension and the fire-main pressure, thereby causing the valve to open.

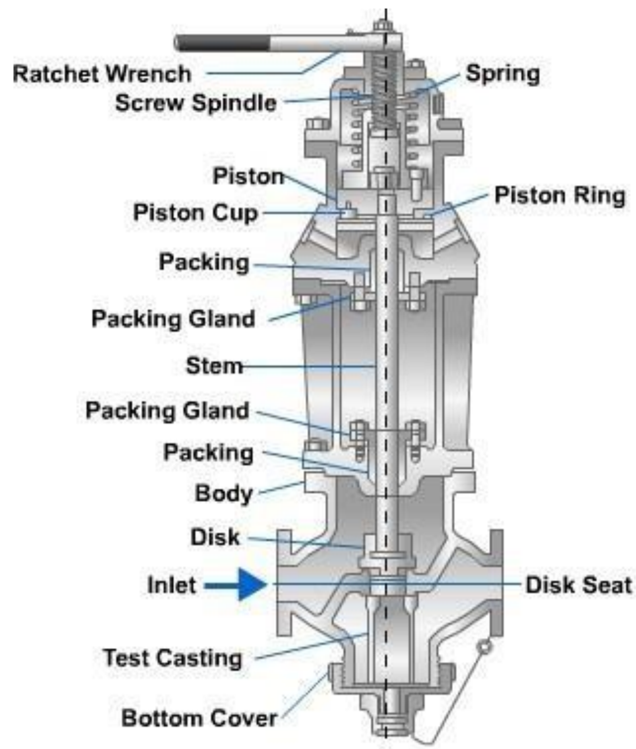


Figure 5-32 — Hydraulic control valve.

When hydraulic pressure is released from under the piston, the spring acts to force the hydraulic fluid out of the cylinder and back to the remote-control station, thus closing the valve.

A ratchet lever is fitted to the valve so in an emergency, the valve can be opened by hand. After the valve has been opened by hand, you should first restore the stem to its normal CLOSED position with the ratchet lever. Then, line up the hydraulic system from a remote-control station, so the hydraulic fluid in the valve cylinder can return to the storage tank at the control station. The full force of the closing spring acts to seat the disk, thereby closing the valve.

The valve shown in *Figure 5-32* is equipped with a test casting in the body of the valve. The bottom cover can be removed so you can check the valve for leakage.

6.1.10 Valve Boxes

Underground valves must have a means of access whereby you can use your hand or a valve key to reach the operating nut or handle. Valve boxes can be made of cast iron, cement, or plastic. Some have covers with lock nuts to prevent unauthorized access.
They also protect the valve and piping against mechanical damage (pedestrian and vehicular traffic), and adverse weather if located outside.

Take care when installing the valve box over the pipe. Never allow the weight of the valve box to rest on the pipe; instead, let the soil around the pipe support the valve box. Clean debris out of the valve box periodically and ensure elevation and alignment are

correct. A valve box that is full of debris or is not aligned properly does not allow proper alignment of the valve key on the operating nut or easy access to the handle. Debris also causes corrosion of valve handles, making it hard to turn off the valve.

Maintenance of valve boxes should be done twice a year, like the valve maintenance schedule for operation.

Maintenance consists of cleaning out debris in the box, checking for corrosion, checking the elevation of the top, and checking alignment of the box, so the valve key can be inserted readily. When the valve box has corroded and is no longer serviceable, remove it and replace it with a new unit. When changes in street or ground level have left the valve box too high or too low, adjust the height so the cover is at street or ground level.

6.1.11 Gear Boxes

Most large manually operated valves are operated through gears, as are motor-operated valves. These gears are housed in gear boxes.

Monthly or quarterly, lubricate the gearing under the manufacturer's instructions.

Semi-annually, check gear operation through a complete cycle of opening and closing. Listen for undue noise and observe smoothness of operation of the valve opening, and check for lubricant leakage from the flanges. Upon finding any evidence of improper operation, the operator should open the gearbox, inspect the gears, and make necessary repairs.

Annually, inspect the housing for corrosion; clean and paint it as necessary.

6.1.12 Valve Position Indicators

Different types of valves have different types of valve position indicators. Non-rising-stem gate valves may have indicators on the floor stand. Filter plant valves may have indicators on the filter operating table, and butterfly valves, or other valves used for flow control or throttling, may have indicator units that are controlled electrically and look like an ammeter. The care required depends on the design of the indicator unit; for example, post indicators require lubrication quarterly, and position indicators that are controlled electrically should be checked for contact, wiring, and so on, yearly.

6.2.0 Valve Repair

Periodic maintenance is the best way to extend the service life of valves and fittings. As soon as you see a leak, check to see what is causing it; then apply the proper remedy. This remedy may be as simple as tightening a packing gland nut. A leaking flange joint may need only to have the bolts tightened or to have a new gasket inserted. Dirt and scale, if allowed to collect, can cause leakage. Loose hangers permit sections of a line to sag. The weight of the pipe and the fluid in these sagging sections may strain joints to the point of leakage.

Whenever you intend to install a valve, make sure you know its function. In other words, is it supposed to prevent backflow, start flow, stop flow, regulate flow, or regulate pressure? Look for the information stamped on the valve body by the manufacturer: type of system (oil, water, gas), operating pressure, direction of flow, and other information.

You should also know the operating characteristics of the valve, the type of metal it is made of, and the type of end connection it has. Operating characteristics and material affect the length and type of service a valve can provide. End connections indicate whether or not a particular valve is suited for installation in the system.

Valves should be installed in accessible places and with enough headroom to allow for full operation. Install valves with stems pointing upward whenever possible. A stem position between straight up and horizontal is acceptable but avoid the inverted position (stem pointing downward). When the valve is installed in the latter position, sediment collects in the bonnet and scores the stem. When a line is subject to freezing temperatures, liquid trapped in the valve bonnet may freeze and rupture it.

Globe valves may be installed with pressure either above or below the disk. It depends upon what method is best for the operation, protection, maintenance, and repair of the machinery. You should ask what would happen if the disk became detached from the stem. This is a major consideration in determining whether pressure should be above the disk or below it. Check the blueprints for the system to see which way the valve should be installed. Pressure on the wrong side of the disk can also cause serious damage.

Valves that have been in constant service over a long period of time eventually require gland tightening, replacing, or a complete overhaul. When a valve is not doing the job, it should be dismantled, and all parts inspected. For proper operation, parts must be repaired or replaced.

6.2.1 Spotting-In Valves

Spotting-in is the method used to determine visually whether or not the seat and the disk make good contact with each other. To spot- in a valve seat, first apply a thin coating of Prussian blue evenly over the entire machined face surface of the disk. Then insert the disk into the valve and rotate it a quarter turn, using light downward pressure. The Prussian blue adheres to the valve seat at those points where the disk makes contact. *Figure 5-33* shows what correct and imperfect seals look like when they are spotted-in.

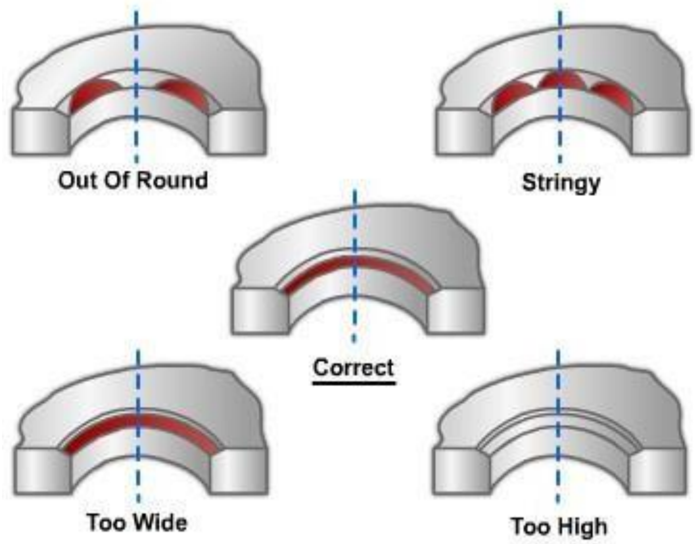


Figure 5-33 — Examples of spotted-in valve seats.

After you have examined the seat surface, wipe all the Prussian blue off the disk face surface. Apply a thin, even coat of blue to the contact face of the seat. Again, place the disk on the seat and rotate the disk a quarter of a turn. Examine the blue ring that appears on the disk. It should be unbroken and of uniform width. If the blue ring is broken in any way, the disk does not fit properly.

6.2.2 Grinding-In Valves

Grinding-in is a manual process used to remove small irregularities by grinding together the contact surfaces of the seat and disk. Grinding-in should not be confused with refacing processes in which lathes, valve reseating machines, or power grinders are used to recondition the seating surfaces.

To grind-in a valve, first apply a small amount of grinding compound to the face of the disk. Then insert the disk into the valve and rotate the disk back and forth about a quarter of a turn. Shift the disk-seat relationship from time to time, so the disk is moved gradually, in increments, through several rotations. During the grinding-in process, the grinding compound is gradually displaced from between the seat and disk surfaces; therefore, it is necessary to stop every minute or so to replenish the compound. When you do this, wipe both the seat and the disk clean before applying the new compound to the disk face.

When it appears that the irregularities have been removed, check your work by spotting- in the disk to the seat in the manner described previously.

Grinding-in is also used to follow up all machine work on valve seats or disks. When the seat and disk are first spotted-in after they have been machined, the seat contact is very narrow and located close to the bore. The grinding-in, using finer and finer compounds as the work progresses, causes the seat contact to become broader. The contact area should be a perfect ring covering approximately one third of the seating surface.

Be careful that you do not over-grind a seat or disk. Over-grinding tends to produce a groove in the seating surface of the disk. It may also round off the straight, angular surface of the disk. Over-grinding must be corrected by machining.

6.2.3 Lapping Valves

When a valve seat contains irregularities that are too large to be removed by grinding- in, you can remove them by lapping. A cast- iron tool, also known as a LAP tool, of exactly the same size and shape as the disk is used to rule the seat surface. Two lapping tools are shown in *Figure 5-34*.

Here are the most important points to remember while using the lapping tool.

1. Do not bear heavily on the handle of the lap.
2. Do not bear sideways on the handle of the lap.

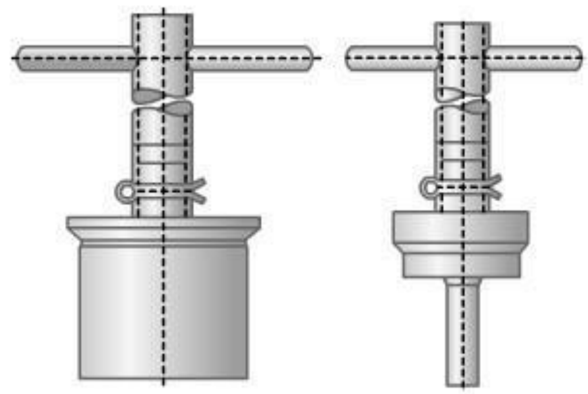


Figure 5-34 – Lapping tools.

3. Change the relationship between the lap and the seat so the lap gradually and slowly rotates around the entire seat circle.
4. Keep a check on the working surface of the lap. If a groove develops, have the lap refaced.
5. Always use a clean compound for lapping.
6. Replace the compound often.
7. Spread the compound evenly and lightly.
8. Do not lap more than is necessary to produce a smooth, even seat.

9. Always use a fine grinding compound to finish the lapping job.
10. When you complete the lapping job, spot-in and grind-in the disk to the seat.

Use only approved abrasive compounds to recondition seats and disks. Compounds for lapping and grinding disks and seats are supplied in various grades. Use a coarse grade compound when there is extensive corrosion or deep cuts and scratches on the disks and seats. Use a compound of medium grade to follow up the coarse grade. It may also be used to start the reconditioning process on valves that are not severely damaged. Use a fine grade compound when the reconditioning process nears completion. Use a microscopic fine grade for finish lapping and for all grinding-in.

6.2.4 Refacing Valves

Badly scored valve seats must be refaced in a lathe with a power grinder or with a valve reseating machine. Use the lathe, rather than the reseating machine, to reface disks and hard-surfaced seats. Work that must be done on a lathe or with a power grinder should be turned over to machine shop personnel. This discussion applies only to refacing seats with a reseating machine.

To reface a seat with a reseating machine (*Figure 5-35*) attach the correct 45-degree facing cutter to a reseating machine. With a fine file, remove all high spots on the surface of the flange upon which the chuck jaws must fit. Note that a valve reseating machine can be used ONLY with a valve in which the inside of the bonnet flange is bored true with the valve seat. If this condition does not exist, the valve must be reseated in a lathe and the inside flange bored true.

Before placing the chuck in the valve opening, open the jaws of the chuck wide enough to rest on the flange of the opening. Tighten the jaws lightly so the chuck grips the sides of the valve opening securely.

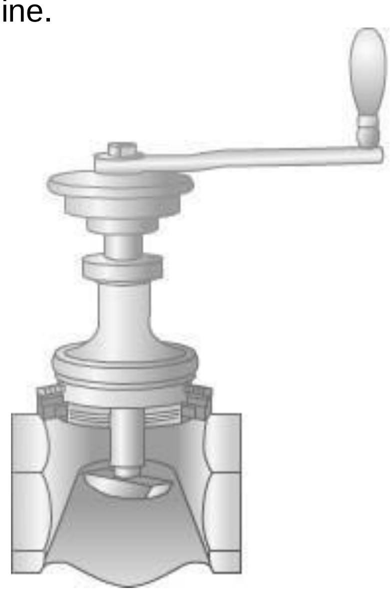


Figure 5-35 – Valve reseating machine.

Tap the chuck down with a wooden mallet until the jaws rest on the flange firmly and squarely. Then tighten the jaws further.

Adjust and lock the machine spindle in the cutting position and begin cutting by turning the crank slowly. Feed the cutter slowly so very light shavings are taken. After some experience, you can tell whether or not the tool is cutting evenly all around. Remove the chuck to see if enough metal has been removed.

Be sure the seat is perfect. Then remove the 45-degree cutter and face off the top part of the seat with a flat cutter. Dress the seat down to the proper dimensions as follows. Refer to *Table 5-1*.

Table 5-1 — Seat to Valve Size Chart.

Width of Seat	Size of Valve
1/16 inch	1/4 to 1 inch
3/32 inch	1 1/4 to 2 inches
1/8 inch	2 1/2 to 4 inches
3/16 inch	4 1/2 to 6 inches

After the refacing, grind-in the seat and disk. Spot-in as necessary to check the work. A rough method of spotting-in is to place pencil marks at intervals of about l/2 inch on the bearing surface of the seat or disk. Then place the disk on the seat and rotate the disk about a quarter of a turn. If the pencil marks in the seating area rub off, the seating is satisfactory.

6.2.5 Repacking Valve Stuffing Boxes

When the stem of a valve is in good condition, stuffing box leaks can usually be stopped by setting up on the gland. If this does not stop the leakage, repack the stuffing box.
The gland must not be set up or packed so tightly that the stem binds. If the leak persists, a bent or scored valve stem may be the cause of the trouble.

Coils (string) and rings are the common forms of packing used in valves. The form to be used in a particular valve is determined, in part, by the size of the packing required. In general, rings are used in valves that require packing larger than 1/4 inch. When a smaller size is required, string packing is used.

When you repack a valve stuffing box, place successive turns of the packing material around the valve stem. When string packing is used, coil it around the valve stem. Bevel off the ends to make a smooth seating for the bottom of the gland. Then put on the gland and set it up by tightening the bonnet nut or the gland bolts and nuts. To prevent the string packing from folding back when the gland is tightened, wind the packing in the direction in which the gland nut is to be turned. Usually, where successive rings are used, the gaps in the different rings should be staggered.

Valves are made to back seat the stem against the valve bonnet when the valve is fully opened. Back seating of valves is a safety feature to eliminate the stem being forced out under pressure while the valve is fully opened. Back seating makes repacking of the stem stuffing box possible under pressure; however, you should attempt this only in emergencies and with extreme caution.

Test your Knowledge (Select the Correct Response)

Which of the following valves allows water flow in one direction only?

A. Swing
B. Check
C. Pressure-reducing
D. Globe

7.0.0 WATER METERS

Water meters measure the flow of water within a line to a point of distribution, such as laundries, housing areas, and so on. There are various types of water meters. One type is the disk type of volume meter. This water meter is used chiefly for services supplied through pipes less than 1 l/2 inches in diameter, although water meters are made in sizes up to 6 inches.

Figure 5-36 shows the nutating disk volume meter. This type of meter is mainly used for individual service connections, as it is accurate for very low flow. A flow above normal causes rapid wear. The disk type of meter contains a measuring chamber of definite content in which a disk is actuated by the passage of water.

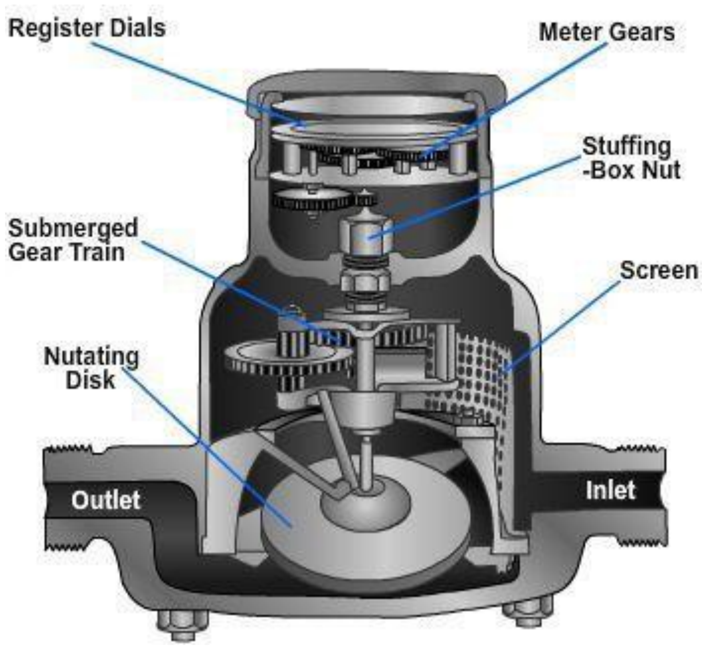


Figure 5-36 — Nutating disk meter.

Each cycle of motion of the disk marks the discharge of the contents of the measuring chamber. By means of gearing, the motion of the disk is translated into units of water volume on the register dial.

When installing a water meter, make sure it is horizontal and that it operates under back pressure. The meter should be located near the pressure-reducing valve at underground level; so in freezing temperatures, ensure the meter is protected from exposure.

Water is measured in terms of rate-of-flow (volume passing in a unit of time) or total volume. Units and equivalents usually are as follows. Refer to *Table 5-2*.

Table 5-2 — Unit to Equivalent Chart.

Unit	Equivalent
Cubic feet per second (cfs)	6448.83 Gallons per minute (gpm)
Cfs	46, 315 gallons per day (gpd)
Gpm	1,440 gpd
Million gallons per day (mgd)	1.547 cfs
mgd	694.4 gpm
Cubic feet (Cu ft)	7.48 gallons

NOTE

In reading a meter, you should first determine whether it is measuring the water flow in cubic feet or in gallons.

7.1.0 Meter Dials

Two general types of meter dials are used: the straight-reading type and the circular-reading type. Each type is discussed in the following paragraphs.

The STRAIGHT-READING DIAL shown in *Figure 5-37* may be read in the same way as mileage on an automobile. When the meter register has one or more fixed zeros, always be sure to read them in addition to the other numerals.

In the CIRCULAR-READING DIAL, when the hand on a scale is between two numbers, the lower number is read. If the hand seems exactly on the number, check the hand on the next lower scale.

Figure 5-37 — Straight-reading meter dial.

If that hand is on the "1" side of zero, read the number on which the hand lies; otherwise, read the next lower number. The procedure for reading the circular reading dial, shown in gallons in *Figure 5-38*, is to begin with the "1,000,000" circle and read clockwise to the "10" circle, the scales registering 9, 6, 8, 7, 2, and 1 respectively, making a total of 968,721 gallons.

7.2.0 Obtaining Current Reading

Since the registers are never reset while the meters are in service, the amounts recorded for any period of time must be determined by subtraction. To obtain a current reading, subtract the last recorded reading from the current dial reading.

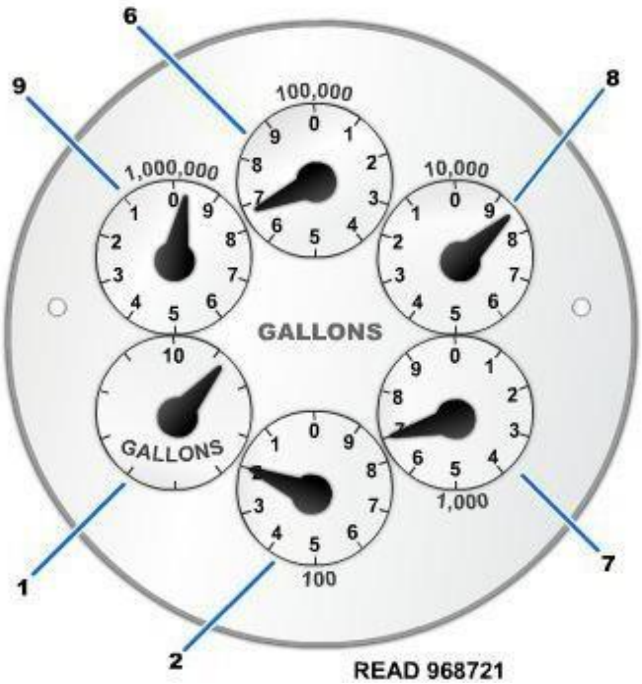


Figure 5-38 — Reading the circular-reading meter dial in gallons.

Remember, the maximum amount that can be indicated on the usual line meter before it turns to zeros and begins all over again is 99,999 cubic feet, or 999,999 gallons. Thus, to obtain a current measurement when the reading is lower than the last previous one, add 100,000 to the present reading on a cubic foot meter, or 1,000,000 to the present reading on a gallon meter. The small denomination scale, giving fractions of one cubic foot or ten gallons, is disregarded in the regular reading. It is used for testing only.

8.0.0 INSULATION

The primary purpose of insulation is to prevent heat passage from steam or hot-water pipelines to the surrounding air or from the surrounding air to cold-water pipes. Thus hot-water lines are insulated to prevent loss of heat from the hot water, while drinking waterlines are insulated to prevent absorption of heat in drinking water.

Insulation keeps moisture from condensing on the outside of cold pipes. An example of condensation is the formation of droplets of moisture on the outside of a glass of ice water on a warm day. The same thing happens to the outside of a pipe containing cold water when the outside of the pipe is exposed to warm air. Insulation also prevents water from freezing in a pipe, especially when the pipe runs outside a building or in a building without heat.

Insulation is used on heating and air-conditioning ducts. The two kinds of duct insulation are (1) inside and (2) outside. The outside insulation is for the protection of heat loss, whereas the inside insulation is used for protection against noise and vibration from heating or air-conditioning equipment.

Insulation subdues noise made by the flow of water inside pipes, such as water closet discharges. Bathrooms directly above living rooms should be insulated. Insulation is vital in high buildings where water falls a long way, especially when the water falls in soil stacks and headers. Insulation also protects refrigerated and chilled waterlines that cool electrical and motor-driven equipment.

Insulation is made in two forms: (1) rigid preformed sections and (2) blankets. Rigid preformed sections are used on pipe runs and for the protection of other objects which they are designed to fit. Blanket-type insulation, manufactured in strips, sheets, and blocks, is wrapped around objects that are irregular in shape and in large, flat areas.

Blanket-type insulation protects against heat loss and fire. This type of insulation is used on boilers, furnaces, tanks, drums, driers, ovens, flanges, and valves. It comes in wool- felt and hair-felt rolls, aluminum foil rolls, and in an irregular preformed covering.

Blanket insulation comes in different widths and thicknesses, depending upon the type of equipment to be insulated. It resists vermin, rodents, and acid. It is also fireproof.

8.1.0 Piping

Some of the insulating materials on the market today for insulating pipe are sponge felt paper, cork pipe covering, wool felt, flex rubber, fiberglass, magnesia, and types called antisweat and frost-proof.

Sponge felt paper is composed of asbestos paper with a maximum amount of sponge evenly distributed within it, as shown in *Figure 5-39, View A*. Sponge felt paper is manufactured to fit most pipe sizes. It comes in 3-foot lengths and from 1 to 3 inches in thickness.

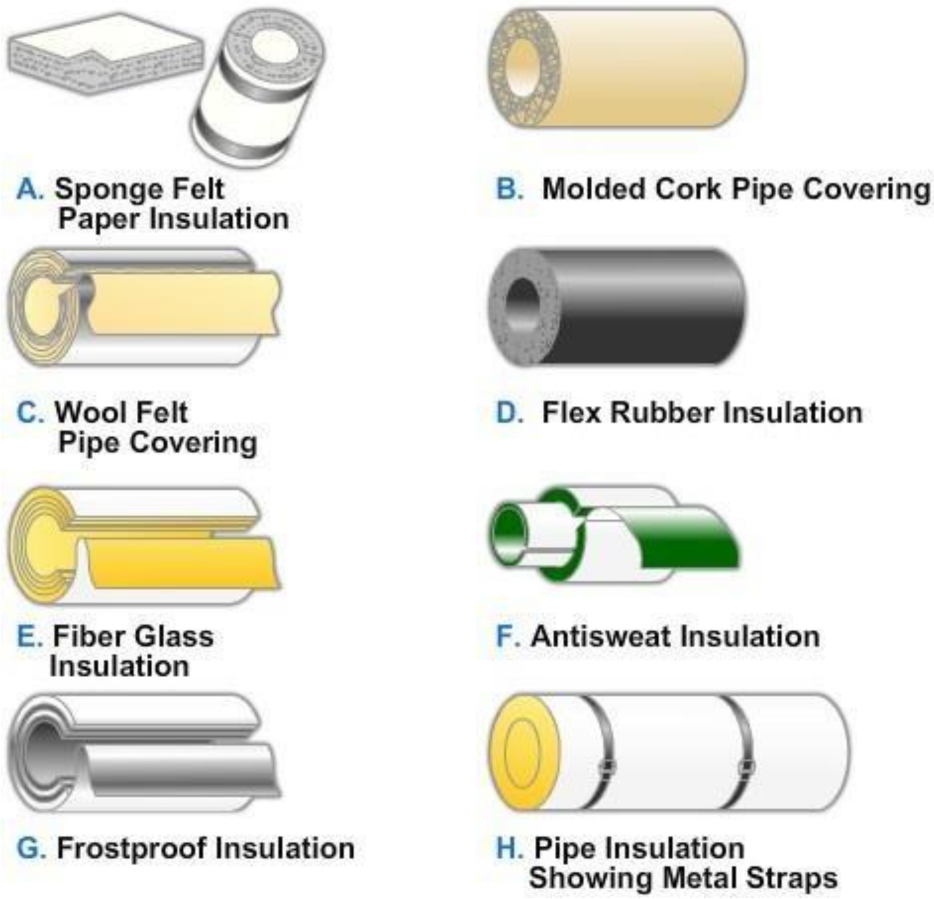


Figure 5-39 — Types of pipe insulation.

Sponge felt paper can be purchased in blocks of straight and preformed shapes for valves and fittings.

Cork pipe covering is a granulated material processed from the bark of cork trees. Granulated cork is compressed and molded to size and shape and finished with a coating of plastic asphalt. Cork pipe covering, as shown in *Figure 5-39, View B*, is an ideal covering for brine, ammonia, ice water, and all kinds of cold waterlines, and it insulates well over a wide low-temperature range. Cork pipe covering does not rot or support combustion. Clean, sanitary, and odor free, it is available in a wide variety of sizes and shapes to fit various sizes of pipes and fittings.

Wool felt is made of matted fibers of wool, wool and fur, or hair, worked into a compacted material by pressure rolling. It is used on cold-water service and hot-water return lines. Wool felt preformed pipe covering is manufactured in thicknesses of l/2 to 1 inch, with a canvas jacket, as shown in *Figure 5-39, View C.* It is manufactured in 3-foot lengths for straight runs of pipe.

Flex rubber insulation, shown in *Figure 5-39, View D*, is a tough, flexible rubber material constructed of millions of uniform closed cells. It has good insulating qualities, good cementing qualities, excellent weather-aging qualities, and it is ideal for the prevention

of sweating cold-water lines. In addition, it is water and flame resistant. Flex rubber insulation is recommended for covering tubing used in refrigeration and cold-water lines in homes, as well as in industrial plants and commercial buildings. This rubber insulating material comes in random lengths, with a wall thickness size of 3/8 to 3/4 inch. It is made to fit pipe sizes up to 4 inches.

Flex rubber insulation can be installed on pipes and tubing by slipping the insulation over the pipe when it is being assembled or by slitting the rubber lengthwise and sealing it with cement. Before installing flex rubber insulation on iron or galvanized pipes, paint the pipes with an asphaltic base primer to prevent corrosion caused by condensation.

Fiberglass pipe insulation, shown in *Figure 5-39, View E*, is composed of very fine glass fibers, bound and formed together by an inactive resin type of mixture. It is formed into a flexible hollow cylinder and slit along its length for applying to pipes or tubing. It is furnished in 3-foot lengths with or without jackets. The insulation comes in thicknesses from l/2 to 2 inches and fits pipes from l/2 to 30 inches. Fiberglass insulation has a long life; it will not shrink, swell, rot, or burn. It is easily applied and light in weight, saves space, and has excellent insulating qualities.

Antisweat insulation, shown in *Figure 5-39, View F*, is designed for cold-water pipes. It keeps the water colder in the pipes than most types of insulation; and when installed properly, it prevents condensation, or sweating, of the pipes.

The outstanding feature of antisweat insulation is its construction. It is composed of an inner layer of asphalt-saturated asbestos paper, a 1/2-inch layer of wool felt, two layers of asphalt-saturated asbestos felt, another l/2-inch layer of pure wool felt, and an outer layer of deadening felts with asphalt-saturated felts. The outer layer has a flap about 3 inches long that extends beyond the joint to help make a perfect seal. A canvas jacket is placed around each 3-foot length to protect the outer felt covering.

Frost-proof insulation, shown in *Figure 5-39, View G*, is manufactured for use on (1) cold-water service lines that pass through unheated areas, and (2) those lines exposed to outside weather conditions.

Frost-proof insulation is generally constructed of five layers of felt. There are three layers of pure wool felt and two layers of asphalt-saturated asbestos felt. Frost-proof insulation is 1 l/4 inches thick and comes in 3-foot lengths with a canvas cover.

The pipe coverings shown in this section are installed easily, primarily because each section is split in half and has a canvas cover with a flap for quick sealing. Joint collars are furnished to cover joint seams on insulation exposed to outside conditions.

Cheesecloth is used on some types of insulation instead of canvas. To install the cheesecloth, use a paste to hold it in place. Allow enough cheesecloth to extend over the end of each 3-foot section to cover the joints.

After you have applied the cheesecloth and smoothed it out, install metal straps to hold the insulation firmly in place, as shown in *Figure 5-39, View H*.

8.2.0 Valves and Fittings

Cover valves and fittings with wool felt, magnesia cement, or mineral wool cement of the same thickness as the pipe covering. These materials are molded into shape to conform to the rest of the insulation. When magnesia or mineral wool cement insulation is used, cover the insulation with cheesecloth to help bind and hold it in place.

Additional Resources and References

This chapter is intended to present thorough resources for task training. The following reference works are suggested for further study. This is optional material for continued education rather than for task training.

Basic Machines, NAVEDTRA 12199, Naval Education and Training Professional Development and Technology Center, Pensacola, FL, 1994.

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National Standard Plumbing Code-Illustrated, National Association of Plumbing- Heating-Cooling Contractors, Washington, DC, 2006.

Safety and Health Requirements Manual, EM-385-1-1, Department of the Army, U.S. Army Corps of Engineers, Washington, DC, 1992.

MIL-STD-17-1, Mechanical

Symbols MIL-STD-101B

International Plumbing Code 2009, International Code Council

International Mechanical Code 2009, International Code Council

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